U.S. Fish and Wildlife Service
Biological and Conference Opinion

for the

Clark, Lincoln, and White Pine Counties
Groundwater Development Project

U.S. Fish and Wildlife Service

Nevada Fish and Wildlife Office
Reno, Nevada

November 19, 2012

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Chapter 1

INTRODUCTION

The federal action that is the subject of this Biological and Conference Opinion (Opinion) is the U.S. Bureau of Land Management's (BLM's) issuance of a right-of-way (ROW) permit to the Southern Nevada Water Authority (SNWA) to construct, operate, and maintain the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) (Figure 1-1). The GWD Project will develop and convey groundwater from rural east-central Nevada to the Las Vegas metropolitan area to the south, where the water will be put to municipal use. This water will be produced from existing and new groundwater rights in Spring, Cave, Dry Lake, and Delamar valleys, the new rights having been awarded to SNWA by the Nevada Division of Water Resources, Office of the State Engineer (Nevada State Engineer [NSE]), on March 22, 2012. The proposed project also provides capacity for future water conveyance by Lincoln County.

The BLM requested formal consultation and provided the U.S. Fish and Wildlife Service (Service or USFWS) with a revised final Biological Assessment (BLM 2012a) for its federal action on May 11, 2012. This request was made pursuant to section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (ESA or Act). Section 7(a)(2) of the Act requires federal agencies to consult with the Secretary of the Interior to ensure that any actions authorized, funded, or carried out by such agencies will not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. Per the Service's recommendation, BLM also requested to conference on proposed (revised) critical habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*). Section 7(a)(4) of the Act requires federal agencies to conference when the proposed action is likely to jeopardize the continued existence of a proposed species or destroy or adversely modify proposed critical habitat. However, such a finding is not required to trigger the conference procedure if the action agency wishes to initiate a review of possible effects on a proposed species or critical habitat.

After discussions with the Service, BLM formally requested that we consult on GWD Project facilities and activities related to the development and conveyance of up to 124,988 acre-feet per year (afy) of groundwater (BLM 2012a). This quantity includes the amount of groundwater identified in the NSE rulings on SNWA's groundwater rights applications in Spring, Cave, Dry Lake, and Delamar valleys (83,988 afy), issued on March 22, 2012 (NSE 2012a–d). This quantity of water also conforms to BLM's preferred alternative identified in the Final Environmental Impact Statement (FEIS) (Alternative F) developed pursuant to the National Environmental Policy Act (NEPA), which would limit the amount of new groundwater to be developed by SNWA to the NSE-awarded quantities (BLM 2012b). The groundwater development and conveyance volumes included in the federal action under consultation are presented in Table 1-1. The amount of groundwater to be developed and conveyed under the federal action for this consultation differs from that considered in any of the alternatives identified in BLM's FEIS, but is within the amounts considered in Alternatives E and F of that document (BLM 2012b).

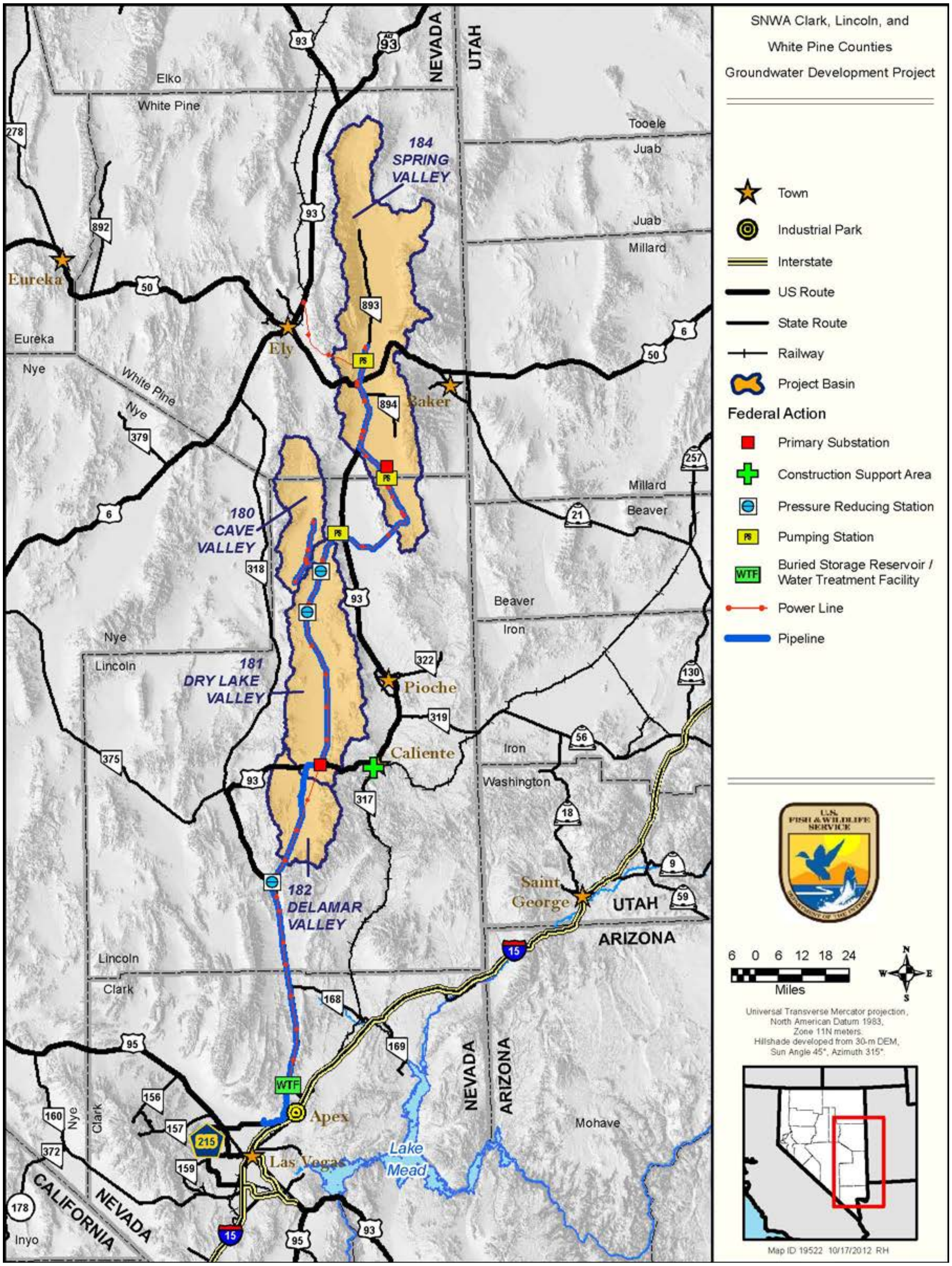

Figure 1-1. Regional location of the proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Table 1-1. Federal action groundwater development and conveyance volumes in acre-feet per year (afy) considered for section 7 Endangered Species Act consultation

Hydrographic Basin	Existing Groundwater Rights (afy)	Nevada State Engineer-awarded Groundwater Rights Considered under Federal Action (afy)
Southern Nevada Water Authority (SNWA) Water		
Spring Valley	8,000	61,127
Cave Valley	—	5,235
Dry Lake Valley	—	11,584
Delamar Valley	—	6,042
Subtotal: SNWA	8,000	83,988
Lincoln County Water		
Lake Valley	11,300	
Additional capacity (future sources to be determined)	21,700	
Subtotal: Lincoln County	33,000	
TOTAL	124,988	

Lastly, the Tier 1 pipeline alignment that we have been asked to consult on is the main and lateral conveyance pipeline alignment contained in Alternative F in the FEIS, which is BLM's preferred pipeline alignment (BLM 2012b). Additionally, we have considered BLM's preferred power line alignment (Option 1, Humboldt-Toiyabe Power Line Alignment), which routes the power line in Steptoe Valley, east of Ely, across U.S. Forest Service lands through an existing utility corridor (BLM 2012c) (see Figure 1-1**)**.

The U.S. Army Corps of Engineers (USACE) will be issuing nationwide or individual permits under Section 404 of the Clean Water Act for the GWD Project. The USACE has designated BLM as the lead federal agency to act on their behalf for purposes of compliance with section 7 of the Act (Appendix A), as provided for in 50 CFR § 402.07. This Opinion satisfies both BLM and USACE compliance with section 7 of the Act, and any incidental take coverage provided in this Opinion applies to both agencies. Additional federal authorizations or permits may be needed for future components of the GWD Project (e.g., Federal Energy Regulatory Commission licensing for hydroturbines at pressure-reducing station sites), and compliance with section 7 will be handled when SNWA applies for those federal authorizations.

This Opinion was prepared by the Nevada Fish and Wildlife Office with assistance from the Utah Fish and Wildlife Office. It is based on information provided in BLM's revised final Biological Assessment (BLM 2012a); BLM's FEIS (BLM 2012b); SNWA's Conceptual Plan of Development (SNWA 2011); Central Carbonate-Rock Province (CCRP) Model reports (SNWA 2009a–c; 2010a–b); data describing the CCRP Model and model predictions for pumping rates awarded to SNWA by the NSE in March 2012 (SNWA 2012b); the NSE rulings on SNWA's groundwater rights applications in Delamar, Dry Lake, Cave, and Spring valleys (NSE 2012a–d); the Department of Interior and SNWA Stipulated Agreement for Spring Valley (BIA et al. 2006); the Department of Interior and SNWA Stipulated Agreement for Delamar, Dry Lake, and Cave valleys (BIA et al. 2008); hydrologic and biological monitoring plans developed per these stipulations (BWG 2009; SNWA 2009d–e; BRT 2011); numerous hydrologic and biological studies, including those done in support of the GWD Project, the stipulated agreements, and otherwise; meetings and discussions with BLM and SNWA; discussions with species experts; and other sources of information available in our files and cited herein.

1.1 PROJECT AUTHORIZATIONS

The Federal Land Policy and Management Act of 1976 (FLPMA) authorizes the Secretary of the Interior to grant ROWs across public lands administered by the BLM. All ROWs requested by SNWA for the GWD Project would be processed in accordance with the FLPMA and the BLM ROW regulations in 43 CFR Part 2800.

In addition to FLPMA, Congress specifically directed BLM to grant ROWs to SNWA for water resource development and conveyance projects in Lincoln and Clark counties pursuant to the Southern Nevada Public Land Management Act of 1998 (SNPLMA) and the Lincoln County Conservation, Recreation, and Development Act of 2004 (LCCRDA) (Public Law No. 108-424, 118 Stat. 2403 § 301). The SNPLMA requires the Secretary of the Interior, upon application and in accordance with FLPMA and other applicable provisions of law, to issue ROW grants on federal lands in Clark County, Nevada, to a unit of local government or regional governmental entity for facilities and systems needed for the impoundment, storage, treatment, transportation, or distribution of water. The LCCRDA established a ROW corridor for utilities in Lincoln County and Clark County, Nevada, and required the Secretary of the Interior to grant in perpetuity nonexclusive ROWs to SNWA and the Lincoln County Water District for any roads, wells, well fields, pipes, pipelines, pump stations, storage facilities, or other facilities necessary for the construction and operation of a water conveyance system. This ROW grant is subject to compliance with NEPA, including the identification and consideration of potential impacts to fish and wildlife resources and habitat.

The USACE has jurisdiction related to this project under the authority of Section 404 of the Clean Water Act for the discharge of dredged or fill material into waters of the United States, which include but are not limited to rivers, perennial or intermittent streams, lakes, ponds, wetlands, vernal pools, marshes, wet meadows, and seeps. Project features that result in the discharge of dredged or fill material into waters of the United States will require a USACE authorization prior to commencement of work. In May 2009, SNWA prepared a preliminary Jurisdictional Determination Report for waters of the United States that may be affected by construction of the main GWD Project pipeline and related infrastructure facilities (SNWA 2008). This report was verified by the USACE in August 2009 for a period of 5 years (McQueary 2009). Additionally, the USACE will require preconstruction notification for this project because of the adverse cumulative impacts to waters of the United States, especially those long-term impacts on wetland habitat associated with the drawdown (BLM 2012b).

The NSE has jurisdiction to grant or deny groundwater applications (NRS § 533.370). On March 22, 2012, the NSE issued Rulings #6164-6167, granting SNWA's groundwater rights applications in Spring, Cave, Dry Lake, and Delamar valleys for a total of 83,988 afy (NSE 2012a–d). All of the rulings require SNWA compliance with hydrologic and biological monitoring and mitigation plans; preparation of annual reports; completion of baseline studies; and periodic updating of a groundwater flow model. A more detailed description of the procedural history associated with the SNWA applications, NSE findings of fact, and conclusions of law can be found in the rulings. Numerous parties have filed petitions calling for judicial review of these NSE decisions.

1.2 TIERED PROGRAMMATIC CONSULTATION APPROACH

This Opinion includes both project-specific and programmatic portions because not all project details are known yet. Therefore, we are utilizing a tiered programmatic consultation approach consistent with our July 16, 2003, draft guidance for programmatic-level consultations (USFWS 2003). Having both project-specific and programmatic portions of the section 7 consultation is consistent with BLM's approach to analyzing GWD Project effects under NEPA.

The consultation for the GWD Project will be a multistage (or step) process that consists of 1) project-level consultations that address the specific effects of project components for which details are known and 2) a programmatic-level consultation that, based on a set of assumptions, conceptually evaluates effects of project components for which details are not yet known. Project specifics are known for the main and lateral pipelines and associated facilities; therefore, this consultation analyzes the specific effects of these project components. Subsequent project-level consultations will be conducted when details of future project components are known, and will "tier" to the programmatic consultation. This approach will result in multiple consultation documents over the lifetime of the GWD Project. The components of this Opinion and a brief description of the Service's responsibilities and decisions at each step are summarized in Table 1-2. Below we also describe the project-specific and programmatic portions of this Opinion.

Table 1-2. Project-level and programmatic components, Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) Biological Opinion

Project Components	Evaluation Information	Decisions/Authorizations
Project-specific Portion		
Tier 1 Rights-of-Way (ROWs): Main and lateral pipelines; power facilities; ancillary facilities; and access roads	The Service will evaluate impacts to federally listed species and/or their designated/proposed critical habitat from the construction, operation, and maintenance of these facilities to determine if a jeopardy or adverse modification situation exists. Site-specific details are known, with the exception of construction water supply. The analysis for construction water supply is therefore based on a set of assumptions.	This Opinion authorizes incidental take for species affected by this component—specifically, the Mojave desert tortoise. Other federally listed species and designated/proposed critical habitat consulted on for the overall action will not be impacted by this portion of the project, and therefore incidental take is not authorized for those species.
Programmatic Portion		
Subsequent Tier ROWs: Exploratory drilling; production wells; collector pipelines; power facilities; ancillary facilities; and access roads distributed within broadly defined groundwater development areas	The Service will evaluate impacts to federally listed species and/or designated/proposed critical habitat from the construction, operation, and maintenance of these facilities to determine if a jeopardy or adverse modification situation exists. Site-specific details are not known, and therefore this analysis is based on a set of assumptions. Groundwater development areas (the broad area in which future groundwater development may occur) are defined by the Proposed Action.	This Opinion does not authorize incidental take for species potentially impacted by this project component, because site-specific information is not known. This Opinion does offer Conservation Recommendations to inform the BLM and the project applicant about information needs for subsequent tier consultations; this Opinion also offers recommendations for avoidance, minimization, and/or mitigation measures. Subsequent tier consultations will be developed as project specifics for future components are identified, and authorizations for incidental take will be provided for affected species at that time.
Groundwater pumping: The long-term effects of groundwater pumping, which are an indirect effect of Bureau of Land Management's issuance of the Tier 1 ROW and any subsequent tier ROWs for the GWD Project	The Service will evaluate potential impacts to federally listed species and/or designated/proposed critical habitat from groundwater pumping to determine if a jeopardy or adverse modification situation exists. Site-specific details (e.g., location, depth, completion units, pumping rates and schedules for production wells) are not known, and therefore this analysis is based on a set of assumptions. Considerable uncertainties are associated with predicted impacts from this project component. Therefore, we have developed this Opinion with the best available information, giving the benefit of the doubt to the species.	

1.2.1 *Project-specific Portion: Tier 1 Rights-of-Way*

Site-specific details are known for the primary water and power conveyance system, the effects of which are analyzed specifically in this Opinion. This is the "project-specific" portion of this Opinion and is referred to herein as Tier 1 ROWs. The BLM must decide whether to issue a ROW permit to SNWA for the primary water and power facilities and any associated infrastructure.

For each federally listed species and designated or proposed critical habitat, we have analyzed the potential effects associated with construction, operation, and maintenance of these facilities. Our analysis of the potential effects of pumping to supply water for construction purposes (e.g., dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) is based on a set of assumptions because the specific details of this activity are not known. These assumptions are described in Chapter 2; please refer to Chapter 5 for a description of our analytical approach for this particular activity.

Because the analysis for Tier 1 ROWs is a project-level analysis, this Opinion authorizes incidental take for these Tier 1 ROW activities, where applicable (see Chapter 6, Desert Tortoise).

1.2.1.1 *Programmatic Portion: Subsequent Tier Rights-of-Way and Groundwater Pumping*

Details regarding future groundwater development facilities (e.g., locations of production wells, collector pipelines, and other associated infrastructure) are not yet known and cannot be determined at this time. This is therefore one of the programmatic portions of this Opinion, and is referred to herein as Subsequent Tier ROWs. Our analysis of effects from construction, operation, and maintenance of these future facilities is based on a set of assumptions about1) the number, spacing, and locations of production wells; 2) the specific lengths and routes of collector pipelines, distribution power lines, and other associated infrastructure; and 3) the acreage of permanent and temporary ROWs that will be disturbed. The anticipated locations of Subsequent Tier infrastructure will be within defined groundwater development areas (see Figure 2-1 in Chapter 2). Our analysis of the potential effects of construction pumping (e.g., dust control, hydrostatic testing) associated with Subsequent Tier ROWs is the same as described above under "Project-specific Portion: Tier 1 ROWs". The SNWA will submit additional ROW applications to BLM for future groundwater development facilities when site-specific location information is known. These future facilities will then be subject to additional section 7 consultation as part of subsequent tiers.

We consider the long-term effects of groundwater pumping to be an indirect effect of BLM's issuance of Tier 1 and Subsequent Tier ROWs for the GWD Project. The potential effects to federally listed species and/or their designated/proposed critical habitat from groundwater pumping are addressed programmatically in this Opinion due to the lack of project specifics; thus, this is the other programmatic portion of the Opinion. Our analyses and overall effects determinations for this Opinion are based on a set of assumptions about project design, including but not limited to the locations, depths, and completion units of production wells and groundwater pumping rates and schedules at individual production wells. Additionally, while we have based our Opinion on the best available hydrologic and biological information, considerable uncertainties exist regarding future activities and impacts from groundwater pumping. Therefore, we have given the benefit of the doubt to the species when formulating our Opinion (H.R. Conf. Rep. No. 697, *supra*, at 12; 50 CFR Part 402, Interagency Cooperation–Endangered Species Act of 1973, as Amended, Final Rule). Subsequent section 7 consultations for groundwater development will occur when project specifics regarding groundwater pumping have been identified. When the SNWA applies for future federal ROWs, additional analyses regarding pumping impacts will be required prior to authorization.

This Opinion does not provide exemption from section 9 of the Act for “programmatic activities” (i.e., Subsequent Tier ROWs and groundwater pumping) and does not authorize any incidental take for programmatic impacts. Incidental take that may occur from programmatic activities, and the specific measures needed to reduce such take, cannot be adequately identified yet, because many future project components (e.g., location of production wells, specific quantities of groundwater to be pumped from each well) are unknown; in addition, considerable uncertainties exist regarding predicted impacts, including but not limited to the response of the groundwater system to pumping stresses and the response of federally listed species and their habitats to reduced spring flow and/or groundwater levels. When site-specific location information is known for subsequent tiers of the GWD Project, the Service will review available information and complete a tiered biological opinion with an incidental take statement for that tier of the project.

Because we are not authorizing incidental take for programmatic activities, this Opinion does not include reasonable and prudent measures and terms and conditions to minimize such take. However, we do provide discretionary conservation recommendations at the end of this consultation (see Chapter 15, Conservation Recommendations) that are meant to inform BLM and the project proponent of 1) the type and quantity of information we believe is needed to adequately develop incidental take statements for subsequent tiered Opinions; 2) monitoring, research, and management needs for assessing and mitigating potential future GWD Project impacts; and 3) additional avoidance, minimization, and compensatory mitigation measures for programmatic activities. Our intention is to encourage BLM, Service, and project applicant to work together to reduce some of the uncertainties about project effects. Reducing the unknowns will improve our ability to predict and quantify potential future impacts and help us determine incidental take from groundwater pumping,—all of which will contribute to subsequent tiered analyses.

Tiering Process

This Opinion was prepared in accordance with the Service’s July 16, 2003, draft guidance for programmatic-level consultations (USFWS 2003); our Endangered Species Consultation handbook guidance; 50 CFR 402 (Interagency Cooperation–Endangered Species Act of 1973, as Amended, Final Rule); and H.R. Conf. Rep. No. 697, *supra*, at 12. This guidance directs the Service to develop biological opinions using the best available information, giving the benefit of the doubt to the species when insufficient information and/or uncertainties exist regarding future activities and impacts. As indicated above, additional analyses will be conducted during subsequent tiered section 7 consultations for groundwater development. This process provides the action agency and project applicant the opportunity to develop and/or obtain additional information to better inform these future analyses. The tiering process also provides the Service with future opportunities to assess potential GWD Project effects to federally listed species and critical habitat, and to revise our effects determinations when new information makes revision necessary.

The following assumptions regarding future tiered consultations are incorporated into the programmatic portion of this Opinion:

- Subsequent tiers of the GWD Project will be submitted to the Service pursuant to section 7 of the Act, as appropriate.
- For each subsequent tiered analysis, the BLM and Service will 1) determine if assumptions for the programmatic analysis are still valid; 2) assess whether anticipated effects are

consistent with the programmatic portion of this Opinion; and 3) describe any additional effects not considered in the programmatic consultation.

- The programmatic portion of this Opinion will be revised as needed at each tiered stage. Revisions will be based on, but not limited to, the following: 1) GWD Project design details; 2) changes to the assumptions that form the basis of the effects analysis; 3) improvements to predictive tools; 4) new information or data on the hydrology, geology, climate, and ecology in the area of potential project effects; 5) new information on federally listed species and their habitats in the area of potential project effects; and 6) updated information on cumulative effects in the area of potential project effects.
- For each subsequent tiered analysis, the Service will determine if a jeopardy or adverse modification situation exists. If the Service concludes that such a situation exists, the Service, BLM, and the project applicant will work together to develop Reasonable and Prudent Alternatives for that tiered action.

At each subsequent tiered stage, we will request that BLM provide us with updated information on 1) the proposed action; 2) the specific areas, federally listed species, and critical habitat that may be affected; 3) baseline conditions; 4) anticipated effects, including any new data, information, and predictive tools developed to assess impacts; 5) cumulative effects; 6) potential climate change impacts; and 7) proposed measures to minimize potential future effects of the action.

1.3 PROGRAMMATIC OPINION TIMEFRAME

The BLM has requested that the Opinion issued by the Service cover the construction, operation, and maintenance of the GWD Project for 75 years after full project build-out (FBO), assumed for purposes of this analysis to be the year 2125. The BLM submitted this request because its ability to predict groundwater pumping impacts over long timeframes is limited, due in part to the inherent uncertainties associated with the groundwater flow modeling results that are the basis of the effects determinations (BLM 2012a). Therefore, our analysis assesses the potential effects of full operation of the GWD Project for 75 years—that is, until 2125—and our Opinion will be in effect until this date. The expiration date of the programmatic portion of the Opinion is set for a calendar year (2125) instead of a general timeframe (i.e., 75 years after FBO) due to the potential for significant project delays. If the GWD Project is likely to continue operations beyond 2125—which seems probable given that abandonment of the GWD Project is not anticipated (BLM 2012a–b) and the ROW will be granted in perpetuity—then BLM will reinitiate consultation on the effects of the GWD Project prior to expiration of the Opinion. This commitment is clearly articulated in BLM's revised final Biological Assessment (BLM 2012a).

In order to assess potential maximum effects of the action under consultation, our analysis extends beyond the timeframe of 75 years after FBO. This extended period is referred to as the recovery period. By extending the analysis timeframe, we are able to consider the potential response of the groundwater system to the termination of pumping (i.e., continued propagation of groundwater drawdown and/or recovery of the hydrologic system). The BLM also evaluated system response following hypothetical cessation of pumping at 75 years after FBO, selecting a 100-year recovery period for its Biological Assessment after evaluating the results of model simulation runs of various recovery periods. BLM found that any effects that would impact the listed species under consultation are reached within 100 years of terminating pumping, after which the effects retreat and moderate (BLM 2012a). However, because our analysis is more site- and resource-specific, the Service has decided to use a lower threshold for the groundwater modeling results, as described in Chapters 5 and 7, which suggest continued propagation of impacts beyond the 100-year recovery period at some sites with listed species and/or critical habitat (e.g., Pahranagat Valley [Hiko, Crystal, and Ash springs], White River Valley [Preston Big Spring], Panaca Valley [Panaca Big Spring], and the Muddy River Springs Area [Muddy River Springs]) (SNWA 2012b). Because the time to maximum impact differs by location, this topic is addressed on a site-by-site basis in Chapter 7.

1.4 FEDERALLY LISTED SPECIES AND EFFECTS DETERMINATIONS

This Opinion assesses the direct and indirect effects of the federal action, and the effects of any interrelated or interdependent activities, on species listed as threatened or endangered under the Act, and on designated or proposed critical habitat for these species. For our analysis of GWD Project effects, we considered the potential for Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping to affect federally listed species and designated or proposed critical habitat occurring within the area of potential project effects (i.e., the action area).

Below, we provide our concurrence or nonconcurrence with BLM’s effects determinations, which were presented in the revised final Biological Assessment (BLM 2012a) (Table 1-3).

Table 1-3. U.S. Fish and Wildlife Service (Service) and Bureau of Land Management (BLM) effects determinations for section 7 consultation

Species	Status[a]	Service Determination of the Potential for Project-related Adverse Effects to Listed Species			Service Effects Call[b]	BLM Effects Call[b]	Formal Consult?
		Tier 1 Rights-of-Way	Subsequent Tier Rights-of-Way	Pumping			
Mojave desert tortoise *Gopherus agassizii*	E, CH	Yes	No	No	MALAA	MALAA	Yes
Southwestern willow flycatcher *Empidonax traillii extimus*	E, pCH	Yes, but unlikely	Yes, but unlikely	Yes	MALAA	MANLAA	Yes[c]
Yuma clapper rail *Rallus longirostris yumanensis*	E	No	No	No	NE	NE	No
White River springfish *Crenichthys baileyi baileyi*	E, CH	Yes, but unlikely	Yes, but unlikely	Yes	MALAA	MANLAA	Yes
Hiko White River springfish *Crenichthys baileyi grandis*	E, CH	Yes, but unlikely	Yes, but unlikely	Yes	MALAA	MANLAA	Yes
Pahrump poolfish *Empetrichthys latos*	E	Yes, but unlikely	Yes, but unlikely	Yes	MALAA	MALAA	Yes
Pahranagat roundtail chub *Gila robusta jordani*	E	Yes, but unlikely	Yes, but unlikely	Yes	MALAA	MANLAA	Yes
White River spinedace *Lepidomeda albivallis*	E, CH	Yes, but unlikely	Yes, but unlikely	Yes	MALAA	MANLAA	Yes
Big Spring spinedace *Lepidomeda mollispinis pratensis*	T, CH	No	No	Yes	MANLAA	NE	No
Moapa dace *Moapa coriacea*	E	No	No	Yes	MANLAA	MANLAA	No
Ute ladies'-tresses *Spiranthes diluvialis*	T	Yes, but unlikely	Yes	Yes	MALAA	MALAA	Yes

[a] E = Endangered, T = Threatened, CH = Critical Habitat, pCH = proposed revised Critical Habitat

[b] MALAA = May affect, likely to adversely affect a listed species or designated/proposed critical habitat; MANLAA = May affect, not likely to adversely affect a listed species or designated/proposed critical habitat; NE = no effect

[c] This document includes a conference opinion on proposed revised critical habitat for southwestern willow flycatcher.

We **do concur** with BLM's determination that the proposed federal action is likely to adversely affect the Mojave desert tortoise and its critical habitat, Pahrump poolfish, and Ute ladies'-tresses. We **do not concur** with BLM's determination that the proposed project may affect, but is not likely to adversely affect the southwestern willow flycatcher, the Hiko White River springfish, the White River springfish, the Pahranagat roundtail chub, and the White River spinedace. We also **do not concur** that the proposed project may affect, but is not likely to adversely affect (disturb, alter, or destroy) designated critical habitat for Hiko White River springfish, White River springfish, and White River spinedace, and we **do not concur** that the proposed project may affect, but is not likely to adversely affect proposed critical habitat for southwestern willow flycatcher. We have completed section 7(a)(2) analyses for all of these species, which we present in Chapter 6 and Chapters 9–15 of this Opinion. Our conference opinion on proposed revised critical habitat for the southwestern willow flycatcher is included in Chapter 14 (Southwestern Willow Flycatcher).

We **do concur** with BLM that the proposed project may affect, but is not likely to adversely affect moapa dace. Our rationale for this concurrence is provided in Appendix B (Informal Consultation).

The BLM is not required to seek, nor are they seeking, our concurrence on no effect determinations. However, for completeness of the record, BLM provided the Service with their rationale for no effect determinations for Yuma clapper rail and Big Spring spinedace in its revised final Biological Assessment (BLM 2012a). We **do concur** that the Yuma clapper rail will not be affected by the proposed action. However, we **do not concur** that the proposed project will have no effect on Big Spring spinedace and its critical habitat. We believe that this species and its critical habitat could be affected by the proposed action, but that these effects will be either discountable (extremely unlikely to occur) or insignificant (we would not be able to detect or meaningfully measure the effect). Therefore, the Service has determined that the GWD Project may affect, but is not likely to adversely affect Big Spring spinedace and its critical habitat. Our rationale for these determinations is presented in Appendix B (Informal Consultation).

1.4.1 *White River Spinedace*

We have concluded that there is substantial risk to White River spinedace and its designated critical habitat at Flag Springs from proposed GWD Project pumping in Cave Valley at NSE-awarded quantities (5,235 afy) (See Chapter 7, Hydrologic Analysis, Flag Springs; and Chapter 9, White River Spinedace). In response to our concerns, SNWA has developed an additional Applicant Committed Measure (ACM) for Cave Valley—submitted to BLM on September 13, 2012, and transmitted to the Service on September 17, 2012; clarified in a letter dated November 7, 2012—for consideration in our effects analysis. In this ACM, SNWA has committed to develop groundwater in Cave Valley in a staged (phased) approach, which is summarized below and included in full in Appendix C of this Opinion.

- Stage 1 Development: Pumping pursuant to the water rights permits will be limited to 2,600 afy, which is approximately one-half of the permitted rights. Before the increase in pumping associated with Stage 2 development can occur, SNWA will pump at least 85% but not more than 100% of the Stage 1 development amount (2,210–2,600 afy) for a period of 5 years.

- Stage 2 Development: Pumping pursuant to the water rights permits will be limited to a total of 3,900 afy. Before the increase in pumping associated with Stage 3 development can occur, SNWA will pump at 85% but not more than 100% of this amount (3,315–3,900 afy) for a period of 5 years.
- Stage 3 Development: Pumping pursuant to the water rights permits will be limited to the full permitted amount of 5,235 afy.

Staged development will be accompanied by hydrologic monitoring and the setting of decision-making triggers, which will be approved by the BLM and Service and be included in future consultations and NEPA analyses prior to initiation of groundwater pumping in Cave Valley. Movement from one development stage to another will depend on the BLM and Service review of data and a determination by these agencies that the risk to White River spinedace remains at an acceptable level.

1.5 CONSULTATION HISTORY

The Service has been engaged with BLM and SNWA in discussions regarding the GWD Project since 2005; discussions specifically regarding the information needed to initiate formal consultation have been going on for over 2 years. During that time, we provided correspondence to BLM and SNWA and met with these agencies to discuss a number of issues, including those related to assumptions used in the effects analysis and potential effects of the GWD Project on listed species and critical habitat. Additionally, the Service has been a cooperating agency in the NEPA analysis and development of the FEIS for the GWD Project. In this capacity, we have provided comments on the effects analysis and the potential for impacts to listed species on numerous occasions since 2005 as part of our review of early drafts of the EIS (correspondence submitted on February 1, 2010; January 21, 2011; October 11, 2011; May 25, 2012 [draft Technical Assistance document]).

The following is a summary of correspondence, meetings, and other actions relevant to our consultation with BLM and the development of this Opinion. While there is a lengthy informal consultation history (beginning in 2005), the final federal action for formal section 7 consultation was not selected until May 2012. A complete administrative record of this consultation is on file at the Service’s Nevada Fish and Wildlife Office in Reno, Nevada.

March 17, 2005	SNWA requested that the Service provide a species list for the GWD Project.
May 10, 2005	The Service provided a species list to SNWA and BLM for the GWD Project.
October 16, 2006	SNWA requested that the Service provide an updated species list for the GWD Project due to substantial changes in project design.

November 20, 2006	The Service provided an updated species list to SNWA and BLM for the GWD Project.
January 29, 2008	The Service met with BLM and SNWA to coordinate preparation of the Biological Assessment and EIS.
October 2008–February 2009	The Service met with BLM and SNWA on numerous occasions to discuss the process for developing the Biological Assessment; agency roles and responsibilities; and timelines for section 7 consultation.
April 24, 2009	BLM requested that the Service provide a current species list for the GWD Project.
June 11, 2009	The Service provided an updated species list to BLM and SNWA for the GWD Project.
June 12, 2009	BLM designated SNWA as the nonfederal representative for informal consultation, including assisting with Biological Assessment preparation.
September 2009–May 2010	The Service met with BLM and SNWA on numerous occasions to discuss the schedule for informal and formal consultation; status and process for Biological Assessment development, including content; preliminary effects analyses and results; USFWS information needs for development of the Opinion; and other section 7 consultation issues.
May–December 2010	The Service provided BLM and SNWA with a detailed list of our hydrologic and biological data and information needs (including GIS and groundwater flow model files) for development of the Opinion.
May 19, 2011	SNWA provided a draft Biological Assessment for the GWD Project to BLM and the Service for review. The federal action selected for consultation was the applicant's proposed action as identified in the Draft EIS, which included pumping groundwater at quantities identified in SNWA's groundwater applications in Spring, Snake, Delamar, Dry Lake, and Cave valleys.
June 9–30, 2011	SNWA provided the Service with much of the information and data (e.g., GIS files) that the Service requested in May–December 2010.

July 14, 2011	The Service provided BLM and SNWA with a memorandum documenting substantive comments on the May 19, 2011, draft Biological Assessment. The Service indicated to BLM that we did not concur with their preliminary determination that the federal action may affect, but was not likely to adversely affect White River spinedace; and that we did not concur that the proposed action would not affect White River springfish, Hiko White River springfish, Pahranagat roundtail chub, and southwestern willow flycatcher.
July 2011–March 2012	The Service, BLM, and SNWA met or participated in conference calls on a regular basis to discuss development of the Biological Assessment, the preliminary effects analysis and determinations, Service comments on the draft Biological Assessments, the Service's data and information needs for development of the Opinion, and other section 7 consultation issues.
July 27, 2011	BLM requested that the Service provide a current species list for the GWD Project.
September 26, 2011	The Service provided BLM and SNWA with a memorandum documenting additional comments on the May 19, 2011, draft Biological Assessment.
December 9, 2011	The Service provided BLM and SNWA with a detailed list of our hydrologic and biological data and information needs (including GIS and groundwater flow model files) for development of the Opinion.
January 25, 2012	The Service provided an updated species list to BLM and SNWA for the GWD Project.
February–May 2012	SNWA provided the Service with much of the information and data that the Service requested on December 9, 2011.
February 23, 2012	SNWA provided BLM and the Service with a revised draft Biological Assessment for review. The federal action selected for consultation was Alternative F from the EIS, which was based on pumping groundwater quantities in the amount equal to SNWA's estimates of perennial yield and available groundwater in Spring, Delamar, Dry Lake, and Cave valleys.
March 12, 2012	SNWA provided BLM and the Service with revised ACMs.

March 16, 2012	The Service provided BLM and SNWA with a memorandum documenting substantive comments on the February 23, 2012, revised draft Biological Assessment. The Service indicated to BLM that we did not concur with their preliminary determination that the proposed action may affect, but was not likely to adversely affect the following species: White River springfish, Hiko White River springfish, Pahranagat roundtail chub, southwestern willow flycatcher, and Ute ladies'-tresses.
April 9, 2012	The Service advised BLM to revise the final Biological Assessment, using the NSE rulings, due to substantial differences between the quantity of groundwater pumping analyzed in Alternative F and the groundwater rights quantities awarded by the NSE in Cave and Spring valleys.
April 10, 2012	BLM provided the Service with a final Biological Assessment based on EIS Alternative F quantities of groundwater pumping, and requested initiation of formal consultation with the Service for BLM issuance of a ROW permit to SNWA for construction, operation, and maintenance of the GWD Project.
April 10–May 11, 2012	Service, BLM, and SNWA managers discussed revising the federal action for the Biological Assessment, using the NSE-awarded quantities of groundwater rights; the Service requested additional (new) data (e.g., GIS files) to complete the effects analysis for the Opinion.
May 11, 2012	BLM provided the Service with a revised final Biological Assessment with a revised federal action based on NSE-awarded groundwater rights quantities, and BLM again requested initiation of formal consultation with the Service for the GWD Project.
May 31, 2012	The Service sent a memorandum to BLM initiating formal consultation for the GWD Project and requested a 13-day extension to the 135-day regulatory timeframe for delivery of an Opinion, due to the complexity and scope of the consultation.
May–August 2012	The Service requested and SNWA provided additional hydrologic information and data (GIS, other data, and groundwater flow model files) for the revised federal action based on NSE-awarded groundwater rights quantities.

April–May 2012	The Service requested and SNWA provided additional GIS files and information on the proposed action, USACE jurisdictional wetland determination, and Spring Valley vegetation monitoring to inform our Ute ladies'-tresses effects analysis.
September 12–October 5, 2012	The Service provided draft chapters of the Biological Opinion to BLM and SNWA.
September 17, 2012	BLM provided the Service with new SNWA ACMs specific to Cave Valley. BLM requested that the Service consider the mitigation measures presented in the Final EIS, including the Construction, Operation, and Maintenance Plan process, and the new ACMs as part of the agency action for the section 7 consultation.
September 27–October 23, 2012	BLM and SNWA provided the Service with detailed comments on the draft Biological Opinion.
November 1, 2012	BLM provided the Service with modifications to BLM mitigation measure ROW-WR-3 (Construction Water Supply Plan) and requested that the Service consider this mitigation measure for the section 7 consultation. (SNWA 2012a)
November 16, 2012	The Service provided BLM with a final Biological Opinion, including an Incidental Take Statement for desert tortoise for construction, operation, and maintenance of Tier 1 facilities, and implementing Terms and Conditions.

1.6 NATIVE AMERICAN TRIBAL CONSULTATION

On February 27, 2012, certified letters were sent to 28 Native American tribes and/or bands (tribes) to provide notice that the Service was entering into formal consultation with the BLM in accordance with section 7 of the Act. The letters included a table of federally listed species and critical habitat that may be affected by the proposed GWD Project and a map of locations of federally threatened or endangered species and designated or proposed critical habitat within the project area. Telephone calls were made to follow up on the letters and determine if the tribes had an interest in further contact. Positive responses for additional contact were received from 5 tribes: the Chemehuevi Tribe, the Confederated Tribes of the Goshute Reservation, the Duckwater Shoshone Tribe, the Las Vegas Band of Paiutes, and the Moapa Band of Paiutes.

Between April 5 and April 17, 2012, meetings were held with each Tribe that requested additional contact. Ted Koch, state supervisor of the Nevada Fish and Wildlife Office, represented the Service at each of these meetings. At all meetings, Mr. Koch explained the ESA consultation process and the Department's consultation framework with the tribes. Additionally, the Service requested local tribal knowledge and traditional use of federally listed species that could be used to inform the Opinion for the GWD Project.

The Service expects and is committed to continue coordination with the Tribes on issues related to the GWD Project and effects to listed species and critical habitat, at the technical and the government-to-government level. The long-term nature of this project and the tiered-programmatic consultation approach provides for continued engagement between the Service and the tribes on these issues.

1.7 REINITIATION NOTICE

As required by 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over an action has been retained (or is authorized by law) and if 1) the amount or extent of incidental take is exceeded; 2) new information reveals that the agency action may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; 3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this Opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. Whenever the amount or extent of incidental take is exceeded, any activities causing such take must cease pending reinitiation.

The programmatic effects analysis in this Opinion is based on numerous assumptions related to the design of future project components; the hydrology, geology, and ecology/biology of the area; and the federally listed species that are the subject of this consultation (these assumptions are necessary due to the scarcity of information and data in some areas and for some species). The assumptions are based on information supplied by the project applicant and/or BLM regarding future project components and mitigation measures; information on the geology and hydrology of the area of potential project effects; information about the ecology/biology of the federally listed species and/or closely related species; and information about the ecological consequences of decreased groundwater levels and decreased flow on aquatic systems and/or riparian vegetation. Some of our assumptions may differ from the analysis in the FEIS (BLM 2012b) because our analysis in this Opinion is guided by a different statute and is more site- and resource-specific; in addition, we have concerns that impacts to threatened and endangered species could be observed more quickly than for other resources analyzed in the FEIS, or impacts could be more significant. Given the lack of site-specific data, we acknowledge our analysis may bear relatively greater uncertainty, and we account for that in our effects determinations. If information becomes available that indicates that a specific assumption is not (or is likely not) true, consideration of this new information may result in effects that were not considered in this Opinion and may require reinitiating consultation at the programmatic level. Additionally, cumulative effects impacting the GWD Project action area may increase over time to the extent that the effects to federally listed species and critical habitat change. If this occurs, the programmatic consultation may need to be reinitiated.

The tiered programmatic consultation approach also provides specific opportunities for BLM and the Service to reevaluate the programmatic analyses at the time of tiered consultations, including changes to the programmatic action analyzed herein (which, as mentioned above, is based on numerous assumptions). New information from studies in progress or initiated between issuance of this programmatic opinion and tiered opinions will be reviewed and incorporated into the analyses as appropriate. Additionally, consultation on the entire GWD Project will be necessary prior to expiration of this Opinion in 2125 if the GWD Project is to continue operations beyond that date. The BLM has committed to this reconsultation (BLM 2012a).

If the currently proposed revised critical habitat for southwestern willow flycatcher is designated, then BLM can submit a written request to the Service, asking that the conference opinion herein be confirmed as a biological opinion issued through formal consultation. Upon receiving BLM's request, the Service will review the proposed action to determine if there have been any significant changes in the action as planned or in the information used during the conference. If no significant changes in planning or information have occurred, the Service will confirm the conference opinion on the GWD Project and no further section 7 consultation will be necessary. After redesignation of critical habitat for the southwestern willow flycatcher and subsequent adoption of this conference opinion as a biological opinion, reinitiation of consultation will be required as described in the first paragraph of this section.

1.8 DOCUMENT ORGANIZATION

Chapters 1–4 of this Opinion provide background information on the federal action and the GWD Project and describe the action area and environmental setting for the proposed project.

Chapter 5 describes the Service's methodology (analytical approach) for determining potential impacts to federally listed species and designated or proposed critical habitat for Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping.

The effects analysis in this Opinion is divided into 2 main sections. Section one focuses on federally listed species and critical habitats that are likely to be adversely affected by construction, operation, and maintenance of Tier 1 infrastructure and activities. This section has only 1 chapter, which discusses impacts to the Mojave desert tortoise (Chapter 6). This section represents a project-level consultation for desert tortoise, and it includes an Incidental Take Statement with implementing terms and conditions as well as tortoise-specific conservation recommendations.

Section Two of this Opinion focuses on federally listed species and critical habitats that we anticipate will be adversely affected by construction, operation, and maintenance of Subsequent Tier ROWs and/or groundwater pumping. As described above, future groundwater development and pumping is being analyzed at a programmatic level, and these activities will not be implemented absent project- or activity-specific consultations that will be tiered to this programmatic Opinion. Section Two begins with our hydrologic analyses of long-term GWD Project pumping for areas that we believe are likely to experience substantial hydrologic impacts and areas that we believe may experience hydrologic impacts, but for which we have insufficient information to assess the likelihood or magnitude of these impacts (Chapter 7). Chapter 8 presents our assessment of potential future impacts of climate change on groundwater-dependent ecosystems and federally listed species that rely on these systems (Chapter 8). Chapters 9–14 provide the species-specific analyses, including an assessment of the possible effects of groundwater drawdown and/or decreased spring flow on the ecology, life history, habitat, and populations of federally listed species. The conference opinion on proposed revised critical habitat for southwestern willow flycatcher is incorporated into Chapter 14 rather than provided as a separate conference report.

Chapter 15 provides the Service’s conservation recommendations for those federally listed species and critical habitats that may be adversely affected by future groundwater development and pumping. Conservation recommendations for the desert tortoise can be found in Chapter 6.

Appendix B comprises our informal consultation for the GWD Project. It includes our rationale for “may affect, not likely to adversely affect” determinations. It also includes our analyses for those geographic areas where hydrologic impacts may occur, but for which available information does not support a conclusion that such effects would be significant. Appendix A provides a copy of a letter from the USACE designating a lead agency for ESA section 7 consultation. And Appendix C provides documentation of a new Cave Valley ACMs to ensure the conservation of White River spinedace.

The specific chapters of this Opinion that contain the hydrologic and biological analyses that support our determinations can be found in Table 1-4.

Table 1-4. Organization of U.S. Fish and Wildlife Service Opinion—Effects Calls by Species and Site and Location of supporting hydrologic and biological analyses

Sites	Federally Listed Species											Location for Supporting Hydrologic Analyses
	Desert tortoise	Southwestern willow flycatcher	Yuma clapper rail	White River springfish	Hiko White River springfish	Pahrump poolfish	Pahranagat roundtail chub	White River spinedace	Big Spring spinedace	Moapa dace	Ute Ladies'-tresses	
Mojave Desert	MALAA											N/A
Flag Springs								MALAA				Chapter 7
Lund Spring								MANLAA				Appendix B
Preston Big Spring								MANLAA				Appendix B
Ash Springs				MALAA								Chapter 7
Crystal Springs					MALAA							Chapter 7
Hiko Spring					MALAA							Chapter 7
Pahranagat Creek		MALAA					MALAA					Chapter 7
Pahranagat National Wildlife Refuge		MALAA										Chapter 7
Key Pittman Wildlife Management Area		MALAA					MALAA					Chapter 7
Lower Meadow Valley Wash		MANLAA										Appendix B
Muddy River Springs Area		MANLAA								MANLAA		Appendix B
Lower Moapa Valley / Overton Wildlife Management Area		NE	NE									N/A
Panaca Spring											MANLAA	Appendix B
Condor Canyon									MANLAA			Appendix B
Shoshone Ponds						MALAA						Chapter 7
Spring Valley springs / wetlands											MALAA	Chapter 7
Hamlin & Snake Valley springs / wetlands											MALAA	Chapter 7

Sites	Federally Listed Species											Location for Supporting Hydrologic Analyses
	Desert tortoise	Southwestern willow flycatcher	Yuma clapper rail	White River springfish	Hiko White River springfish	Pahrump poolfish	Pahranagat roundtail chub	White River spinedace	Big Spring spinedace	Moapa dace	Ute Ladies'-tresses	
Willow Spring near Callao, Utah											NE	N/A
Location for supporting biological analyses	Chapter 6	Chapter 14	N/A	Chapter 12	Chapter 12	Chapter 10	Chapter 13	Chapter 9	Appendix B	Appendix B	Chapter 11	

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Chapter 2
DESCRIPTION OF THE PROPOSED ACTION

2.1 LOCATION AND SETTING

The Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) is proposed for construction and operation within a portion of 3 counties in southeastern Nevada, as depicted on Figure 1-1 in Chapter 1 (Introduction). The GWD Project infrastructure will be constructed in the following Hydrographic Basins ("project basins"): Spring Valley, Steptoe Valley, Lake Valley, Cave Valley, Dry Lake Valley, Delamar Valley, Pahranagat Valley, Coyote Springs Valley, Hidden Valley (north), Garnet Valley, and Las Vegas Valley. The project applicant (Southern Nevada Water Authority [SNWA]) proposes to pump 83,988 acre-feet per year (afy) of recently awarded groundwater rights from 4 of the project basins (Delamar, Dry Lake, Cave, and Spring valleys) for municipal use in the Las Vegas Valley (Note: total anticipated pipeline conveyance volume is 124,988 afy, based on other sources of water and reserve capacity described in this chapter). The magnitude of the proposed groundwater withdrawals is large compared to the rate of natural discharge from the project basins. Consequently, the proposed groundwater withdrawals are likely to result in widespread declines in groundwater levels over time, accompanied by reductions in natural discharge, both within and beyond the project basins. Chapter 3 (Action Area) describes the project basins where direct and indirect project-related effects (including pumping-induced groundwater drawdown) could occur.

2.2 TIER 1—INFRASTRUCTURE AND ACTIVITIES

As identified in the preliminary construction schedule (BLM 2012a) and discussed in the Final Environmental Impact Statement (FEIS) (BLM 2012b), construction of the Tier 1 infrastructure is anticipated to take approximately 8–10 years. Construction will start at the southern terminus and proceed generally from south to north along the pipeline alignment. The start of construction could be deferred for several years, accelerated, or completed in phases, depending on the SNWA's need for water (based in part on climate effects to the Colorado River water supply); project financing; and/or other factors (BLM 2012b). However, we have based our analysis on the assumptions inherent in the preliminary construction schedule, with timing of Tier 1 construction beginning so as to allow for groundwater conveyance by 2020 from the southernmost valleys (Delamar, Dry Lake, and Cave) (BLM 2012a). These assumptions are discussed further in Chapter 5 (Analytical Approach).

2.2.1 *Infrastructure*

As described in sections 2.5 and 2.6 of the FEIS (BLM 2012b), and section 2.1 of the Biological Assessment (BLM 2012a), the footprint of Tier 1 includes proposed infrastructure for 3 project components: main and lateral pipelines; power facilities; ancillary facilities, and access roads. The Tier 1 pipeline alignment that we have been asked to consult on is the main and lateral conveyance pipeline alignment contained in Alternative F in the FEIS, which is the BLM's preferred alternative (BLM 2012b). Additionally, we have considered the Bureau of Land Management's (BLM's) preferred power line alignment (Option 1, Humboldt-Toiyabe

Power Line Alignment), which routes the power line in Steptoe Valley, east of Ely, across U.S. Forest Service lands through an existing utility corridor (BLM 2012b). Based on our analysis, we have found that the Mojave desert tortoise (*Gopherus agassizii*) is the only federally listed species that will be affected by Tier 1 project components and associated rights-of-way (ROWs). Direct and indirect effects to the tortoise will primarily be the result of lost habitat, but also will result from potential interaction between tortoises and infrastructure during the various phases of construction. Activities associated with Tier 1 project infrastructure will also affect the Mojave desert tortoise and are described in the section 2.1.2. For locations of infrastructure and to view the following information in tabular format, please reference Table 2-1. For species-specific effects analyses based on the footprint of the Tier 1 portion of the GWD Project, please reference Chapter 6 (Desert Tortoise) and Chapters 9–14 (all other species).

Pipeline infrastructure includes the following:

- 423.3 kilometers (km) (263 miles) of buried pipeline (326.7 km [203 miles] of main pipeline and 96.6 km [60 miles] of lateral pipelines) and 321.9 meters (m) (200 feet) of accompanying permanent and temporary ROWs. Although pipeline diameters are not yet finalized, the SNWA has provided estimations of 106.7213.4 centimeters (cm) (42–84 inches) for the main pipeline and 40.6167.6 cm (16–66 inches) for the lateral pipelines. The total footprint of the permanent and temporary pipeline ROWs is 1289.7 hectares (ha) (3,187 acres) and 1284.1 ha (3,173 acres), respectively.
- 1.2 ha (3-acre) staging areas sited every 4.8 km (3 miles) along the ROW, for a total of 103.2 ha (255 acres) of temporary ROW
- 49.0 ha (121 acres) of permanent ROW for Caliente construction support area to be used for pipe and equipment storage, temporary construction management offices, and other support activities
- 19 plant nursery sites, for a total of 100.8 ha (249 acres) of temporary ROW
- Temporary construction camps (ROW to be determined)
- 7 temporary borrow pits, for a total of 19.8 ha (49 acres) of temporary ROW
- 53 new access spur roads, for a total of 13.4 ha (33 acres) of temporary ROW

Table 2-1. Location and acreage of rights-of-way (ROWs) required for Tier 1 infrastructure

Tier 1 Project Component	Valleys Affected	Permanent ROW on BLM, Private and State of Nevada lands	Temporary ROW on BLM, Private and State of Nevada lands
Pipeline Infrastructure			
327 kilometers (km) (203 miles) of main pipeline (30.5-m [100-foot] permanent ROW + 30.5-meter [100-foot] temporary ROW)	• Spring Valley (27.4 km [17 miles]) • Lake Valley (33.8 km [21 miles]) • Dry Lake Valley (106.2 km [66 miles]) • Delamar Valley (37.0 km [23 miles]) • Pahranagat Valley (11.3 km [7 miles]) • Coyote Springs Valley (66.0 km [41 miles]) • Hidden Valley (north) (19.3 km [12 miles]) • Garnet Valley (11.3 km [7 miles]) • Las Vegas Valley (14.5 km [9 miles])	1290 ha 3,187 acres	1284 ha 3,173
97 km (60 miles) of lateral pipeline (30.5-meter [100-foot] permanent ROW + 30.5-meter [100-foot] temporary ROW)	• Spring Valley (61.2 km [38 miles]) • Cave Valley (30.6 km [19 miles]) • Dry Lake Valley (4.8 km [3 miles])		
Staging areas (1.21 hectares (ha) [3 acres] every 4.8 km [3 miles] along the ROW)	• All valleys through which the main and lateral pipelines will be constructed	NA	103.2 ha 255 acres
Construction support area at Caliente	• Lower Meadow Valley wash	49.0 ha 121 acres	NA
19 plant nursery sites	• Garnet Valley (2) • Hidden Valley (north) (2) • Coyote Springs Valley (12) • Pahranagat Valley (1) • Delamar Valley (2)	NA	100.8 ha 249 acres
Construction camps	• Central Lincoln County	NA	TBD
7 borrow pits (2.8 ha [7 acres] each)	• Cave Valley (2) • Lake Valley (2) • Dry Lake Valley (2) • Spring Valley (1)	NA	19.8 ha 49 acres

Tier 1 Project Component	Valleys Affected	Permanent ROW on BLM, Private and State of Nevada lands	Temporary ROW on BLM, Private and State of Nevada lands
53 access spur roads	• Spring Valley • Dry LakeValley • Delamar Valley • Pahranagat Valley • Coyote Springs Valley • Hidden Valley (north) • Garnet Valley • Las Vegas Valley	NA	13.4 ha 33 acres
Power Facilities			
148.1 km (92 miles) of 230-kilovolt (kV) power line (requires 30.5-meter [100-foot] permanent ROW) 90.1 km (56 miles) of 230-kV power line with 69-kV and 25-kV underhang (requires 30.5-meter [100-foot] permanent ROW) 156.1 km (97 miles) of 230-kV power line with 69-kV underhang (requires 30.5-meter [100-foot] permanent ROW) 9.7 km (6 miles) of 69-kV power line with 25-kV underhang (requires 30.5-meter [100-foot] permanent ROW) 33.8 km (21 miles) of 25-kV power line (requires 18.3-meter [60-foot] permanent ROW)	• Steptoe Valley • Spring Valley • Lake Valley • Dry Lake Valley • Cave Valley • Delamar Valley • Pahranagat Valley • Coyote Spring Valley • Hidden Valley (north) • Garnet Valley	1,291 ha 3,191 acres	NA
2 primary electrical substations (require 4.05 ha [10 acres] of permanent ROW each)	• Spring Valley (south)—located entirely within permanent ROW of Spring Valley south pumping station site • Dry Lake Valley (south)	NA 4.05 ha (10 acres)	NA NA
4 secondary electrical substations (require 0.4 ha [1 acre] of permanent ROW each)	• Spring Valley (north) • Spring Valley (south) • Cave Valley • Coyote Spring Valley—located entirely within the permanent ROW of the Coyote Spring Valley pressure reduction site	0.4 ha (1 acres) 0.4 ha (1 acres) 0.4 ha (1 acres) NA	NA NA NA NA

Tier 1 Project Component	Valleys Affected	Permanent ROW on BLM, Private and State of Nevada lands	Temporary ROW on BLM, Private and State of Nevada lands
Ancillary facilities			
3 pumping stations	• Spring Valley (south) • Spring Valley (north) • Lake Valley	24.3 ha (60 acres) 2.0 ha (5 acres) 2.0 ha (5 acres)	NA 2.02 ha (5 acres) 2.02 ha (5 acres)
5 regulating tanks	• Spring Valley • Lake Valley • Cave Valley • Dry Lake Valley • Delamar Valley	0.8 ha (2 acres) 0.8 ha (2 acres) 0.8 ha (2 acres) 2.0 ha (5 acres) 2.0 ha (5 acres)	1.2 ha (3 acres) 1.2 ha (3 acres) 1.2 ha (3 acres) 1.2 ha (3 acres) 1.2 ha (3 acres)
3 pressure-reducing stations	• Dry Lake (2) • Coyote Spring Valley (north) (1)	1.6 ha (4 acres) 2.8 ha (7 acres)	4 ha (10 acres) 2.4 ha (6 acres)
1 water treatment facility and buried storage reservoir	• Garnet Valley	30.4 ha (75 acres)	NA
Fiber-optic cables and communication facilities	—	NA	NA
Access Roads	**—**	**12.6 ha (31 acres)**	**—**
45.1 km (28 miles) of existing access roads that will be improved within a6.1-meter (20-foot) ROW	• Dry Lake Valley (south) • Delamar Valley (north)	6.1 m (20-foot)-wide permanent ROW, for a total of 27.5 ha (68 acres)	NA
22.5 km (14 miles) of existing access roads that will be improved within a 6.1-meter (20-foot) ROW	• Steptoe	6.1 m (20-foot)-wide permanent ROW, for a total of 13.4 ha (33 acres)	NA
31.4 km (13.3 miles) of existing access roads (within the permanent pipeline ROW) that will be paved between U.S. Highway 93 and the Spring Valley south pumping station, Lake Valley Pumping Station, and water treatment facility/buried storage reservoir	• Spring Valley (16.9 km [10.5 miles]) • Lake Valley (3.2 km [2.0 miles]) • Garnet Valley (1.3 km [0.8 miles])	NA	NA

Power facilities for the operation of project facilities include the following:

- An additional 30.5 m (100 feet) of permanent ROW for the construction of 404 km (251 miles) of 230-kilovolt (kV) and 69-kV power lines, and an additional 18.3 m (60 feet) of permanent ROW for the construction of 33.8 km (21 miles) of 25-kV power lines (for a total footprint of 1291.4 ha [3,191 acres])
- 30.5-meter (100-foot) by70-meter (200-foot) work areas spaced along the power line every 1.6 km (1 mile) to operate tensioning equipment (within the above-referenced permanent ROW for the power lines)
- Two 4 ha (10-acre) primary electrical substations (one of which is sited within the permanent ROW of Spring Valley south pumping station site)
- Four 0.4 ha (1-acre) secondary electrical substations (one of which is sited within the permanent ROW of the Coyote Spring Valley pressure reduction facility)

Ancillary facilities and access roads include the following:

- 3 pumping stations, for a total permanent footprint of 28.3 ha (70 acres) and an additional temporary footprint of 4 ha (10 acres)
- 5 regulating tanks, for a total permanent footprint of 6.5 ha (16 acres) and an additional temporary footprint of 6 ha (15 acres)
- 3 pressure-reducing stations, for a total permanent footprint of 4.5 ha (11 acres) and an additional temporary footprint of 6.5 ha (16 acres)
- A water treatment facility and buried storage reservoir (requiring 30.4 ha [75 acres] of permanent ROW)
- 496 km (308 miles) of 7.9-meter (26-foot)-wide access roads, approximately 1/3 of which are existing, within the previously described 70-meter (200-foot) temporary and permanent pipeline ROWs
- Short segments of unimproved spur roads within the permanent power line ROW, extending between the main pipeline road and individual power poles. These permanent spur roads will be 6.1 m (20 feet) wide and will extend approximately 3 m (10 feet) beyond each power pole to provide access for future maintenance.
- 45.1 km (28 miles) of existing access roads to be improved for access to the power line in Dry Lake and Delamar valleys (requiring 27.5 ha [68 acres] of permanent ROW)
- 22.5 km (14 miles) of existing access roads to be improved for access to the power line in Steptoe Valley (requiring 13.4 ha [33 acres] of permanent ROW)
- 21.4 km (13.3 miles) of existing access roads (within the permanent ROW of the pipeline) to be paved between U.S. Highway 93 and the Spring Valley south pumping station, the Lake Valley pumping station, and the water treatment facility/buried storage reservoir.
- Fiber-optic cables and communication facilities (requiring no additional ROW). Radio antennas of up to 6.1 m (20 feet) may be mounted on top of buildings or tanks on communication facility sites.

- 53 temporary access spur roads between existing roads and ancillary facilities (requiring 13.4 ha [33 acres] of temporary ROW)

2.2.2 *Activities*

This section describes preconstruction, construction, and postconstruction activities associated with Tier 1 that may directly or indirectly affect species in this consultation. Disturbance, injury, or mortality to species may originate from human presence and operation of equipment. Effects may also originate from temporary and permanent loss of habitat, obstructions to movement, introduction of hazards such as deep trenches or chemicals, and postconstruction application of herbicides. We have divided Tier 1 activities into 3 categories: preconstruction surveying and site preparation, construction, and postconstruction. For specific locations where certain activities will occur, please reference Table 2-1. For species-specific effects analyses based on Tier 1 project construction, maintenance, and operation activities, please reference species-specific chapters (Chapter 6 for desert tortoise and Chapters 9–14 for all other species).

2.2.2.1 Preconstruction Surveying and Site Preparation for Construction of Pipelines, Power lines, and Associated Facilities

These activities will include the following:

- Crews will survey and stake the 30.5-meter (100-foot) and 18.3-meter (60-foot) permanent power line ROW and survey and stake the 30.5-meter (100-foot) permanent and 30.5-meter (100-foot) temporary pipeline ROW boundaries, sensitive environmental features/areas (e.g., sensitive plant populations, cultural sites, etc.), and existing utility lines, culverts, etc. SNWA ACM A.1.9, A.1.10
- Documentation of vegetation conditions of the ROW and adjacent reference site locations to establish baseline conditions for postconstruction restoration (SNWA Applicant Committed Measure [ACM] A.1.70)
- Application of BLM-approved control methods (e.g., chemical, mechanical, and/or biological controls) for preexisting noxious weed infestations (ACM A.1.83)
- Within the staked boundaries of the permanent and temporary pipeline ROW, crews will clear (i.e., remove) materials that will interfere with construction activities or create safety concerns. Equipment for this activity will include graders, haul trucks, bulldozers, excavators, and loaders. Within the power line ROW, only temporary work areas of approximately 30.5 m (100 feet) by 70 m (200 feet) around each power pole structure will be cleared. SNWA ACM A.1.19
- Within the federal ROW, crews will salvage plants (as described in an approved restoration plan, including cacti and yucca, sensitive plants, and additional shrubs within special designation areas) for storage in designated temporary nursery sites within the ROW or in off-site nurseries. SNWA ACM A.1.71-1.76

Table 2-2. Tier 1 Activities—Location

Tier 1 Project Activity	Valleys Affected[a]	Specific locations
Preconstruction surveying and site preparation		
Surveying and staking 30.5-meter (100-foot) temporary pipeline ROW, 30.5-meter (100-foot) permanent pipeline ROW, and 30.5-meter (100-foot) and 18.3-meter (60 foot) permanent power line ROW	All valleys except Steptoe Valley	Along the 423 kilometers (km) (263 miles) of main and lateral pipelines and the 438 km (272 miles) of power lines
Clearing and grading 30.5-meter (100-foot) temporary and 30.5-meter (100-foot) permanent pipeline ROWs	All valleys except Steptoe Valley	Along the 423-kilometer (263-mile) length of the main and lateral pipelines
Clearing and grading temporary work areas of 30.5-meter (100 feet) by 70 m (200 feet) around each power pole structure within the 30.5-meter (100-foot) permanent power line ROW	All valleys	Around each power pole structure within the 30.5-meter (100-foot) permanent power line ROW
Salvaging plants from all ROWs for storage either on-site or off-site	Salvage: All valleys On-site storage: Delamar, Pahranagat, Coyote Springs, Hidden Valley (north), Garnet, and Las Vegas Off-site storage: Unknown	Salvage: Within all ROWs Storage: Temporary on-site nursery sites; off-site nursery sites
Salvaging topsoil from all ROWs for storage	Salvage: All valleys Storage: All valleys	Salvage: Within all ROWs Storage: Along edge of the ROW in windrows or in stockpiles <1.8 m (6 feet) in height
Constructing berms and drainage ditches	All valleys	Pipeline ROW; power line ROW; all facilities
Constructing temporary and permanent security fencing	All valleys except Steptoe Valley	Around facility construction sites (pumping stations, regulating tanks, substations, etc.); staging areas where materials/equipment will be stored (including plant nurseries)
Installing temporary and permanent tortoise-exclusion fencing	Coyote Springs Valley, Hidden Valley (north), Garnet, and Las Vegas Valleys	Around facility sites in desert tortoise habitat
Constructing new temporary and permanent roads and improving existing ones	All valleys	Within the temporary and permanent pipeline ROWs; from the pipeline road to power poles within the permanent power line ROW

Tier 1 Project Activity	Valleys Affected[a]	Specific locations
Transporting construction equipment and building materials to temporary staging areas and portions of temporary ROW for storage	All valleys except Steptoe Valley	Temporary staging areas within pipeline ROW
Leveling deep ruts and conducting minor grading on 67.6 km (42 miles) of existing roads (for which the Southern Nevada Water Authority has acquired an additional 6.1-meter (20-foot)-wide permanent ROW)	Dry Lake Valley (south), Delamar Valley (north), and Steptoe Valley	45 km (28 miles) of North and South Poleline Roads in Dry Lake Valley (south) and Delamar Valley (north); 22.5 km (14 miles) of existing road from the Gonder Substation in Steptoe Valley
Operating vehicles on existing roads and highways	All valleys	Interstate 15, U.S. Highways 6, 50,and 93; Nevada Highways 168, 317, 318, 319, 320, 487, 893, and 894 ; Cave Valley Road (from Ely into Cave Valley); Atlanta Road (from U.S. 93 to the pipeline alignment in Spring Valley); Stampede Road (from Pioche to the pipeline alignment in Dry Lake Valley); Pan American/Ely Springs Road; and Turtle Walk (from Alamo to the pipeline alignment in Delamar Valley)

Tier 1 Project Activity	Valleys Affected[a]	Specific locations
Construction of pipeline, power lines, and facilities		
Constructing open trench for pipeline, using standard cut-and-cover	All valleys except Steptoe Valley	Within permanent pipeline ROW
Transporting pipe sections to trench segments	All valleys except Steptoe Valley	Within permanent and temporary pipeline ROW
Backfilling and compacting trench	All valleys except Steptoe Valley	Within permanent pipeline ROW
Spreading excess soil; adding 5.1-7.6 centimeters (cm) (2-3 inches) to existing grade	All valleys except Steptoe Valley	Within permanent pipeline ROW
Tunneling underground, using jack-and-bore techniques or tunnel-boring machine	Las Vegas Valley	3.2-kilometer (2-mile) segment in Apex area of northeastern Clark County
Using jack-and-bore techniques to tunnel underground at highway crossings	Spring, Lake, Dry Lake, Coyote Springs, and Garnet Valleys	U.S. Highways, 50, 50/6, and 93; Nevada Highways 215, 487, and 894
Using jack-and-bore techniques to tunnel underground at 2 locations where the pipeline crosses the Kern River gas pipeline	Garnet Valley and Las Vegas Valley	Main Mile 194 in Garnet Valley and Main Mile 201 in Las Vegas Valley
Constructing a narrow trench, using trench boxes or other structural trench support measures	Pahranagat Valley	Pahranagat Canyon
Blasting	All valleys except Steptoe Valley	Locations currently unknown; generally, in areas where existing soils are composed of caliche or contain large boulders
Constructing water supply wells for dust control, pipe bedding, trench backfill compaction, and hydrostatic testing	All valleys except Steptoe Valley	Every 16.1 km (10 miles) along the pipeline alignment, but within the pipeline ROW; additional wells within construction staging areas if necessary
Hydrostatic testing and discharge of water	Testing: All valleys except Steptoe Valley Discharge: Unknown locations in all valleys; Garnet Valley, Las Vegas Valley	Testing will occur along entire pipeline; water will be discharged to various dry washes (locations unknown) along the pipeline route, to the buried storage reservoir in Garnet Valley, and/or to the existing storm drain system at the pipeline terminus

Tier 1 Project Activity	Valleys Affected[a]	Specific locations
Constructing power line poles	All valleys except Las Vegas Valley	Within permanent 30.5-meter (100-foot) and 18.3-meter (60-foot) power line ROW
Stringing power lines between poles	All valleys except Las Vegas Valley	Within permanent 30.5-meter (100-foot) and 18.3-meter (60-foot) power line ROW
Testing electrical equipment on each power line network	All valleys except Las Vegas Valley	
Paving 3 road segments to allow for operational access to ancillary facilities	Spring Valley, Lake Valley, and Garnet Valley	Between U.S. Highway 93 and the Spring Valley south pumping station, Lake Valley pumping station, and water treatment facility/buried storage reservoir
Operating vehicles on existing roads and highways	All valleys	Interstate 15, U.S. Highways 93, 6, and 50; Nevada Highways 168, 317, 318, 319, 320, 893, 894, and 487; Cave Valley Road (from Ely into Cave Valley); Atlanta Road (from U.S. 93 to the pipeline alignment in Spring Valley); Stampede Road (from Pioche to the pipeline alignment in Dry Lake Valley); Pan American/Ely Springs Road; and Turtle Walk (from Alamo to the pipeline alignment in Delamar Valley)
Postconstruction activities		
Storm water management		
Removal of nonnatural berms, ditches, temporary erosion/sediment controls, bales, wattles, other energy-dissipating/filtering devices	All valleys	Permanent and temporary pipeline ROW and facility ROW; permanent power line ROW
Restoration of drainages to original form		
Restoration of desert washes and ephemeral drainages to preconstruction conditions		
Vegetation restoration, berming, placement of riprap, placement of matting on steep slopes		

Tier 1 Project Activity	Valleys Affected[a]	Specific locations
Reclamation and rehabilitation of ROWs, access roads		
Recontouring areas of surface disturbance	All valleys	Permanent and temporary pipeline ROW and facility ROW; permanent power line ROW; access roads outside of ROW
Ripping of ground surface		
Spreading salvaged topsoil, vegetation, and boulders		
Revegetation		
Restoration monitoring		
Noxious weed control		
Application of herbicides/pesticides	All valleys	Permanent and temporary pipeline ROW and facility ROW; permanent power line ROW; access roads outside of ROW
Washing vehicles before leaving construction site		
Maintenance activities		
Air inspections of pipeline	All valleys	Permanent pipeline ROW and facility ROW; permanent power line ROW; access roads outside of ROW
Ground inspections of pipeline and facilities		
Repair of pipeline infrastructure		
Cleaning of pipeline infrastructure		
Delivery and use of chemicals to water treatment facility		
Grading, graveling, and pavement repair for permanent access roads		
Operation of vehicles on existing roads and highways	All valleys	Interstate 15, U.S. Highways 93, 6, and 50; Nevada Highways 168, 317, 318, 319, 320, 893, 894, and 487; Cave Valley Road (from Ely into Cave Valley); Atlanta Road (from U.S. 93 to the pipeline alignment in Spring Valley); Stampede Road (from Pioche to the pipeline alignment in Dry Lake Valley); Pan American/Ely Springs Road; and Turtle Walk (from Alamo to the pipeline alignment in Delamar Valley)

[a] The term “all valleys” represents all valleys where project infrastructure and activity exist: Steptoe, Spring, Cave, Lake, Dry Lake, Delamar, Pahranagat, Coyote Springs, Hidden (North), Garnet, and Las Vegas.

- Crews will salvage and store topsoil along the edge of the ROW or in stockpiles < 1.8 m (6 feet) in height and then remove a deep surface layer that includes stumps and roots. SNWA ACM A.1.23
- Crews will construct berms and drainage ditches to contain runoff and divert floodwaters from construction area. SNWA ACM A.1.61
- Crews will enclose facility construction sites (pumping stations, regulating tanks, etc.) and staging areas where materials/equipment will be stored (including plant nurseries) with temporary and permanent security fencing (1.8-2.4-meter-high [6–8-foot-high] chain-link fencing). SNWA ACM A.1.12, A.1.13
- Within desert tortoise habitat, crews will install temporary tortoise-exclusion fencing in the pipeline and power line ROWs and permanent exclusion fencing around aboveground facility sites. SNWA ACM A.1.14, A.1.16
- To accommodate construction traffic and future maintenance and operations within the temporary and permanent pipeline ROWs, crews will improve existing temporary and permanent roads (by grading, installing culverts, and stabilizing); crews will also construct new temporary and permanent roads (activities will include grading, installing culverts, and graveling). Within the permanent power line ROW, crews will construct permanent access roads (grading, installing culverts, and graveling) from the pipeline road to power poles, using drive-and-crush methods as much as feasible. SNWA ACM A.1.36
- Crews will level deep ruts and conduct minor grading on 67.6 km (42 miles) of existing roads, for which the SNWA has acquired an additional 6.1-meter-wide (20-foot-wide) permanent ROW.
- Crews will transport construction equipment and building materials to temporary staging areas and portions of the temporary ROW for storage. Equipment and materials include but are not limited to sections of pipe, pumps, motors, fill material, fuel for construction equipment, and water for dust control and construction use.
- At power substations, pumping and pressure-reducing stations, regulating tank sites, and the water treatment facility/buried storage reservoir, crews will conduct the following activities:
    - Installing permanent security fencing and permanent tortoise-exclusion fencing where necessary
    - Clearing and grading sites
- Constructing berms and drainage ditches to contain runoff and divert floodwaters where necessary

2.2.2.2 Construction of Pipeline, Powerline, and Associated Facilities

Pipeline construction will include the following activities:

- Except in areas of difficult topography, construction of the main and lateral pipelines will be standard cut and cover, using an open trench. Crews operating excavators, backhoes, track hoes, or other similar equipment will dig 4-kilometer (2.5-mile) segments of pipeline trench at least 1.83 m (6 feet) deep and varying in top width from 15.2-21.3 m (50–70 feet). Material excavated from the trench will be stockpiled adjacent to the trench.

- Crews will lay screened (or otherwise processed) excavated materials or materials imported from borrow pits in the bottom of the pipeline trench. Some bedding material may be a cement-based, controlled, low-strength material.
- Trucks will transport pipe sections to trench segments, and crews will string the pipe alongside the trench for weld inspection and testing. Upon final approval, appurtenant structures will be affixed to the pipe.
- Crews will use backhoes, track hoes, bulldozers, or similar equipment to backfill and compact the following:
    - The upper zone of the pipe, using controlled low-strength material, excavated soils, or materials imported from borrow pits that have been screened or otherwise processed (crushed rock, gravel, and/or sand up to 0.95 cm [3/8 inch] in diameter)
    - The remaining trench, to finished grade, with material 15.2 cm (6 inches) in diameter or less (clean, well-graded earth material free of excessive fine particles, vegetation, or other deleterious material)
- Crews will spread excess soils (any soils not placed in borrow pits) evenly over the ROW, adding 5.1-7.6 cm (2–3 inches) to the ground surface.
- Where topography is not conducive to standard cut-and-cover techniques, construction crews will tunnel underground, using either jack-and-bore techniques or a tunnel-boring machine. It is anticipated that tunneling will be used for a 3-kilometer (2-mile) segment in the Apex area of northeastern Clark County. Crews will dig access shafts from the surface to the tunnel location, between one hundred and several hundred feet belowground.
- Where the pipeline crosses highways, the existing Kern River natural gas pipeline, and areas requiring greater trench depths, construction crews will use jack-and-bore techniques to construct these pipeline segments. Jack-and-bore techniques require preparation of a 30.5-by-6.1 meter (100-by-20 foot) pit at the crossing site where the boring equipment will operate.
- Where the pipeline crosses steep terrain in the Pahranagat Canyon area, trench boxes or other structural trench support measures may be used.
- Crews may use blasting, when necessary, to expose pipeline trench where existing soils are composed of caliche or contain large boulders. A blasting plan will be developed and submitted for BLM approval.
- Crews will construct water supply wells for dust control, pipe bedding, trench backfill compaction, and hydrostatic testing. To provide adequate water supply for these purposes, the SNWA has assumed that water will be obtained from existing wells or exploratory wells that are available at the time of construction (and have gone through their own authorization process), and that water supply wells will be needed approximately every 16.1 km (10 miles) along the pipeline alignment. For each 1.6 km (1 mile) of pipeline, construction activities will require approximately 17–27 acre-feet (5.5–8.7 million gallons) of water. Additional wells may be constructed within construction staging areas if necessary.
- Hydrostatic testing will be conducted in segments to pressure-test the completed pipeline. The volume of water necessary for testing is unknown at this time. Water leaving the pipeline

will be discharged into dry washes (rates and locations are not yet known), the buried storage reservoir in Garnet Valley, and/or the existing storm drain system at the pipeline terminus. A detailed hydrostatic testing discharge plan will be prepared and approved by the BLM prior to testing.

- Construction personnel will use existing roads and highways.

Power line system construction will include the following activities:

- For powerline pole construction, crews will carry out these specific steps:
  - Use truck-mounted rotary augers to bore pole locations to a depth of approximately 4.6 m (15 feet).
  - Install hardware and insulators on each pole.
  - Use a truck-mounted crane to erect and place poles.
  - Use soil removed by auger to backfill and spread around each pole.
  - Construct a concrete foundation where extra support is needed.
- To install power lines, crews will string conductor wires between power poles, using tensioning (pulling) equipment (i.e., one truck will pull conductor wire from a large spool mounted on a second truck).
- Electrical equipment on each power line network will be tested.
- For substation construction, crews will carry out these specific steps:
  - Construct concrete pads, including a perimeter spill-containment curb, for transformers at each site.
  - Construct concrete foundations for electrical structures.
  - Construct a concrete block control building to house controls and relay equipment.
  - Use a pulley system to string conductors.
- Construction personnel will use existing roads and highways.

Ancillary facility construction will include the following activities:

- For the construction of pumping and pressure-reducing stations, crews will carry out these specific steps:
  - Build plumbing, power conduits, and other infrastructure beneath facility flooring.
  - Construct structure foundations, followed by flooring, walls, and roof.
  - Construct pumps, valves, and appurtenances.
  - Connect pipelines to incoming and outgoing water pipelines.
- For the construction of regulating tanks, crews will carry out these specific steps:
  - Build concrete foundation.
  - Construct steel tanks with steel panels welded and bolted together to form the floor, walls, and roof.
  - Construct concrete tanks, either on-site or off-site, and transport to site (as necessary) for installation.
  - Construct accompanying overflow pipes, drainpipes, inlet and outlet pipes, ladders, and other appurtenances.

  - Conduct hydrostatic testing of the pipeline.

- For the construction of the water treatment facility and buried storage reservoir, crews will carry out these specific steps:
  - Build plumbing, power conduits, and other infrastructure beneath the treatment facility and reservoir floors.
  - Construct structure foundations, followed by flooring, walls, and roof.
  - Construct ancillary components inside and outside facilities.
  - Conduct hydrostatic testing of the pipeline.

- For the communications system, crews will bury fiber-optic cables at least 1.8 m (6 feet) deep in the pipe trench, adjacent to the pipeline, or approximately 0.9-1.2 m (3–4 feet) deep in the ground adjacent to the trench.

- For access road construction, crews will carry out these specific steps:
  - Grade and level the road surface as necessary.
  - Apply gravel where necessary.
  - Install culverts where necessary.
  - Pave 3 road segments to allow for operational access to ancillary facilities.

- Construction personnel will use existing roads and highways.

2.2.2.3 *Postconstruction Activities*

This section outlines the activities—including storm water management, restoration, and operation and maintenance—that will occur during postconstruction in the project ROW. Some activities will be conducted under separate plans developed by the SNWA and approved by the BLM.

Postconstruction storm water management activities will include the following:

- Removal of nonnatural berms, ditches, temporary erosion and sediment controls, bales, wattles, and other energy-dissipating/filtering devices not required for protection of facilities (ACM A.1.66)

- Restoration of drainages to original form (ACM A.1.66)

- Restoration of desert washes and ephemeral drainages to preconstruction conditions (some washes and drainages may require additional stabilization measures such as riprap and thus will require approval from the BLM) (ACM A.1.67)

- Postconstruction storm water management and erosion control measures (e.g., vegetation restoration, tracking and matting of steep slopes, berming, and/or placement of riprap) (ACM A.1.68)

Postconstruction site reclamation and rehabilitation activities will include the following:

- Recontouring and reclamation in areas of surface disturbance (ACM A.1.69)

- Rehabilitation and restriction of access points (ACM A.1.69)

- Ripping of ground surface to relieve compaction, establish a seedbed, and facilitate water penetration and plant establishment (ACM A.1.77)

- Spreading salvaged topsoil, mulched vegetation, and boulders (ACM A.1.77)
- Restoration (ACMs A.1.68–A.1.81)
- Restoration monitoring (ACMs A.2.9–A.2.13)

Per ACM A.1.69, where postconstruction site reclamation and rehabilitation is proposed within habitat for federally listed species, these activities will be subject to a detailed restoration plan developed by the SNWA and approved by the BLM and the U.S. Fish and Wildlife Service (USFWS or Service) prior to the start of construction.

Postconstruction weed control will be subject to a detailed Integrated Weed Management Plan prepared by the SNWA, which the SNWA will submit to the BLM and the Service for approval prior to the start of construction. Prior to the planned application of any herbicide, the SNWA or its certified licensed contractor will also submit to the BLM for approval a Pesticide Use Proposal; after weed herbicide use, the SNWA or its certified licensed contractor will submit a Pesticide Application Record an an annual report on noxious weed conditions and control activities. Noxious weed control activities will include the following:

- Application of herbicides and pesticides (ACM A.1.82–1.83, A.1.88, A.1.89)
- Washing construction equipment/vehicles for noxious weeds before leaving construction sites (ACM A.1.86, A.1.87)
- Inspection of weed-free materials entering construction sites (ACMs A.1.84–1.85)

Maintenance and operation activities will include remote and on-site monitoring of system functions, inspection of the pipelines and facilities, regular maintenance of equipment, repairs as needed, and responses to emergency conditions should they occur. Maintenance and operation activities apply to all Tier 1 project components—main and lateral pipelines, power facilities, ancillary facilities, and access roads—and will be conducted within the permanent ROW.

Routine maintenance of the pipeline and appurtenances will include the following:

- Monthly inspections conducted by air and on the ground to identify areas of exposed pipeline, erosion, third-party excavation, encroachment, vandalism, or other conditions that present a safety hazard or require preventive maintenance or reporting
- Repair
- Cleaning

Maintenance and operation of pumping stations, regulating tanks, and pressure-reducing stations will include the following:

- Remote monitoring to ensure proper operation
- Visual inspections of facilities ranging from daily (pumping stations) to 2–3 times per week (regulating tanks)

Maintenance and operation of the water treatment facility/buried storage reservoir will include the following:

- Remote system monitoring
- On-site control and operations staff

- Visual inspections of the facility and reservoir
- Delivery and use of chemicals for water treatment (e.g., sodium chloride, sodium hypochlorite, zinc orthophosphate, hydrofluorosilicic acid, and arsenic)

Maintenance and operation of power facilities will include the following:

- On-the-ground inspections of power structures, insulators, conductors, and related hardware, on an annual basis
- Inspections of substations, on a monthly basis
- Maintenance, as needed

Maintenance and operation of improved and paved access roads within the ROW will include additional grading, graveling, and pavement repair.

2.3 SUBSEQUENT TIERS: INFRASTRUCTURE AND ACTIVITIES

Like the Tier 1 infrastructure, future facility development and pumping will be phased, beginning in the southern basins (Delamar, Dry Lake, and Cave) and moving northward into Spring Valley. Again, timing of construction of future facilities will depend on water availability from SNWA’s other sources (e.g., Colorado River water), water demand, drought status, and other factors (BLM 2012b). Future facility development is anticipated to begin in year 5 (following initiation of Tier 1 construction) in the southernmost valley (Delamar), with full project build-out projected to occur by year 33 (BLM 2012b).

For purposes of this Biological and Conference Opinion (Opinion), we have assumed that construction of production wells, collector pipeline, and other facilities and activities associated with subsequent tiers will begin so as to facilitate groundwater conveyance by 2020 in Delamar, Dry Lake, and Cave valleys, and by 2028 in Spring Valley (BLM 2012a). Full project build-out is expected to occur by calendar year 2050. These assumptions are based on the preliminary construction schedule provided by the project applicant and included in the BLM’s Biological Assessment, and are inherent to the Central Carbonate-Rock Province (CCRP) Model simulations provided to the Service in support of this consultation. However, we recognize that the preliminary construction schedule can and likely will change, based on the factors described above.

2.3.1 *Infrastructure*

As described in section 2.0 of the Biological Assessment (BLM 2012a), the footprint of subsequent tiers includes infrastructure for exploratory drilling and production wells, collector pipelines, additional pumping stations, construction water supply wells, distribution power lines, additional secondary substations, communications facilities, hydroturbines, and access roads roads. These future project components are described programmatically (i.e., conceptually) in the following paragraphs and in Table 2-3. Because details for future groundwater development are still unknown, the following represents only an estimate of well numbers, location, and size of infrastructure.

<u>Exploratory drilling</u>: An exploratory drilling program, including pump testing, will be conducted to determine if wells are suitable for groundwater production. If exploratory wells are not suitable for groundwater production, they will either be abandoned, in accordance with State of

Nevada requirements, or converted to groundwater monitoring wells; wells that are determined to be suitable will be equipped for production (BLM 2012a). ROWs associated with the exploratory drilling program will be subject to additional environmental review under the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA or Act), as appropriate, as part of subsequent tiered analyses.

For this Opinion, we have assumed that impacts associated with exploratory drilling, including pump testing, will occur within the programmatic analysis timeframe; that the footprint of any infrastructure associated with this activity will fall within future ROWs in the groundwater development areas (see Figure 2-1); and that effects associated with exploratory drilling will not exceed estimates for the disturbance footprint of future infrastructure/activities and the quantities of groundwater that will be pumped during the analysis timeframe. If rates and duration of groundwater withdrawal associated with pump tests cause localized impacts to federally listed species and/or critical habitat that have not been considered in this Opinion, then the BLM will reinitiate section 7 consultation.

<u>Production wells</u>: For groundwater production in Spring, Cave, Dry Lake, and Delamar valleys, the SNWA will construct approximately 71–88 wells (the majority of which will be in Spring Valley). Wells will be spaced at least 1.6 km (1 mile) apart and will be drilled to approximately 305 m (1,000 feet) in basin-fill and 610 m (2,000 feet) in bedrock. Each well will require a permanent ROW of 0.6 ha (1.5 acres) plus an additional temporary construction ROW of 0.2 ha (0.5 acres). While the exact location of future groundwater production wells is not yet known, the SNWA anticipates that these wells will be located within the groundwater development areas depicted in Figure 2-1. Location of production wells will be based on the exploratory drilling program and other factors, including but not limited to the following: geology; hydrology; well interference studies; presence of wetlands; special-status species and their habitats; senior water rights; and proximity to roads, utility corridors, and main and lateral pipelines (BLM 2012a,b).

<u>Collector pipelines</u>: To transport water from wells to the main and lateral pipelines, SWNA will construct approximately 154.5-408.8 km (96–254 miles) of buried collector pipelines. The size and length of collector pipeline in each valley will depend upon as yet undetermined well locations and how they will be clustered. Pipeline size will likely range from 25.4 cm (10 inches) to 76.2 cm (30 inches) in diameter.

The collector pipelines will require a 15.2-meter (50-foot) permanent ROW and an adjacent 15.2-meter (50-foot) temporary ROW. The SNWA also anticipates temporary 0.4-hectare (1-acre) construction staging areas every 4.8 km (3 miles) along the collector pipelines (i.e., 32–85 total areas).

<u>Pumping stations</u>: Two pumping stations will convey water from groundwater production wells into the main and lateral pipelines. Each will require 2 ha (5 acres) of permanent and 5 acres of temporary ROW.

<u>Construction water supply wells</u>: To provide a water supply for future tier construction activities (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing), the SNWA will build construction water supply wells. To provide adequate water supply for these purposes, the SNWA has assumed that water will be obtained from existing wells or exploratory wells that are available at the time of construction (and have gone through their own authorization process), and that water supply wells will be needed approximately every 16 km (10 miles) along the pipeline alignment. For each 1.6 l km (1 mile) of pipeline, construction activities will require

approximately 17–27 acre-feet (5.5–8.7 million gallons) of water. Additional wells may be constructed within construction staging areas if necessary.

Distribution power lines: Approximately 154.5-408.8 km (96–254 miles) of overhead 25-kV distribution power lines will be constructed to convey power to groundwater production wells and pumping stations. The power lines will require a 15.2-meter (50-foot) permanent ROW, which will be routed alongside the collector pipeline ROW.

Secondary substations: Two 69-kV and 25-kV secondary electrical substations may be required to provide power to future groundwater production wells and pumping stations. Each substation will require a 0.4-ha (1-acre) permanent ROW.

Communications facilities: Details about these facilities are still unknown, but no new ROWs will be required.

Hydroturbine energy recovery facilities: One or more underground facilities will house hydroturbines to generate electrical power as water flows from higher to lower elevations. No new ROWs will be required because these facilities will be built within the 3 pressure-reducing station sites constructed in Tier 1.

Access/maintenance roads: New or improved roads will be located within the 15.2-meter (50-foot) permanent collector pipeline ROW. Improved roads will be 6.1 m (20 feet) wide.

Table 2-3. Location and acreage of Right-of-Way (ROWs) on Bureau of Land Management (BLM), Private, and State of Nevada Lands required for Subsequent Tier infrastructure

Subsequent Tier Project component	Valleys Affected	Permanent ROW on BLM, Private and State of Nevada lands	Temporary ROW on BLM, Private, and State of Nevada lands
Groundwater Production Wells			
Groundwater production wells in Spring, Cave, Dry Lake, and Delamar valleys (0.6 hectare [ha] [1.5 acre] permanent ROW + 0.2 ha [0.5 acre] temporary ROW)	Spring: 52–65 wells Cave: 4–6 wells Dry Lake: 10–11 wells Delamar: 5–6 wells	Spring Valley: 31.6-40.0 ha (78–98 acres) Cave Valley: 2.4-3.6 ha (6–9 acres) Dry Lake Valley: 6.1-6.9 ha (15–17 acres) Delamar Valley: 3.2-3.6 ha (8–9 acres)	Spring Valley: 10.5-13.4 ha (26–33 acres) Cave Valley: 0.8-1.2 ha (2–3 acres) Dry Lake Valley: 2.0-2.4 ha (5–6 acres) Delamar Valley: 1.2 ha (3 acres)
Collector pipelines (15.2-meter-wide [50-foot-wide] permanent ROW + 15.2-meter-wide [50-foot-wide] temporary ROW)	Spring: 62.8-164.2 kilometer (km) (39-102 miles) Cave: 19.3-77.3 km (12–48 miles) Dry Lake: 32.2-70.8 km (20–44 miles) Delamar: 40.2-96.6 km (25–60 miles)	Spring Valley: 95.9-250.5 ha (237–619 acres) Cave Valley: 29.5-117.8 ha (73–291 acres) Dry Lake Valley: 49.0-108.1 ha (121–267 acres) Delamar Valley: 61.5-147.3 ha (152–364 acres)	Spring Valley: 95.9-250.5 ha (237–619 acres) Cave Valley: 29.5-117.8 ha (73–291 acres) Dry Lake Valley: 49.0-108.1 ha (121–267 acres) Delamar Valley: 61.5-147.3 ha (152–364 acres)
Temporary construction staging areas (0.4-hectare (1-acre) temporary ROW every 4.8 km (3 miles) of collector pipeline length)	Spring: 13–34 areas Cave: 4–16 areas Dry Lake: 7–15 areas Delamar: 8–20 areas	Spring Valley: NA Cave Valley: NA Dry Lake Valley: NA Delamar Valley: NA	Spring Valley: 5.3-13.8 ha (13–34 acres) Cave Valley: 1.6-6.5 ha (4–16 acres) Dry Lake Valley: 2.8-6.1 ha (7–15 acres) Delamar Valley: 3.2-8.1 ha (8–20 acres)
2 pumping stations (each requires 2.0 ha [5 acres] of permanent ROW + 2.0 ha [5 acres] of temporary ROW)	Dry Lake Delamar	Dry Lake Valley: 2.0 ha (5 acres) Delamar Valley: 2.0 ha (5 acres)	Dry Lake Valley: 2.0 ha (5 acres) Delamar Valley: 2.0 ha (5 acres)
Distribution power lines (15.2-meter-wide [50-foot-wide] permanent ROW routed alongside the collector pipeline ROW)	Spring: 62.8-164.2 km (39–102 miles) Cave: 19.3-77.3 km (12–48 miles) Dry Lake: 32.2-70.8 km (20– 44 miles) Delamar: 40.2-96.6 km (25–60 miles)	ROW routed alongside permanent ROW for collector pipelines in all 4 valleys	Spring Valley: NA Cave Valley: NA Dry Lake Valley: NA Delamar Valley: NA
2 secondary electrical substations (each requiring 0.4 ha [1-acre] permanent ROW)	Dry Lake Delamar	Dry Lake Valley: 0.4 ha (1 acre) Delamar Valley: 0.4 ha (1 acre)	Dry Lake Valley: NA Delamar Valley: NA
Communications facilities (no additional ROW required)	—	NA	NA
Hydroturbine energy recovery facilities	Dry Lake (2) Coyote Spring (1)	Dry Lake Valley: NA Coyote Spring Valley: NA	Dry Lake Valley: NA Coyote Spring Valley: NA

NA = Not applicable

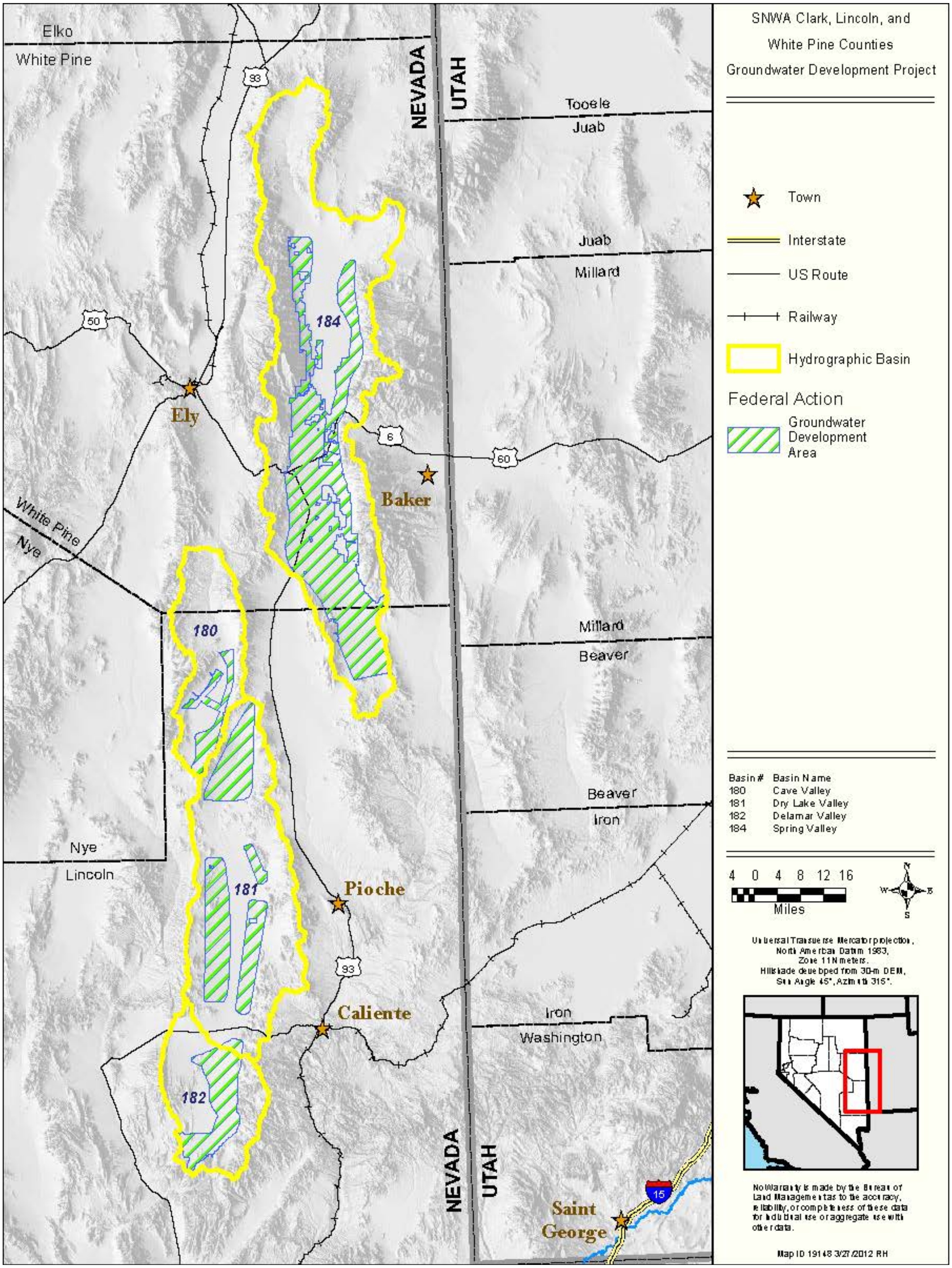


Figure 2-1. Groundwater development areas

2.3.2 *Activities*

Preconstruction, construction, and postconstruction activities associated with subsequent tiers are generally the same as those described for Tier 1; construction and operation of groundwater wells for development purposes is the only exception.

Construction and operation of groundwater production wells will include the following activities:

- An initial exploratory process to determine suitability for groundwater production (drilling of well, cleaning of borehole, aquifer testing, and associated discharge of groundwater to the local drainage network)
- Installation of wellhead piping, pumps, fencing, lighting (if necessary), and electrical equipment
- Spread of gravel over the site for dust control and to provide a working surface
- Pumping at rates of approximately 800–1000 gallons per minute (gpm) per well

Groundwater withdrawal: The Nevada State Engineer (NSE) recently awarded groundwater rights to the SNWA for 11,584 afy in Dry Lake Valley; 6,042 afy in Delamar Valley; 5,235 afy in Cave Valley; and 61,127 afy in Spring Valley (NSE 2012a–d). The NSE’s rulings (issued March 22, 2012) drew petitions for judicial review from a number of sources, including local governments, Native American tribes, ranchers, farmers, environmental groups, and individuals. The date for judicial review in the Nevada state court has not been set.

Although specific points of diversion are associated with approved groundwater rights, the SNWA will likely request changes in points of diversion. Any future NSE decisions for change requests will also be subject to appeal.

The sources of groundwater for withdrawal from Spring Valley include not only the recently awarded groundwater rights mentioned above (61,127 afy of municipal and industrial groundwater rights), but also 8,000 afy of agricultural groundwater rights associated with SNWA-owned ranches in Spring Valley. These groundwater rights are being put to beneficial use; but as part of the GWD Project, they are subject to future applications to the NSE for changes in points of diversion, place of use, and/or manner of use. Finally, under a 2003 cooperative agreement, the SNWA agreed to transfer a total of 3,000 afy of its groundwater rights in Dry Lake and Delamar valleys to Lincoln County; however, this transfer has not yet occurred.

For the BLM’s NEPA and ESA analyses, assumptions regarding project design (e.g., location of production wells, depths, pumping rates and schedules) were developed to allow for a programmatic-level analysis of potential project impacts related to groundwater withdrawal. These assumptions are inherent in the CCRP Model simulations provided to the Service in support of this consultation and are used as a starting point for our analysis of potential project effects related to groundwater withdrawal. For purposes of this analysis, we have assumed that pumping will begin in 2020 in the southernmost basins (Delamar, Dry Lake, and Cave valleys) and in 2028 in Spring Valley, with full groundwater production reached by 2050. A discussion of these and other assumptions that form the basis of our hydrologic analyses can be found in Chapter 5 (Analytical Approach) or Chapter 7 (Hydrologic Analyses).

The main pipeline constructed in Tier 1 will also convey water from other sources. Through a negotiated agreement with the SNWA (2006), the Lincoln County Water District (LCWD) has reserved additional pipeline capacity (33,000 afy) in the GWD Project pipeline. The LCWD has identified 1 source of privately owned groundwater rights in Lake Valley, allocated to Tuffy Ranch Properties (but now owned by Coyote Springs Investment, LLC), to whom the NSE issued Ruling 5918 on December 3, 2008, for the export of up to 11,300 afy of existing agricultural water rights for municipal use in Coyote Spring Valley, Lincoln County. The remaining 21,700 afy of additional pipeline capacity is reserved, but Lincoln County has not identified a water source. To develop and convey any portion of the 33,000 afy of groundwater, additional federal action associated with ROW across federal lands will be required.

2.4 ABANDONMENT

The BLM describes the potential process associated with project abandonment in its Biological Assessment (BLM 2012a,b). However, abandonment of the GWD Project is not anticipated, and we were not asked to consult on this activity as part of the proposed action. If abandonment were to occur, it would constitute either a new action or a modification of the proposed action, which would trigger formal section 7 consultation if the abandonment caused an impact to federally listed species or critical habitat that was not considered in this Opinion (50 CFR § 402.16(c)).

2.5 INTERRELATED AND INTERDEPENDENT ACTIONS

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. If an activity would not occur “but for” the proposed action, it is interrelated or interdependent.

We are not aware of any interrelated or interdependent activities associated with the GWD Project. Although the main project pipeline will convey groundwater for Lincoln County, we do not believe that development of this groundwater is an interrelated or interdependent activity. Development of Lincoln County’s water has independent utility and could occur in the absence of the GWD Project. The LCWD previously filed a ROW application with the BLM for the development and conveyance of its water rights, but subsequently withdrew the application per a cooperative agreement with the SNWA in 2006 (SNWA 2006). As described previously, the source of this groundwater has not yet been identified.

Finally, we have considered whether availability of water from the proposed GWD Project will induce growth in the Las Vegas Valley and other parts of Lincoln and Clark counties, Nevada. We agree with the BLM’s assessment presented in the FEIS (BLM 2012b) that the long-term production and conveyance of water to these areas may function to indirectly enable future population growth, but that the availability of water would not itself induce growth in these areas. Therefore, we consider urban/suburban growth in the Las Vegas Valley and other parts of Lincoln and Clark counties to be a potential indirect effect of the federal action rather than an interrelated-interdependent activity (i.e., the growth does not satisfy the “but for” criteria above; see additional discussion in Chapter 5).

2.6 APPLICANT COMMITTED MEASURES

The SNWA has committed to ACMs that will be implemented as part of the construction and operation of the GWD Project. The ACMs include design features, monitoring, standard operating procedures, and other resource protection practices, many of which have been referenced in this chapter. The ACMs also include measures the SNWA has previously agreed to in stipulations or other agreements with federal, State, or local agencies and entities, as well as measures required by the NSE water right permit conditions. One of the ACMs the SNWA has agreed to is the implementation of an adaptive management approach relative to future groundwater development; this adaptive management approach will also be used in determining whether and how additional environmental protection measures should be implemented. Appendix E of the FEIS (BLM 2012b) describes the adaptive management approach stipulated by the ACMs.

Species-specific effects analyses found in Chapter 6 and Chapters 9–15 of this Opinion will reference applicable ACMs. Most ACMs can be found in Appendix E of the FEIS and are organized into 3 categories: 1) detailed measures associated with the Tier 1 ROW; 2) programmatic measures associated with future ROWs; and 3) landscape-scale measures associated with potential effects related to groundwater withdrawal. Landscape-scale measures are further divided into those that originate from 4 preexisting agreements (Spring Valley Stipulated Agreement; Delamar, Dry Lake, and Cave Valleys Stipulated Agreement; and 2 Conservation Agreements and Strategies, 1 for least chub [*Iotichthys phlegethontis*] and 1 for Columbia spotted frog [*Rana luteiventris*]) and those encompassed in an Adaptive Management Framework (AM Framework). The AM Framework outlines a process to collect baseline data, identify environmental indicators, establish adaptive management thresholds, conduct monitoring, and determine the cause and strategy for addressing groundwater pumping related impacts.

The SNWA developed additional ACMs as part of the section 7 ESA consultation process to address Service concerns about potential effects of groundwater pumping in Cave Valley on the endangered White River spinedace (*Lepidomeda albivallis*) and its critical habitat. The new Cave Valley ACM (Appendix C) was developed after the FEIS was published and therefore were not included in that document.

2.7 BUREAU OF LAND MANAGEMENT MITIGATION AND MONITORING MEASURES

We reference Table 3.20 in the FEIS (BLM 2012b) for BLM-proposed mitigation and monitoring measures. There, measures are organized by project tiers (labeled with the prefixes "ROW" or "GW") and by resource. In a letter dated September 17, 2012, the BLM described its intention to include in the Record of Decision (ROD) for this project all those measures within the BLM's jurisdiction (Woods 2012). The BLM also requested that the Service consider specific mitigation measures as part of the agency action for the section 7 ESA consultation, including measures presented in the FEIS; the Comprehensive Monitoring, Management, and Mitigation Plan (COM Plan) process (described below); and related information found in Chapter 3.20 of the FEIS (Woods 2012).

Main conveyance pipeline measures are related to the Tier 1 NEPA impact analyses and are tied to decisions that will be made by the BLM in the ROD. These measures are identified with a "ROW" prefix. They also may be applied to future groundwater development facilities (e.g., impacts related to placement of future wells, collection pipelines, power lines, and access roads).

Measures identified with a "GW" prefix are specific to impacts involving future groundwater development and pumping that were analyzed at a programmatic level. They will be applied where appropriate to actions associated with the FEIS or to subsequent NEPA analyses (i.e., mitigation and monitoring may be adjusted or supplemented as appropriate in subsequent NEPA tiers). In particular, these measures are based on currently available information that would be applied to future activities. They are general in nature; however, until they are replaced by more-specific measures that would result from future NEPA analyses, these measures would apply to future activities (BLM 2012b).

2.8 BUREAU OF LAND MANAGEMENT RESOURCE MANAGEMENT PLANS AND BEST MANAGEMENT PRACTICES

As described in Section 3.20 of the FEIS (2012b), all actions approved or authorized by the BLM must conform to existing land use plans. The applicable Resource Management Plans (RMPs) include the BLM Ely District RMP (BLM 2008) and the BLM Las Vegas District RMP (BLM 1998). Appendix D of the FEIS (2012b) identifies the Best Management Practices from these RMPs that will apply to the GWD Project. The Ely RMP measures will also be applied in land use authorizations related to the GWD Project in the BLM Southern Nevada District (BLM 2012b).

2.9 COMPREHENSIVE MONITORING, MANAGEMENT, AND MITIGATION PLAN

Following issuance of the ROD and the ROW grant, as well as SNWA's Final Plan of Development, the BLM will develop a COM Plan in conjunction with other federal, state, local, and tribal agencies/governments. This plan will ultimately contain the ACMs and BLM monitoring and mitigation measures referenced in this Opinion, as well as additional measures developed during COM Plan preparation. A description of the goals and objectives, conceptual outline, and development and implementation processes for the COM Plan can be found in Section 3.20 of the FEIS (BLM 2012b).

2.10 LITERATURE CITED

[BLM] Bureau of Land Management. 1998. Proposed Las Vegas Resource Management Plan and Final Environmental Impact Statement. Las Vegas, NV: U.S. Department of the Interior, BLM.

[BLM] Bureau of Land Management. 2008. Ely district record of decision and approved resource management plan. Ely, NV: U.S. Department of the Interior, BLM, Ely District Office. August 20.

[BLM] Bureau of Land Management. 2012a. Revised biological assessment for the Clark, Lincoln, and White Pine Counties groundwater development project. Las Vegas NV: U.S. Department of the Interior, BLM.

[BLM] Bureau of Land Management. 2012b. Final environmental impact statement for the Clark, Lincoln, and White Pine Counties Groundwater Development Project. U.S. Department of the Interior, Bureau of Land Management. August 2012.

[NSE] Nevada State Engineer. 2012a. Ruling #6164, In the Matter of Applications 54003 through 54021, Inclusive, Filed to Appropriate the Underground Waters of the Spring Valley Hydrographic Basin (184), Lincoln and White Pine Counties, Nevada. March 22, 2012.

[NSE] Nevada State Engineer. 2012b. Ruling #6165, In the Matter of Applications 53987 and 53988 Filed to Appropriate the Underground Waters of the Cave Valley Hydrographic Basin (180), Lincoln County, Nevada. March 22, 2012.

[NSE] Nevada State Engineer. 2012c. Ruling #6166, In the Matter of Applications 53989 and 53990 Filed to Appropriate the Underground Waters of the Dry Lake Valley Hydrographic Basin (181), Lincoln County, Nevada. March 22, 2012.

[NSE] Nevada State Engineer. 2012d. Ruling #6167, In the Matter of Applications 53991 and 53992 Filed to Appropriate the Underground Waters of the Delamar Valley Hydrographic Basin (182), Lincoln County, Nevada. March 22, 2012.

Woods, P.D. 2012. Letter to Ted Kock, U.S. Fish and Wildlife Service Region 8, from P. D. Woods, Project Manager, Nevada Groundwater Projects Office, Nevada State Office, Bureau of Land Management, Reno. September 17, 2012.

Chapter 3

ACTION AREA

The action area is defined as all areas to be affected directly or indirectly by the federal action, including interrelated and interdependent actions, and not merely the immediate area involved in the action (50 CFR § 402.02). Subsequent analyses of the environmental baseline, effects of the action, cumulative effects, and levels of incidental take are based upon the action area as defined by the U. S. Fish and Wildlife Service (Service).

As described in Chapters 1 and 2, the federal action that is the subject of this consultation is the Bureau of Land Management’s (BLM’s) issuance of a right-of-way (ROW) to the Southern Nevada Water Authority (SNWA) for the construction, operation, and maintenance of the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project). In keeping with BLM’s approach under the National Environmental Policy Act (NEPA), we consider groundwater pumping to be an indirect effect of the proposed action. Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur, while direct effects are the direct or immediate effects of the action on species and habitat. The action area for this consultation is thus based on the following: 1) the potential direct and indirect effects of Tier 1 ROWs (infrastructure and activities associated with the main and lateral pipeline, power facilities, ancillary facilities, and access roads); 2) the potential direct and indirect effects of Subsequent Tier ROWs (infrastructure and activities associated with future ROWs in groundwater development areas); and 3) the potential effects of pumping groundwater for 75 years following full project build-out (FBO) (Note: FBO is assumed to be 2050 for this analysis, and thus 75 years after FBO is calculated to be 2125).

For this Biological and Conference Opinion (Opinion), the Service is defining a broad action area due to considerable uncertainties concerning the geographic extent of impacts from groundwater pumping. Using the best available information and predictive tools, we have delineated an action area that we believe will encompass the maximum spatial extent of these effects. The Service’s action area is shown in Figure 3-1 and Figure 3-2. We anticipate that the action area will be revised during subsequent tiered consultations, when new information and data and new and refined predictive tools may be available.

The BLM utilized a groundwater flow model (the Central Carbonate-Rock Province [CCRP] Model), which was developed by SNWA with BLM oversight, as the basis of its programmatic NEPA and section 7 ESA analyses of potential effects of groundwater pumping (BLM 2012a,b). Uncertainties are inherent in the results of the groundwater flow modeling, due in part to the scarcity of available data in the region and the unavoidable generalization of geologic features that is required for model construction (BLM 2012a,b) (for a discussion of model uncertainties, see Chapter 5, Analytical Approach). The CCRP Model is nevertheless an important tool for aiding in the assessment of potential impacts to federally listed species and critical habitat from GWD Project pumping. Therefore, we have used the CCRP Model predictions of groundwater drawdown when delineating the action area, while also considering other data and information about the hydrologic connectivity of Hydrographic Basins (HBs) in the area of potential project effects. For a very basic description of the groundwater flow systems, see Chapter 4 (Environmental Setting); for a more detailed description, please refer to the Final Environmental Impact Statement ([FEIS] Chapter 3.3, Water Resources in BLM 2012a,b).

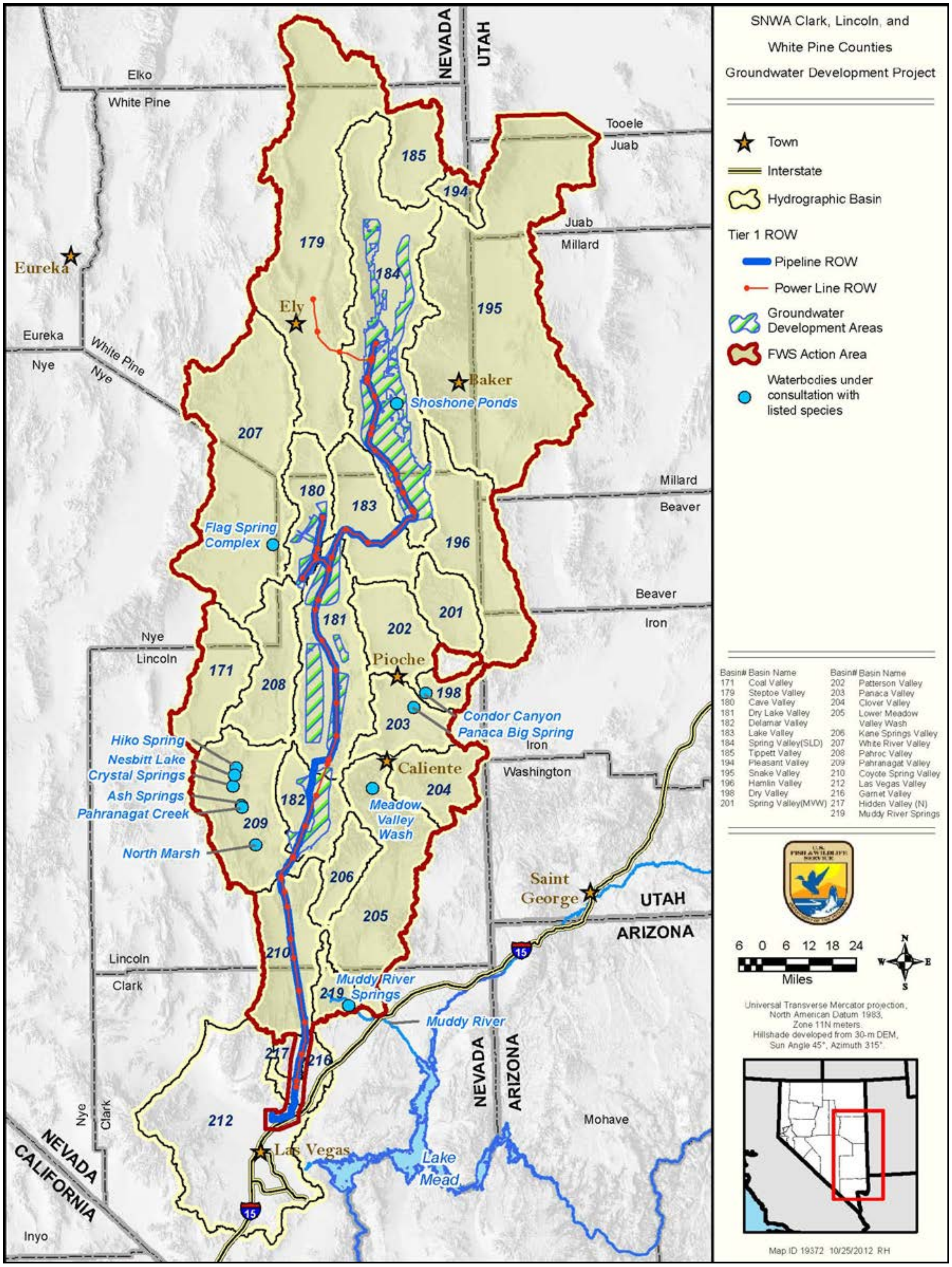
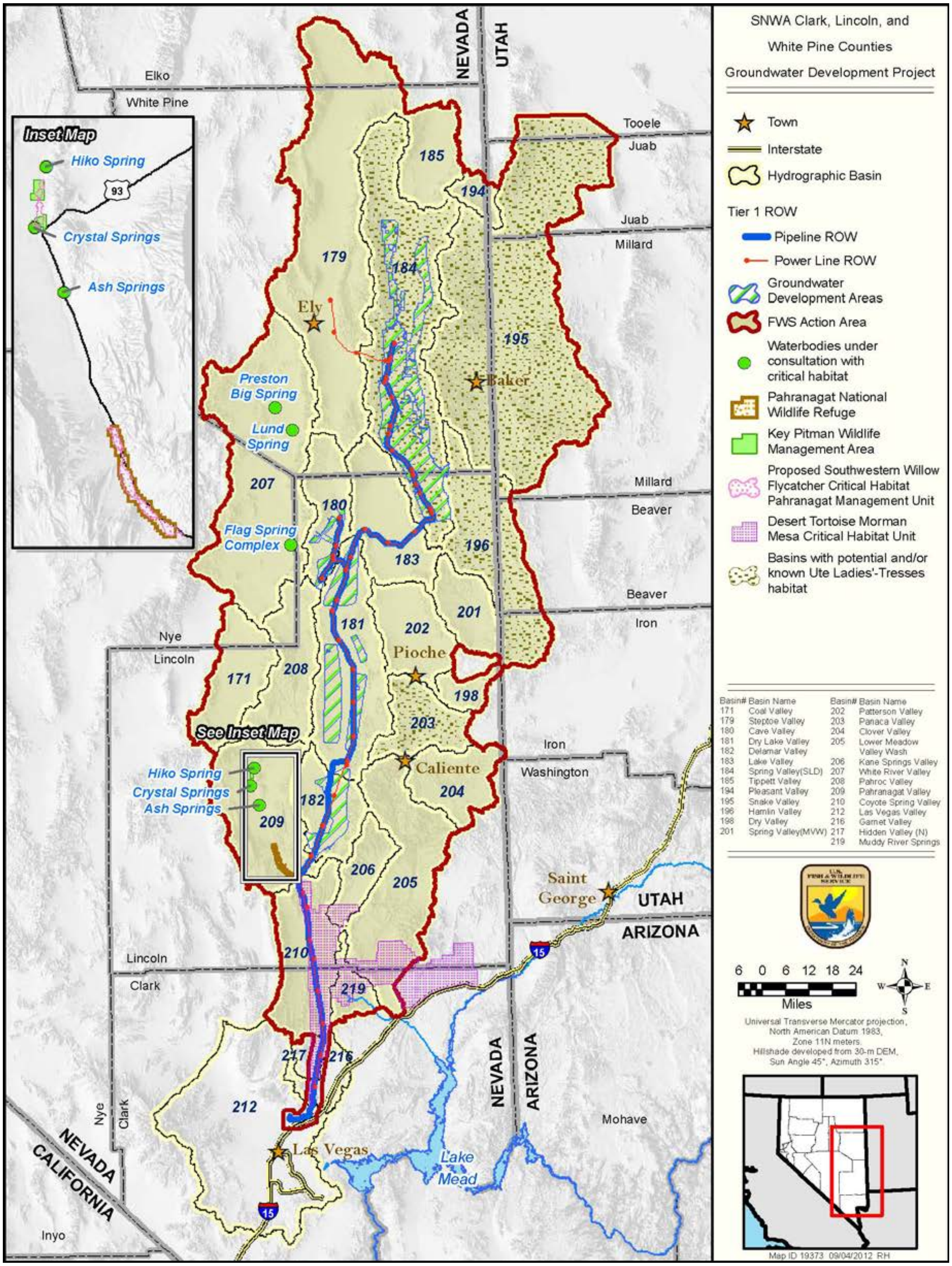


Figure 3-1. Action area and waterbodies under consultation, with listed species



Basin#	Basin Name	Basin#	Basin Name
171	Coal Valley	202	Patterson Valley
179	Steptoe Valley	203	Panaca Valley
180	Cave Valley	204	Clover Valley
181	Dry Lake Valley	205	Lower Meadow Valley Wash
182	Delamar Valley	206	Kane Springs Valley
183	Lake Valley	207	White River Valley
184	Spring Valley(SLD)	208	Pahroc Valley
185	Tippett Valley	209	Pahranagat Valley
194	Pleasant Valley	210	Coyote Spring Valley
195	Snake Valley	212	Las Vegas Valley
196	Hamlin Valley	216	Garnet Valley
198	Dry Valley	217	Hidden Valley (N)
201	Spring Valley(MVW)	219	Muddy River Springs

Figure 3-2. Action area, critical habitat, and potential or known Ute ladies'-tresses habitat

The Service based its delineation of the action area on simulations provided by the CCRP Model—specifically, simulated 0.3-meter (1-foot) groundwater drawdown contours at 75 years after FBO. In order to consider the potential maximum extent of impacts resulting from the federal action, we also considered the potential for additional propagation of drawdown following a hypothetical cessation of project pumping at 75 years after FBO. Because of uncertainties associated with the predicted spatial extent of the 0.3-meter (1-foot) drawdown contours, we expanded the boundary of the action area to include the entirety of any HB that the 0.3-meter (1-foot) drawdown contour extended into. Lastly, we expanded the action area to include the Muddy River Springs Area HB. While the 0.3-meter (1-foot) drawdown contour did not extend into this basin, the Muddy River Springs Area is a major discharge area for the White River groundwater flow system and is hydraulically connected to basins that may be affected by the proposed pumping in Delamar, Dry Lake, and Cave valleys. Additionally, after conducting our analysis and review of available information (see Appendix B, Informal Consultation), we have concluded that the discharge of the Muddy River Springs Area may be affected by the proposed action, and thus have included it in the action area.

We believe that our approach results in an action area that encompasses all groundwater-dependent ecosystems (GDEs) (e.g., springs, streams, riparian vegetation, wetlands, artesian well flow) that may be adversely affected by project pumping over the timeframe relevant to this consultation (2020–2125); and we believe that by delineating the action area broadly, we have avoided potential errors of omission.

We believe that it is appropriate to base delineation of the action area on the areal extent of the model-simulated 0.3-meter (1-foot) drawdown contours, because small changes in groundwater levels (e.g., 0.3 meter [m] [1 foot] or less) can have significant effects on the discharge of a spring or the areal extent of a wetland. This fact suggests the need for a conservative approach, an approach that is further recommended by the identified uncertainties associated with the model-predicted outcomes. These uncertainties are due to 1) unknowns regarding GWD Project design (e.g., pumping locations, depths, completion units, rates, and schedules); 2) unknowns regarding the response of the hydrologic system to pumping stresses, including the areal extent, timing, and magnitude of drawdown; and 3) unknowns regarding responses of the GDEs and federally listed species to pumping-induced hydrologic changes. A conservative approach is not only prudent, but consistent with the Service’s draft programmatic consultation guidance (USFWS 2003), which directs us to consider the maximum level of impacts that may be caused by the proposed action when uncertainties exist regarding future activities and impacts. Additionally, this approach is consistent with our Endangered Species Consultation handbook guidance; 50 CFR 402 (Interagency Cooperation–Endangered Species Act of 1973, as Amended, Final Rule); and H.R. Conf. Rep. No. 697, *supra*, at 12. This guidance directs the Service to develop Opinions based on the best available information, giving the benefit of the doubt to the species when insufficient information exists. As we learn more about the hydrogeology of the groundwater flow systems in the area of potential project effects and the response of those systems to groundwater withdrawal, the CCRP Model will be refined and its predictive capacity should improve. Additionally, other predictive tools may be developed to help with assessing project effects. As mentioned above, we anticipate that these improvements will lead to a more refined action area for subsequent tiered consultations.

By delineating the action area based on impacts to the groundwater system, we included sites on the ground (e.g., perched mountain block springs, expanses of dry land devoid of surface water resources) that are not likely to be affected by pumping-induced groundwater drawdown from the proposed action. However, we believe that the action area should be defined based on the spatial extent of potential impacts to the groundwater system, since such impacts could ultimately affect the ecosystems upon which listed species depend. Additionally, the interconnected nature of the regional (carbonate rock) aquifer is such that groundwater pumping in one basin could propagate through adjacent basins to affect surface water resources at distant sites.

The surface water resources in this arid region tend to be patchily distributed on the landscape; thus, listed species that depend on GDEs are also patchy in distribution. The action area and the surface waterbodies (with listed species) that are the subject of this consultation are depicted in Figure 3-1. Designated and proposed critical habitat that is the subject of this consultation is depicted in Figure 3-2; also depicted in this figure are those HBs with potential and/or known Ute ladies'-tresses (*Spiranthes diluvialis*) habitat. While only 2 occurrences of the federally listed Ute ladies'-tresses orchid have been documented within the action area, we cannot rule out the possibility that this species occurs at other sites within the action area that have appropriate habitat features. The occurrence of federally listed species and/or critical habitat by site is displayed in Table 3-1.

We do not anticipate that the southernmost HBs depicted in Figure 3-1 and Figure 3-2 (Garnet, Hidden [North], and Las Vegas valleys) will be affected by infrastructure and/or activities associated with subsequent tiers of the GWD Project or long-term pumping associated with the GWD Project. However, effects associated with construction, operation, and maintenance of the Tier 1 ROWs in these 3 southern valleys will occur, and we anticipate that these effects will propagate beyond the boundary of the ROW. Therefore, the action area at the southern extent of the project area is centered on the Tier 1 ROW, and includes a buffer zone around the ROW to capture the area that may be directly or indirectly affected by Tier 1 activities. We anticipate effects to the groundwater system from temporary pumping for construction purposes (e.g., dust control, hydrostatic testing), and effects to the federally listed Mojave desert tortoise (Gopherus agassizii) from construction, operation, and maintenance of the Tier 1 ROW (see Chapter 6, Desert Tortoise). As described in Chapter 6, the area of potential direct and indirect effects for the tortoise includes the proposed main pipeline, electrical power transmission and distribution lines, and all access roads within desert tortoise habitat buffered at 0.8 kilometer (km) (0.5 mile) either side of center for a total width of 1.6 km (1 mile). However, impacts due to construction pumping could extend further from the Tier 1 ROW, as explained below.

As described in Chapter 2, the exact locations of the temporary water supplies that will be used for construction are unknown, but SNWA anticipates that this water will come from existing or future wells located approximately every 16.1 km (10 miles) along the pipeline alignment. Because of the relatively low volumes of groundwater that will be pumped for construction, the resting of the wells during nonworking hours/days and seasons when water is not needed, and the short duration of use of each well, BLM anticipates that drawdown will be minimal and that it will not propagate measurably beyond the ROWs (BLM 2012a). However, without more details regarding the location of wells, depths, units of completion, or rate and schedule of pumping, we cannot be sure that effects to the groundwater system will be confined to the ROW corridor. Based on our reasonable assumptions and Theis analyses (see the "Construction Pumping" section in Chapter 5), groundwater drawdown from construction pumping could propagate approximately 2.5–40 km (1.5–25 miles) from water supply wells, depending on aquifer type.

However, we do not anticipate that this propagation will translate into impacts to surface water resources, due to BLM mitigation measure ROW-WR-3 (Construction Water Supply Plan) and BLM's commitment to modify this measure for the Record of Decision. In correspondence dated September 27, 2012, BLM clarified that SNWA anticipates using its existing agricultural wells for temporary construction water needs associated with main pipeline construction (Tier 1) rather than drilling a temporary construction water well near Shoshone Ponds; and that SNWA would not pump more groundwater from these wells than is currently used and authorized for agricultural production (Woods 2012). Also, season of use would likely be similar, as agricultural water is generally pumped in the summer, which is when dust control water would be needed.

We also included within the action area, those areas that may experience population growth as a potential indirect effect that enables growth under certain future real estate and economic development conditions. We anticipate that population growth could occur in the Las Vegas Valley and other parts of Lincoln and Clark counties as an indirect effect of the GWD Project, specifically in those areas serviced by SNWA (Boulder City, Henderson, Las Vegas, North Las Vegas, and areas of unincorporated Clark County) and/or Lincoln County Water District (e.g., Coyote Spring Valley). These areas are not shown in Figure 3-1 and Figure 3-2 but are included by way of this textual description (see Chapter 5– Analytical Approach, for discussion on this topic).

The Service's action area differs from that delineated by BLM in its Biological Assessment (BLM 2012a). The BLM relied on the CCRP Model predictions of groundwater drawdown and spring flow reductions at 75 years after FBO and during a subsequent 100-year simulated recovery period to delineate the action area, but used the 3.0 m (10-foot) drawdown contours and a 5% flow reduction criteria as thresholds to identify areas of risk. For reasons that are explained and discussed in Chapter 5 (Analytical Approach), we do not rely on the model-predicted changes in spring flows for our analysis. The BLM also applied a generalized understanding of the groundwater flow system based on hydrogeologic considerations to further expand their action area, which resulted in the inclusion of additional waterbodies with listed species and/or critical habitat (e.g., sites in northern White River Valley, Pahranagat Valley, and the Muddy River Springs Area). The Service's overall action area is larger than BLM's; however, the Service's action area does not include any surface waterbodies with federally listed species and/or critical habitats that were not also considered by BLM in its analysis. Similarly, the Service's action area does not include any HBs that were not also included in either the Natural Resources Study Area or the Water Resources Study Area in BLM's NEPA analysis (BLM 2012b).

Lastly, for each species, we have defined an analysis area that is a subset of the overall action area. The analysis area for each species is based on species distribution and the distribution of project components that have the potential to generate adverse effects to the species/critical habitat; the analysis area includes areas through which effects generated in project basins would have to propagate to reach sites occupied by the species or within critical habitat. Each analysis area is presented in the appropriate species-specific chapter (Chapter 6 for desert tortoise and Chapters 9–14 for species reliant on GDEs).

Table 3-1. Surface waterbodies in the action area, with listed species

Surface Waterbody	Listed Species	Critical Habitat
Great Salt Lake Desert Groundwater Flow System		
Spring Valley		
Shoshone Ponds	Pahrump poolfish	No
Springs, wetlands, and streams	Ute ladies'-tresses[a]	No
Snake Valley		
Willow Spring near Callao, Utah	Ute ladies'-tresses	No
Springs, wetlands, and streams	Ute ladies'-tresses[a]	No
Hamlin Valley		
Springs, wetlands, and streams	Ute ladies'-tresses[a]	No
White River Groundwater Flow System		
White River Valley		
Preston Big Spring[b]	White River spinedace	Yes
Lund Spring[b]	White River spinedace	Yes
Flag Springs	White River spinedace	Yes
Pahranagat Valley		
Hiko Spring	Hiko White River springfish	Yes
Key Pittman WMA (Nesbitt Lake or well-fed pond)	Southwestern willow flycatcher, Pahranagat roundtail chub	No[c]
Crystal Springs	Hiko White River springfish, Southwestern willow flycatcher	Yes (springfish only)
Ash Springs	White River springfish	Yes
Pahranagat Creek	Pahranagat roundtail chub, Southwestern willow flycatcher	No[c]
Upper Pahranagat Lake	Southwestern willow flycatcher	No[c]
Muddy River Springs Area		
Muddy River Springs and upper Muddy River	Southwestern willow flycatcher, Moapa dace	No
Meadow Valley Wash Groundwater Flow System		
Dry Valley		
Condor Canyon	Big Spring spinedace	Yes
Panaca Valley		
Panaca Spring	Ute ladies'-tresses	No
Springs, wetlands, streams	Ute ladies'-tresses[a]	No
Lower Meadow Valley Wash		
Meadow Valley Wash	Southwestern willow flycatcher	No

[a] Potential Ute ladies'-tresses habitat exists in areas outside of documented occurrences.

[b] Unoccupied critical habitat for the White River spinedace

[c] Currently, no designated critical habitat for southwestern willow flycatcher exists in the action area. However, the USFWS (2011) has issued a proposed rule to revise critical habitat for the flycatcher to include these sites, and we are conferencing with BLM on proposed critical habitat as part of this Opinion.

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Chapter 4

ENVIRONMENTAL SETTINGS

4.1 GEOGRAPHIC SETTING

The action area lies within the Great Basin–Mojave Desert region of the greater Basin and Range physiographic province. The Basin and Range is generally characterized by hundreds of long, narrow, and roughly parallel mountain ranges separated by deep valleys (Hunt 1967, as cited in Mac et al. 1998). These mountain ranges and arid valleys trend north to south, extending from southern Oregon and Idaho into Mexico. Although the Colorado River bisects the Basin and Range province, many other Great Basin rivers have no outlet to the sea. Instead, they form large lakes and playas, including, for example, the Great Salt Lake.

The Great Basin–Mojave Desert region can be divided geographically and climatically into hot and cold deserts (Mac et al. 1998). The higher, cold Great Basin Desert encompasses most of Nevada and portions of Oregon, Idaho, California, and Utah. It receives most of its moisture as snow. The lower, hot Mojave Desert encompasses portions of southern California, Nevada, Utah, and Arizona. It receives most of its precipitation as rain (MacMahon 1988, as cited in Mac et al. 1998). Within the action area, the transition between the two ecoregions occurs in southern Dry Lake Valley and northern Delamar Valley at approximately 38 degrees latitude (BLM 2012).

4.1.1 *Climate*

The climate of the Great Basin–Mojave Desert region is one of the most varied and extreme in the world (Hidy and Klieforth 1990, as cited in Mac et al. 1998). The arid conditions that characterize the region are created by mountain ranges that abut the region's western and eastern boundaries. The Sierra Nevada to the west captures moisture from Pacific storm fronts before the moisture can reach the desert (Houghton et al. 1975, as cited in Mac et al. 1998); similarly, the Rocky Mountains to the east intercept storms from the Gulf of Mexico (Hidy and Klieforth 1990, as cited in Mac et al. 1998).

The topographic relief in the Great Basin–Mojave Desert region creates powerful elevation gradients to which all the organisms in the region respond. Within the action area, land-surface elevations range from 3,982 meters (m) (13,063 feet) above mean sea level (amsl) at Wheeler Peak in Great Basin National Park to approximately 338.6 m (1,111 feet) amsl at Lake Mead (BLM 2012). As elevation increases, air density decreases and solar radiation and precipitation increase. The interaction of these factors produces different temperature regimes at different elevations, which significantly affect the distribution of plants (Billings 1970, as cited in Mac et al. 1998) and the animals that depend on them (Hall 1946, as cited in Mac et al. 1998). This mountainous terrain thus provides many opportunities for a multitude of organisms with diverse life strategies (Mac et al. 1998).

Regional temperature and precipitation data for 3 cities in the action area are presented by the Bureau of Land Management (BLM) in the Clark, Lincoln, and White Pine Counties Groundwater Development Project Final Environmental Impact Statement (FEIS; BLM 2012). The city of Ely lies in Steptoe Valley in the Great Basin Desert, where the climate is generally cooler in the summer and wetter in the winter than in the Mojave Desert to the south. Average annual temperatures demonstrate a slight upward trend over the 69-year period of record (1938–

2007) (BLM 2012). Precipitation records for Ely over the period of record depict wet and dry cycles lasting up to a decade or more, with a slight trend toward wetter conditions (BLM 2012). In fact, since 1950, annual precipitation increases have ranged from 6% to 16% for most of the Great Basin, accompanied by a decrease in snowpack at most monitoring sites and an earlier spring snowmelt contribution to stream flow (Chambers 2008, as cited in BLM 2012).

The city of Caliente lies in Lower Meadow Valley Wash at about the same latitude as southern Dry Lake Valley, which the BLM calls the transitional area between the Great Basin Desert and the Mojave Desert (BLM 2012). Here, average annual temperature and precipitation data mimic records for Ely, although temperatures are generally higher at Caliente, due to its lower latitude.

Las Vegas is located in the Mojave Desert and is generally hotter in the summer and drier in the winter than Ely or Caliente to the north. Average annual temperatures have increased by 3–4 degrees Fahrenheit over the period of record referenced in the FEIS, a more severe upward trend than found for Ely or Caliente. Precipitation records for Las Vegas differ from those in Ely in amount and seasonal distribution. Las Vegas generally receives less precipitation over the year; in Las Vegas, precipitation is greatest in January and February, whereas Ely receives most of its precipitation in March, April, and May (BLM 2012).

The differences in temperature and precipitation between the 2 ecoregions can be observed in the frequency and distribution of aquatic habitat and depth to groundwater. In general, perennial waterbodies in the form of streams and springs are more common in the Great Basin Desert ecoregion than in the southern, Mojave Desert part of the action area. Similarly, depth to groundwater is typically more shallow in the Great Basin Desert ecoregion. Accordingly, vegetation communities vary from north to south. Phreatophytic plant communities are common in the Great Basin Desert (BLM 2012), whereas these communities are almost completely absent from the Mojave Desert portion of the action area.

4.1.2 *Vegetation Communities*

The principal distinguishing feature of the Great Basin Desert and Mojave Desert floristic regions is the presence of creosote bush (*Larrea tridentata*) in the Mojave Desert and its absence from the Great Basin Desert (Billings 1951; Holmgren 1972, as cited in Mac et al. 1998). Big sagebrush (*Artemisia tridentate*) dominates much of the Great Basin floristic region, but it is mostly absent from the Mojave Desert, except at moderate-to-high elevations in the mountains (Mac et al. 1998). As described in the previous section, phreatophytic vegetation, such as greasewood (*Sarcobatus vermiculata*), is also more commonly found in the Great Basin Desert ecoregion (BLM 2012).

4.1.3 *Aquatic Systems*

Aquatic systems in the Great Basin and Mojave deserts are generally small and scarcely distributed throughout the landscape (Miller et al. 2010). Surface water can result from point sources of discharge (springs) or from broader discharge (streams, wetlands, and wet playas). Within the project area, a number of springs are expressing surface water. Aquatic systems include pools, streams, wetlands, and muddy/boggy areas. Some are warm springs, and many are important systems for endemic plants, riparian birds, amphibians, and aquatic macroinvertebrates. Riparian vegetation communities associated with aquatic systems may host a variety of emergent grasses/sedges and riparian trees, as well as subaquatic macrophytes and planktonic/benthic algae. Species such as saltgrass (*Distichlis spicata*), sedges (*Carex* sp., *Scripus* sp.), mesquite (*Prosopis* sp.), willow (*Salix* spp.), and salt cedar (*Tamarix ramosissima*) are found in association with these areas.

4.1.4 *Groundwater flow systems*

The action area includes portions of 4 groundwater flow systems[1] in east-central Nevada and western Utah:

- Great Salt Lake Desert groundwater flow system
- Goshute Valley groundwater flow system
- Meadow Valley Wash groundwater flow system
- White River groundwater flow system

BLM (2012) provides a brief description of the groundwater flow systems, including hydrographic areas (valleys) located within each of the flow systems and the FEIS water resources region of study (Figure 4-1). A more detailed description of the flow systems can be found in Heilweil and Brooks (2011).

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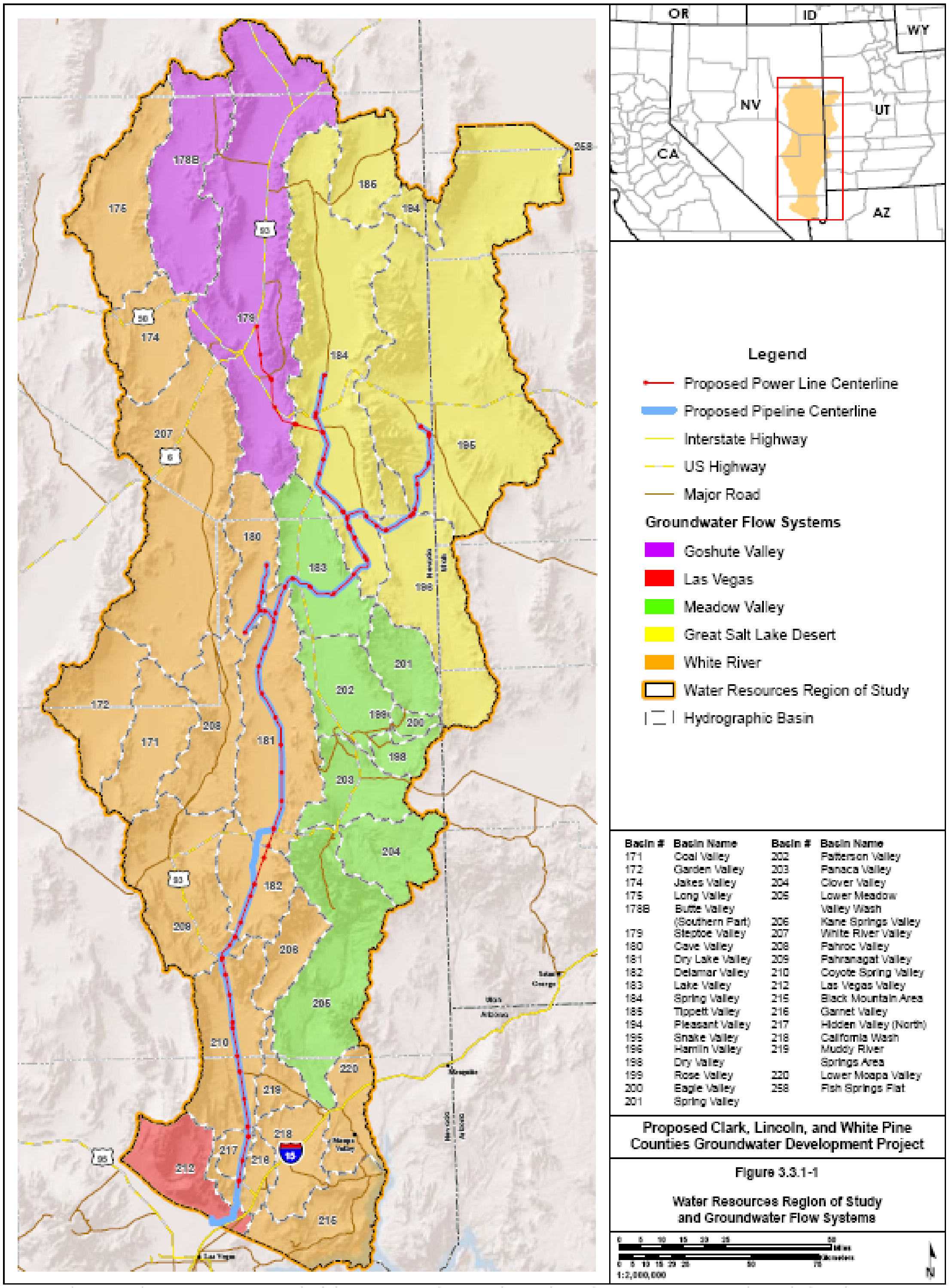
[1] Areas in which groundwater flow is generally contiguous under natural gradient conditions.



Basin #	Basin Name	Basin #	Basin Name
171	Coal Valley	202	Patterson Valley
172	Garden Valley	203	Panaca Valley
174	Jakes Valley	204	Clover Valley
175	Long Valley	205	Lower Meadow Valley Wash
178B	Butte Valley (Southern Part)	206	Kane Springs Valley
179	Steptoe Valley	207	White River Valley
180	Cave Valley	208	Pahroc Valley
181	Dry Lake Valley	209	Pahranagat Valley
182	Delamar Valley	210	Coyote Spring Valley
183	Lake Valley	212	Las Vegas Valley
184	Spring Valley	215	Black Mountain Area
185	Tippett Valley	216	Garnet Valley
194	Pleasant Valley	217	Hidden Valley (North)
195	Snake Valley	218	California Wash
196	Hamlin Valley	219	Muddy River Springs Area
198	Dry Valley	220	Lower Moapa Valley
199	Rose Valley	258	Fish Springs Flat
200	Eagle Valley		
201	Spring Valley		

Proposed Clark, Lincoln, and White Pine Counties Groundwater Development Project

Figure 3.3.1-1

Water Resources Region of Study and Groundwater Flow Systems

Figure 4-1. Water resources region of study and groundwater flow systems (Source: BLM 2012)

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Chapter 5

ANALYTICAL APPROACH

5.1 FRAMEWORK FOR JEOPARDY—ADVERSE MODIFICATION DETERMINATIONS

Section 7(a)(2) of the Endangered Species Act (ESA or Act) requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this Biological and Conference Opinion and (Opinion) relies on the following components:

- The status of the species, which describes the rangewide condition of federally listed species in the action area, the factors responsible for that condition, and their survival and recovery needs.
- The environmental baseline, which analyzes the condition of the federally listed species in the action area, factors responsible for that condition, and relationship of the action area to the survival and recovery of those species.
- The effects of the action, which determine the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on federally listed species.
- The cumulative effects, which evaluates the effects of future, State, tribal, local or private activities in the action area on federally listed species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the rangewide status of the listed species and considering any cumulative effects in the action area to determine if implementing the proposed action is likely to appreciably reduce the likelihood of both the survival and recovery of the species in the wild. For the purposes of making the jeopardy determination, the analysis in this Opinion emphasizes the rangewide survival and recovery needs of the federally listed species and the role of the action area in the survival and recovery of the species together with cumulative effects as the context for evaluating the significance of the effects of the proposed federal action.

Section 7(a)(2) of the Act also requires that federal agencies ensure that any action they authorize, fund, or carry out does not destroy or adversely modify designated critical habitat. This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR § 402.2. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

Section 7(a)(4) of the Act requires federal agencies to conference when the proposed action is likely to jeopardize the continued existence of a proposed species or destroy or adversely modify proposed critical habitat. However, such a finding is not required to trigger the conference procedure if the action agency wishes to initiate a review of possible effects on a proposed species or critical habitat. Per the U.S. Fish and Wildlife Service's (Service's) recommendation, the Bureau of Land Management (BLM) has requested to conference on effects of the proposed federal action to proposed critical habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*).

The adverse modification analysis in this Opinion relies on the following components:

- The status of critical habitat, which evaluates the rangewide condition of designated critical habitat for those species for which critical habitat has been designated in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall.
- The environmental baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area.
- The effects of the action, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units.
- Cumulative effects, which evaluates the effects of future, nonfederal activities in the action area on the PCEs and how they will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, effects of the proposed federal action on critical habitats were evaluated in the context of the rangewide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat rangewide would remain functional (or retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the species.

The analysis in this Opinion emphasizes the intended rangewide recovery function of critical habitat and the role of the action area relative to that intended function as the context together with cumulative effects for evaluating the significance of the effects of the proposed federal action for purposes of making the adverse modification determination.

5.2 APPROACH FOR ASSESSING EFFECTS OF THE ACTION

5.2.1 *Construction, Operation, and Maintenance of Project Facilities*

Where site-specific project details are known (i.e., Tier 1 Rights-of-Way [ROWs] for the main pipeline and associated facilities), our analysis of impacts related to construction, operation, and maintenance of the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) facilities is relatively straight forward. Our assessment of the likelihood of impacts and the potential nature and magnitude of impacts is based largely on the proximity of the federally listed species or designated/proposed critical habitat to the project facilities and activities. The Mojave desert tortoise (*Gopherus agassizii*) and its critical habitat are the only federally listed entities for which we anticipate adverse effects from construction, operation, and maintenance of the Tier 1 ROW facilities. Our approach for assessing impacts to the tortoise and its critical habitat is provided in Chapter 6. The Ute ladies'-tresses (*Spiranthes diluvialis*) presents a unique situation that requires us to assess effects to not only known occurrences within the action area (of which there are only two) but also effects to potential habitat within the action area. Our approach to this analysis is presented in Chapter 11.

Where site-specific project details are not known, we have based our analysis of the effects of construction, operation, and maintenance of GWD Project facilities on a set of project design assumptions. As described in Chapter 2, project details are not known for construction-related pumping to supply water for dust control, hydrostatic testing, pipe bedding, and trench backfill compaction, for both the Tier 1 and Subsequent Tier ROWs. However, the Southern Nevada Water Authority (SNWA) has assumed that water for these purposes will be obtained from existing wells or exploratory wells that are available at the time of construction, and that water supply wells will be needed approximately every 16 kilometers (km) (10 miles) along the pipeline alignment. For each mile of pipeline, construction activities will require 5.5–8.7 million gallons of water (approximately 17–27 acre-feet), with less water needed for dust control in wet winter conditions (BLM 2012a). Our approach to assessing potential impacts to the groundwater system from construction pumping is described below ("Construction Pumping" section). To assess construction pumping impacts to groundwater-dependent[2] federally listed species and critical habitat, we also considered BLM mitigation measure ROW-WR-3, which specifically addresses this activity, as well as any subsequent modifications to this measure made by the BLM that will be carried forward to the Record of Decision (Dow 2012).

Site-specific project details (e.g, production wells, collector pipelines, power facilities, and other associated infrastructure) are not known for the Subsequent Tier ROWs component of the GWD Project. Thus, our analyses of the effects of construction, operation, and maintenance of the Subsequent Tier ROWs are based on a set of assumptions about project design as described in Chapter 2. We have assumed that these facilities will be located within broadly defined groundwater development areas, as identified by the project applicant and depicted in Figure 2-1 in Chapter 2. To determine potential effects to federally listed species and critical habitat from Subsequent Tier ROWs, we evaluated species/critical habitat occurrence with respect to the groundwater development areas (i.e., species/critical habitat within the groundwater development areas are assumed to be potentially impacted at this time). To evaluate effects to the Ute ladies'-tresses, we evaluated presence of potential habitat (e.g, springs, wetlands, and perennial streams) within the groundwater development areas (see Chapter 11).

Our analysis assumes that construction of the Tier 1 ROW facilities will take approximately 8–10 years, and will begin in order to facilitate groundwater withdrawal by 2020 in Delamar, Dry Lake, and Cave valleys and by 2028 in Spring Valley. We assume that construction of Subsequent Tier ROWs (e.g., collector pipelines, production wells, and other associated facilities) will begin in year 5 following initiation of Tier 1 construction, and that full project buildout will be reached and pumping at full quantities will occur in approximately 30 years (estimated to be 2050 for purposes of this analysis) (BLM 2012b).

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[2] By this we mean species that rely on groundwater-dependent ecosystems, and groundwater-dependent critical habitat.

5.2.2 *Construction Pumping*

A Construction Water Supply Plan will be provided to the BLM for approval prior to construction pumping per BLM monitoring and mitigation measure ROW-WR-3 (BLM 2012b). For the purposes of this programmatic consultation, we have prepared preliminary estimates of the radial extent of potential construction pumping impacts (setbacks from resources of concern) by aquifer type using aquifer parameter estimates from selected pumping tests within the general vicinity of the project. Specifically, we use the pumping test solution of Cooper and Jacob (1946) to arrive at estimates of the radial extent of drawdown[3] associated with each potential construction supply well (existing or new) pumping at a maximum anticipated volume of 87 million gallons (MG) (8.7 MG per mile times 10 miles) over the estimated minimum construction period of 6 months (approximately 534 acre-feet per year or 330 gallons per minute). In addition to the pumping rate above, we used the estimates of aquifer transmissivity and storativity for upper valley fill and unconfined carbonate rocks from the selected pumping tests that are shown in Error! Reference source not found.. We relied on aquifer parameter estimates from the tests shown in Error! Reference source not found. since no ‘typical’ values for these parameters exist. Since no pumping test has yet been performed in the project area in a confined portion of the upper or lower (regional) carbonate-rock aquifers (SNWA 2012b; USGS 2012a), we evaluated the potential maximum extent of construction pumping impacts in these rocks using hypothetical transmissivity and storativity values that fall within the range of values estimated from pumping tests in the Great Basin, Nevada (Dettinger et al. 1995; SNWA 2009a, 2010a,b, 2011a,b; Belcher et al. 2001; Belcher and Sweetkind 2010; USGS 2012b; and Welch et al. 2007). While the hypothetical aquifer parameter estimates employed in the latter case are uncertain, they represent neither high nor low values based on the reported results of hydraulic field tests.

We further note that the transmissivity and storativity of volcanic rocks are particularly variable and no pumping tests have been conducted by the project proponent in volcanic rocks within the project area (e.g., in Delamar Valley) to date (SNWA 2012a). Consequently, we make no preliminary estimate of the setback for construction pumping in volcanic rocks but rather defer such analyses to a later time when the results of site-specific pumping tests are available.

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[3] Estimates of the radial distance over which 0.1 or more feet of drawdown may occur as a result of construction pumping, subject to assumptions inherent in the solution of Cooper and Jacob (1946).

Table 5-1.Estimated setbacks for construction pumping

Aquifer Type	Transmissivity (feet^2/day)	Storativity	Pumping Test/Source of Aquifer Estimates	Estimated Setback (Radial Distance to Drawdown of 0.1 feet)
Upper valley fill	5,600 to 9,000	0.12 to 0.18	Interpretation of response to pumping in multiple irrigation wells near Baker, Spring Valley, Nevada (USGS 2012b)	0.8 miles
Upper valley fill (alluvial fan)	35,600	0.22	Constant rate pumping test 7007X in alluvial fan near Swallow Springs, Spring Valley (SNWA 2010g)	1.2 miles
Upper carbonate-rock aquifer (unconfined)	11,000	0.035 to 0.069	Constant rate pumping test 184W103 (SNWA 2010b)	1.4 to 2.0 miles
Lower carbonate-rock aquifer (unconfined)	9,800 to 11,000	0.024 to 0.020	Constant rate pumping test 184W101 (USGS 2012b)	2.3 to 2.6 miles
Carbonate-rock aquifer (confined)	10,000	0.00025	Hypothetical case under confined conditions[a]	23 miles

[a] Based on a range of aquifer parameter estimates reported in Dettinger et al. 1995; SNWA 2009a, 2010a,b, 2011a,b; Belcher et al. 2001; Belcher and Sweetkind 2010; USGS 2012b; and Welch et al. 2007.

5.2.3 *Groundwater Pumping*

5.2.3.1 Hydrologic Analyses

Available Information

The proposed groundwater development is located in the Great Basin within the Carbonate-Rock Province in east-central Nevada. A large body of information is available describing the geology, precipitation, estimates of groundwater evapotranspiration and recharge (groundwater budget components), depths to groundwater and current directions of groundwater flow in basin fill aquifers, and hydrologic properties of major geologic units comprising aquifers, aquitards, and aquicludes within the project basins and neighboring basins that may be impacted by the proposed groundwater development, including but not limited to the following:

- Geologic maps and studies (Stewart and Carlson 1978; Stewart 1980; Raines et al. 2003; Page et al. 2005 and 2006; SNWA 2007a; and numerous others)
- Geophysical studies (Snyder et al. 1981, 1984; Bol et al. 1983; Ponce 1992, 1997; Phelps et al. 2000; Scheirer 2005; Scheirer at al. 2006; Mankinen et al. 2006, 2007, 2008; Mankinen 2007; Watt and Ponce 2007; Scheirer and Andreasen 2008; Mankinen and McKee 2009, 2011; Rowley et al. 2011; and numerous others)
- Precipitation magnitude and distribution (Hardman 1936, 1962, 1965; Daly et al. 2004, 2008; Jeton et al. 2005; and PRISM Climate Group 2012)

- Reconnaissance-level hydrogeologic studies by the State of Nevada in cooperation with the U.S. Geological Survey (USGS) (Maxey and Eakin 1949; Eakin 1962, 1963a, 1963b, 1964, 1966; Rush 1964, 1968; Rush and Kazmi 1965; Hood and Rush 1965; Eakin and Hughes 1967; Scott et al. 1971; and others)
- Additional hydrologic studies by the USGS in the area of potential impacts (Eakin et al. 1976; Thomas et al. 1986; Harrill et al. 1988; Plume and Carlton 1988; Dettinger 1989,1992; Nichols 1993, 1994, 2000; Nichols and VanDenburgh 2001; Prudic et al. 1995; Dettinger et al. 1995; Plume 1996; Dettinger and Schaefer 1996; Thomas et al. 1996; Tumbusch and Schaefer 1996; Laczniak et al. 1996; Burbey 1997; Harrill and Prudic 1998; Belcher et al. 2001; Maurer et al. 2004; Flint et al. 2004; Moreo et al. 2007; Smith et al. 2007; Watt and Ponce 2007; Flint and Flint 2007; DeMeo et al. 2008; Welch et al. 2007; Heilweil and Brooks 2011; Gardner et al. 2011; USGS 2012b; and others)
- Hydrologic studies by the University of Nevada, Desert Research Institute and M.S. theses (Mifflin 1968; Kirk and Campana 1988, 1990; Thomas et al. 1996, 2001, 2006; Epstein 2004; Thomas and Mihevc 2007, 2011; Hersey et al. 2007; Lundmark et al. 2007; Mizell et al. 2007; Zhu et al. 2007; and others)
- Hydrologic studies by the Sothern Nevada Water Authority (SNWA) (Brothers et al. 1993a, 1993b, 1994; LVVWD 2001; SNWA 2011e; and others)
- Analytical aquifer parameter estimates based on hydraulic tests conducted in Nevada (Dettinger et al. 1995; Dettinger and Schaefer 1996; Belcher et al. 2001; Belcher and Sweetkind 2010; Maurer et al. 2004; SNWA 2009a, 2010a, 2010b, 2011a, 2011b; USGS 2012b; and others)

Much less information is available about the following topics:

- Water levels (hydraulic head[4]) in the carbonate-rock aquifers that are the source of many of the springs supporting habitat for species with a "may affect likely to adversely affect" (MALAA) determination (USGS 2012a; SNWA 2008b,c, 2009e,f, 2010e,f, 2011c,d, 2012a)
- Spring discharges under current (preproject) conditions, particularly the variability of discharge under existing climatic conditions (Beck et al. 2006; Meyers 2007; BIO-WEST 2007; SNWA 2008a; USGS 2012a)
- Interbasin groundwater inflows and outflows from the project and neighboring basins (reconnaissance series reports, 1949–1971; Thomas et al. 1996, 2001; Lundmark et al. 2007; Thomas and Mihevc 2007; Hersey et al 2007; Welch et al. 2007; and Heilweil and Brooks 2011)
- The hydrologic character/properties of numerous faults in the area of potential impacts and their influence on the groundwater flow system and propagation of pumping-induced drawdown[5] at specific locations

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[4] Defined as the sum of elevation head and pressure head. In a confined aquifer, such as the regional carbonate-rock aquifer, pressure head has some positive value at a given elevation in the aquifer and hydraulic head is the sum of pressure head and elevation head, measured as the level of water in a well completed in the aquifer at a particular elevation.

[5] Change in hydraulic head, typically due to pumping.

As stated in the FEIS (BLM 2012b), "reliable estimates of hydraulic properties of faults included in the model are not available". These properties may be highly variable from fault to fault, as well as with location along any particular fault (both along strike and dip), and can only be determined through site-specific hydraulic tests or detailed groundwater flow model calibration (i.e., cannot be generalized or anticipated from the structural characteristics of faults).

Groundwater flow models, which are required to make projections about the response of the groundwater system to the proposed pumping, are available in limited numbers:

- Great Basin Regional Aquifer Systems Analysis (RASA) Model, developed by the USGS for the Basin and Range Carbonate-Rock Province; a steady-calibrated model (Prudic et al. 1995); and a transient-calibrated version of the same (Schaefer and Harrill 1995)
- Central Carbonate-Rock Province (CCRP) Model developed by SNWA for the GWD Project under the guidance of the BLM; a steady and transient calibrated model (SNWA 2009b–d, 2010c–d); input provided by a the BLM model oversight team during development. Although the model has not undergone a formal USGS peer-review, the model oversight team assembled by the BLM for the project, included groundwater modeling experts.
- A regional scale groundwater flow model developed for the BLM, National Park Service (NPS), Service, and Bureau of Indian Affairs (BIA) by West Yost Associates, Davis, California, to evaluate potential pumping impacts in east-central Nevada and western Utah, including developments proposed by SNWA in Spring and Snake valleys, for water right hearings in Utah (Durbin and Loy 2010; and Loy and Durbin 2010); USGS peer-reviewed in 2011, unamended to date
- A model developed by USGS for the NPS for the area of Spring and Snake valleys, including Great Basin National Park, based on a refinement and update of the RASA Model of Schaefer and Harrill (1995) (Halford and Plume 2011)
- A model of the southern Colorado Groundwater Flow System, which includes the southernmost portion of the area of potential impacts, developed by Tetra Tech, Denver, Colorado, for the NPS, BLM, Service, and U.S. Forest Service (USFS) (Tetra Tech Inc. 2012a,b)

For the purposes of future ESA analyses, an additional groundwater flow model is now under development:

- Great Basin Carbonate and Alluvial Aquifer System (GBCAAS) model, USGS Utah Water Science Center (Heilweil and Brooks 2011), which includes the entire area of potential pumping impacts.

Analytical Approach

Given the complexity of the groundwater flow system and many factors influencing the response of the system to the proposed pumping, a numerical groundwater flow model is needed to evaluate potential impacts to springs, wetlands, and flowing artesian wells supporting federally listed species within the area of potential project effects (the action area). The CCRP Model developed by SNWA for the GWD Project (with guidance from the BLM assembled technical review team) is the only groundwater flow model that has been used to simulate the Nevada State Engineer awarded pumping rates (NSE 2012a–d), for the proposed action. As such, we begin each of our hydrologic analyses with an evaluation of the CCRP Model predictions provided by the BLM in support of this consultation, as a starting point for additional analysis that considers uncertainties associated with the model and model predictions.

Timeframe of Analysis

The Service has been asked to consult on the effects of project pumping to 75 years after full build-out, which depends on the rate of propagation of drawdown and recovery from the proposed wellfields to the resources of concern (in addition to other factors), further necessitating the use of the available model predictions as a starting point for our analyses of site-specific impacts to habitat for federally listed species.

Regional versus Site-specific Assessment

The CCRP Model is a regional-scale groundwater flow model constructed to simulate the groundwater flow system in the potentially affected area and the regional effects of the proposed project pumping and cumulative pumping as is appropriate for the BLM's environmental impact statement (EIS) analyses (BLM 2012b). Specifically, BLM (2012b) states that "… the calibrated CCRP model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time resulting from various pumping alternatives…" and further that, "The model results provide valuable insight as to the general, long-term drawdown patterns and relative trends likely to occur from the various pumping scenarios…"

Under the ESA, the Service is tasked in this Opinion with assessing the potential effects of the project on federally listed species, many of which rely on site-specific groundwater-dependent habitat (springs and flowing artesian wells that discharge from discrete locations and wetlands and riparian habitat of limited areal extent). Therefore, we use the predictions of the regional flow model as a starting point for our analyses and examined whether and to what extent impacts to site-specific resources (those providing or creating habitat for federally listed species) may have been over- or underestimated by the regional model.

BLM (2012b) states that "The CCRP Model results… do not have the level of accuracy required to predict absolute values at specific points in time, especially decades or centuries into the future." The Service adds that the regional model does not have the level of accuracy required to predict impacts at specific locations, including springs, streams, flowing artesian wells, wetlands, and riparian habitat supporting federally listed species in the area of potential project effects. Uncertainties in the model structure and calibration and/or assignment of model parameters raise uncertainties in the regional model predictions that may vary from one location (site) to another, unrelated to time or the magnitude of the predicted site-specific impacts, specifically drawdown. In our analysis of site-specific impacts, we do not rely exclusively on the predictions of the regional model, but rather use the predictions of the model as a starting point for our analysis of site-specific impacts, followed by a detailed examination of factors related to the construction and calibration of specific portions of the regional model and their effect on the potential over- or underestimation of impacts to the resource in question.

The regional CCRP Model and model simulations provided to the Service in support of this consultation are valuable, necessary, and an essential component of the 'best available information' for the purposes of conducting these analyses (i.e., in view of the complexity of the hydrogeologic system, and challenge of accounting for the rate of propagation of drawdown and potential recovery). Due to the regional nature of the CCRP Model, the analyses presented in Chapter 7 also consider possible factors that could result in over or underestimation of site-specific impacts in the regional model simulations, as well as a range of other hydrogeologic considerations (other available relevant information and analyses).

Evaluating Potential Impacts to Springs

In this Opinion, the Service is tasked with evaluating the potential for pumping-related impacts to springs that discharge from specific hydrogeologic units as well as specific locations. Where the source aquifer of the spring is known (reasonably certain), the regional CCRP Model predictions of pumping-induced drawdown in the source aquifer are used as a starting point for our assessment of potential site-specific impacts. Specifically, where the preponderance of available information indicates that the discharge of a spring originates in basin fill deposits (the spring is a water table spring), the regional CCRP model predictions of drawdown of the water table are used as a starting point for our analysis of potential hydrologic impacts to the habitat in question. Where the preponderance of available information indicates that the discharge of a spring originates in one of the carbonate-rock aquifers (e.g., the regional carbonate-rock aquifer), the regional CCRP Model predictions of drawdown in the applicable carbonate-rock aquifer, at a depth which is consistent with available water temperature data, are used as a starting point for the analysis of potential hydrologic impacts presented in Chapter 7. We have not used the regional model predictions of changes in spring discharge (due to pumping) for the reasons below.

BLM (2012b) states that, "… there is considerable uncertainty regarding the ability of the model to accurately predict spring flow changes." We also note that a large number of smaller springs were removed from the CCRP Model in the last major model revision in 2010 because the model was not designed to replicate flows in small localized springs (SNWA 2010c). These are not relevant to listed species, the subject of this Biological Opinion. A number of springs are important to our analyses for listed species for which the regional model reproduces considerably less than the known flow under current (preproject) conditions, including approximately 17% of the discharge of Flag Springs; <50% of the documented discharge of Big Springs, with implications for other springs that provide potential habitat for Ute ladies'-tresses in Hamlin and southern Snake valleys; and roughly 45% of the observed discharge of Panaca Spring (SNWA 2012b).

In other cases, the model more accurately approximates known flows and reproduces 80–90% of current spring discharge (e.g., Hiko, Crystal, and Ash springs in Pahranagat Valley; Lund Spring and Preston Big Springs in White River Valley; and the Muddy River Springs) but may not reproduce physical processes that impact discharge and consequently limit the model's capacity to predict changes in spring discharge from pumping. In the case of a number of biologically important springs, spring conduits have been simulated to depths that greatly exceed those which are physically tenable on a geologic/hydrogeologic basis and moreover significantly exceed the maximum depth of circulation indicated by available water temperature data. For example, Hiko, Crystal, Ash, Flag, Muddy River, and Preston Big springs have been simulated as discharging from conduits which extend to 11,000 or more feet below ground surface (bgs) (i.e., from 11,000 and 14,000 feet bgs to land surface, inclusively) (SNWA 2012b). In some cases, spring discharge has been simulated from hydrogeologic units that appear to be inconsistent with our understanding of the spring source. For example, discharge from Flag and Lund springs, which we believe originates from 'carbonate springs,' has been simulated as originating largely in upper valley fill (SNWA 2012b). Since no transient spring or stream flow data were utilized during the calibration of the CCRP Model (SNWA 2009c), MODFLOW 'stream' and 'drain' conductances, which have a strong influence on the magnitude of model-simulated spring discharge and magnitude of model-simulated changes in spring discharge, are weakly constrained[6]. This lack of transient spring or stream flow data may further limit the capacity of the regional model to predict changes in spring flow from project and cumulative pumping.

Simulation of Production Pumping and Production Units

Since this is a programmatic assessment, the action is defined only in terms of an annual volume of pumping from each of the project basins. The number, locations, depths, and units of completion of future project production wells are unknown at this time (BLM 2012a). Some assumption concerning the distribution of the production wells is necessary to estimate the potential effects of the proposed pumping (including aggregate effects) using the regional CCRP Model, as a starting point for additional analysis which considers uncertainties associated with the regional model and regional model predictions. The assumption made in the model simulations provided to the Service in support of this consultation is that project pumping will be distributed to "minimize pumping effects" (SNWA 2009d, 2010d, 2012b). The simulated project production wells are largely distributed across the floor of the project basins and located in upper valley fill (sands, gravels and other largely unconsolidated deposits); an assumption which is reflected in the model simulations provided to the Service and upon which the analyses of Chapter 7 are predicated. Therefore, uncertainties concerning the value of specific yield attributed to upper valley fill in the project basins (the simulated production units) have a significant effect on the regional model predictions of pumping-induced drawdown.

The calibrated CCRP model is the most appropriate tool of its kind currently available to evaluate the potential effects to water dependent resources over the area in question. As described in the FEIS (BLM 2012b), "Although there are inherent uncertainties and limitations associated with results of a regional groundwater flow model over a broad region with complex hydrogeologic conditions, the calibrated CCRP model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time, resulting from the various pumping alternatives that were evaluated. When combined with the baseline information on water resources in the study area, the simulated drawdowns, flow estimates, and water budget estimates provide reasonable and relevant results for analyzing the probable regional-scale effects and comparing alternatives for this programmatic level analysis." The BLM's revised model simulation report (SNWA 2010d) included a sensitivity analysis. As explained in the FEIS (BLM 2012b), "There is uncertainty regarding the final set of aquifer parameters used to represent the HGUs across the region. A sensitivity analysis was performed by adjusting the hydraulic conductivity and storage properties simultaneously and within a reasonable and plausible range, to evaluate how this adjustment in parameters could change the drawdown results. The results of this sensitivity analysis (using the Alternative A pumping scenario) are provided in Figure 5-2 in SNWA 2010b…. However, the model simulation results from the sensitivity analysis reduced the model fit compared with the calibrated model." The sensitivity analysis, in which the specific yield of upper valley fill was assigned a bounding low value of 0.10 and the hydraulic conductivity and transmissivity of upper and lower valley fill were reassigned values that are 1.5-fold greater than the model-calibrated values, is referred to as the

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[6] Highly uncertain; not optimized (calibrated) using adequate field observations.

high-diffusivity scenario. These values represent a modest (or no) perturbation to transmissivities attributed to upper valley fill, lower valley fill, and the regional carbonate-rock aquifer (and no perturbation to storativities attributed to the regional aquifer). The perturbation to the specific yield of upper valley fill (the simulated production unit) is important in that a higher value of 0.18 has been attributed to this unit in the calibrated CCRP Model at all locations and depths within the approximately 20,000 square mile model domain based on transient calibration data available for a subset of basins. Uncertainties associated with this assignment of specific yield, may cause the calibrated CCRP Model to over or underestimate drawdown from project pumping[7]. To address uncertainties associated with the specific yield of upper valley fill (the simulated production unit), drawdown predictions produced using the ‘high-diffusivity’ scenario of the model (originally set up for the parameter sensitivity analysis)have been employed in this Opinion, in conjunction with the predictions of the calibrated CCRP Model, as a starting point for the hydrologic analyses presented in Chapter 7 with the intent of bracketing differences in drawdown predictions using a range of model input values represented within these two different model scenarios. .

Analytical Approach to Hydrologic Analysis

Analyses of the potential effects of the proposed groundwater withdrawals on springs, flowing artesian wells, wetlands, and riparian zones providing habitat for species with a MALAA determination are presented by geographic area in Chapter 7. Whereas the approach taken is unique to the resource in question and the assumptions reflected in specific portions of the CCRP Model and regional model simulations, the general structure of our hydrologic analyses are as follows:

- Description of the resource, specifically its hydrologic characteristics
- An examination of the magnitude of the proposed groundwater withdrawal(s) compared to the natural discharge of the project basin(s) under current conditions as a first step in evaluating the potential impacts of the proposed pumping on the resource(s) in question
- A description of the regional model predictions of site-specific impacts (using the results of both the calibrated and ‘high-diffusivity’ model simulations provided to the Service)
- An examination of uncertainties associated with the calibration and/or assignment of aquifer parameters in the regional model and their effect on the regional model predictions of drawdown at the location of the resource in question
- A more detailed examination of factors related to the structure, assignment of aquifer parameters, and/or degree of calibration of specific portions of the regional model and their effects on the potential over- or underestimation of site-specific impacts, specifically drawdown and by extension spring discharge (where applicable)
- A summary of findings concerning the potential magnitude of pumping-induced drawdown at the location in question, taking into account the predictions of the regional model,

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[7] Specifically, if the value assigned to the specific yield of upper valley fill (the simulated production unit) is higher than actual values, then the calibrated model underestimates drawdown due to the proposed pumping and if the value of specific yield is lower than actual values, then the calibrated model overestimates drawdown due to the proposed pumping.

uncertainties associated with those predictions, and a range of other hydrogeologic considerations as appropriate

- Where applicable and feasible, an analysis of the driving head on the spring under current (pre-project) conditions
- A discussion of the potential impacts of pumping-induced drawdown on the discharge of the spring (where applicable)
- A description of the potential impacts of project versus cumulative pumping within the timeframe of this analysis
- A description of uncertainties related to potential long-term climate change over the timeframe of this analysis

5.2.3.2 Biological Analyses

For each of the federally listed species that may be affected by groundwater pumping, two types of analyses were conducted. First, as discussed in the previous section of this chapter, we assessed the likelihood of hydrologic impacts to sites with federally listed species and/or designated or proposed critical habitat due to pumping of groundwater for 75 years following full project build out (FBO). To the extent possible, we described the nature of these hydrologic effects while recognizing uncertainties associated with magnitude and timing of impacts. These analyses are presented in Chapter 7 by geographic area. The results of the hydrologic analyses were then used to inform the biological analyses for each of the federally listed species and critical habitats that are groundwater dependent. These results are presented in subsequent species-specific chapters (Chapters 9–14). At the biological level, the nature of potential effects are described conceptually because we do not know the precise nature, magnitude, and extent of hydrologic impacts that will occur during the analytical timeframe of this consultation and we do not have sufficient information to know what the exact response of (critical and other) habitats, individual animals, and populations of listed species will be to declines in groundwater levels and spring flow reductions that could result from the proposed action. However, using available information on the species and their habitats, related species (where appropriate), and other aquatic systems where ecological and/or biological responses to changes in flow have been studied, we developed a conceptual, qualitative description of potential consequences of decreased spring flow and groundwater levels to federally listed species and critical habitat.

As noted in Chapter 1 and elsewhere, we considered the potential maximum effects of the federal action by extending our analysis beyond the timeframe that we were asked to consult on, which was 75 years after FBO. By doing so, we were able to consider the potential response of the groundwater system following a hypothetical cessation of pumping at 75 years after FBO (i.e., we considered the continued propagation of groundwater drawdown and/or recovery of the hydrologic system following cessation of pumping).

Available Information and its Limitations

Limited information is available on the life history and habitat requirements of many of the groundwater-dependent species that are the subject of this Opinion. Available information often consists of short-term studies, many of which were done decades ago under habitat conditions that no longer exist today. Some information is available from laboratory studies (e.g., experiments in aquaria settings), which, while limited, does provide insight into aspects of species' life history. The one species for which we have more detailed life history and habitat information is the southwestern willow flycatcher; however, much of this information comes from locales that are outside of the action area for this consultation. Where appropriate, we draw on information about life history and habitat use/requirements from closely related species to inform our analyses.

For our biological analyses, we have drawn upon a large body of literature on the ecological response of lotic (flowing) and, to a lesser extent, lentic (still) aquatic systems and associated flora and fauna to altered flow regimes and responses of riparian vegetation to lowered groundwater levels and reduced spring flows. However, limited information is available on ecological responses to diminished flow in spring systems and spring-dominated streams, with the bulk of literature focused on larger river systems or run-off dominated streams. Therefore, this information has to be viewed with an understanding of the differences in these system types. The following types of information were accessed to inform our analyses:

- Ecology of desert fishes and fish life history strategies
- Ecology and life history of the species that are the subject of this consultation and/or closely related species or subspecies
- Population survey reports for the federally listed species, including Nevada Department of Wildlife (NDOW) field trip reports
- Hydrologic and ecological characteristics of desert springs and spring-dominated streams
- Ecological effects of drought and low flows (natural or manipulated) on lotic and lentic aquatic systems
- Responses of fish, macroinvertebrates, aquatic and riparian vegetation, and other habitat characteristics (e.g., substrates) in stream and spring systems to changes in flow regime, water volume, water velocity, groundwater levels, water temperature and quality, and other environmental factors

The paucity of life history and habitat information for many of the listed species that are the subject of this consultation speaks volumes about the need for more targeted research on life history characteristics, habitat preferences, limiting environmental factors, and species' response to change (especially decrease) in flow. This information is needed in order to assess GWD Project effects with greater accuracy; therefore, we recommend that the BLM require this information be collected prior to tiered section 7 consultations to help inform future analyses, determine incidental take, and develop minimization and mitigation measures. These information needs are addressed in our conservation recommendations, which can be found in Chapter 15.

Conceptual "Models" of Ecosystem and Species' Response

The complexity of ecosystem processes makes it difficult to predict *specifically* how groundwater drawdown or diminished spring flow will affect federally listed species and their groundwater-dependent habitat. This difficulty is further complicated by our incomplete knowledge of life history, habitat requirements, and individual and population-level responses of these species to diminished water quantity and/or quality. A flow-ecological response model that describes the relationship between hydrologic variability and ecological response has not been developed for any of the species that are the subject of this consultation. However, we can make general qualitative predictions about species' and habitat response to hydrologic change (decreased groundwater levels and spring flow) based on available sources of information in the literature and our files.

Based on our current knowledge of each listed species' life history and habitat requirements, as well as a review of the literature on impacts of groundwater drawdown and flow reductions on aquatic systems and aquatic biota, we developed a conceptual "model" of the potential impacts of spring flow reductions and/or groundwater drawdown on federally listed species and designated or proposed critical habitat (including impacts to PCEs of critical habitat). For our analysis, we considered habitat use at different life stages (e.g., spawning, breeding) and for different activities (e.g., foraging,feeding); species' dependence on specific habitat types or features; and sensitivity or tolerance of species to different environmental conditions and environmental change, where available information allowed us to do so.

These "models" take various forms in this Opinion. Primarily, they are written qualitative descriptions of potential ecological responses to reduced spring flows and/or groundwater levels; we also included a structural diagram (box and arrow) for the White River spinedace (*Lepidomeda albivallis*) to visually illustrate these (potential or likely) relationships. These models or qualitative descriptions of ecosystem responses should be viewed as a set of working hypotheses about how particular species and/or habitat components could be affected by pumping-induced reductions in spring flow or groundwater levels. Conceptual models, such as these, can be used to direct future monitoring and research efforts), and can form the basis for development of quantitative models that can be used to predict outcomes (Woodward and Beever 2011). These conceptual "models" should be revised based on new information at future tiered consultations.

The detail included in our conceptual, qualitative discussion of biological impacts is proportional to the level of risk to the species/critical habitat identified through our hydrologic analyses. In other words, for species and sites for which we have identified a high level of risk (i.e., substantial hydrologic impacts could occur during the timeframe of our analysis), we have provided a more detailed discussion of what we believe could be the resulting biological effects. For species and areas for which we have identified a possibility of measurable hydrologic impact during the timeframe of our analysis, but for which we have insufficient information to assess magnitude of these impacts, a more general and abbreviated description of possible biological effects is provided. In all instances, additional information is needed to determine specific impacts associated with groundwater withdrawal.

5.2.3.3 *Treatment of Applicant Committed and Bureau of Land Management Mitigation Measures*

As discussed in Chapter 2, SNWA has developed measures to avoid, minimize, and mitigate adverse effects to federally listed species (Applicant Committed Measures [ACMs]). Additionally, the BLM has identified Best Management Practices (BMPs) that apply to the GWD Project and will be requiring additional mitigation identified through the National Environmental Policy Act (NEPA) process. Per the BLM's request, we are assuming that all BLM-proposed monitoring and mitigation measures in the Final EIS that are within the BLM's authority will be brought forward to the Record of Decision, and those measures relevant to Tier 1 will become terms and conditions of the Tier 1 ROW permit (Woods 2012). Additionally, following issuance of the Record of Decision and the ROW grant, the BLM will be developing a Comprehensive

Monitoring, Management, and Mitigation Plan (COM Plan) in conjunction with other federal, State, local and tribal agencies/governments. This plan will ultimately contain the ACMs and BLM monitoring and mitigation measures referenced in this Opinion, as well as additional measures developed during COM Plan preparation.

These ACMs, BMPs, BLM monitoring and mitigation measures, and COM Plan process are presented in the Final EIS (BLM 2012b; see Chapter 3.20, Appendix D and E). The SNWA has also developed an additional ACM as part of the section 7 ESA consultation process to address concerns from the Service about potential effects of groundwater pumping in Cave Valley on the endangered White River spinedace and its critical habitat. The Service considered this new ACM as part of the proposed agency action, as requested by the BLM (Woods 2012). This new "Cave Valley" ACM is presented in this Opinion in Appendix C. Below we discuss our general approach to analyzing project effects with implementation of these measures.

As described by the BLM in the Final EIS (Chapter 3.20, p. 3.20-1 in BLM 2012b), measures for future groundwater development and pumping are necessarily general in nature since they are based on the programmatic NEPA analysis for the groundwater development and related facilities. These measures may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to aquatic resources from SNWA's groundwater development and pumping (BLM 2012b). Both agencies have also identified processes for developing monitoring, management, and mitigation plans for future groundwater development and pumping, including the identification of triggers for management action (see BLM's COM Plan framework [BLM 2012b, Chapter 3, p. 3.20-20–3.20-25] and SNWA's Conceptual Adaptive Management (AM) Framework [see BLM 2012b, Appendix E]). The BLM's intent is to identify more specific mitigation measures associated with tiered analyses for groundwater development and pumping.

Many of the current measures in the Final EIS require developing plans to monitor, manage, and mitigate effects from groundwater development and pumping. These measures (some much more than others) lay out a process for plan development, and may include some or all of the following: 1) general goals and objectives; 2) information that must be specified within the plan; 3) minimum periods for monitoring; 4) reporting requirements; 5) how adaptive management will occur; and/or 6) the approval process the plan will go through. Some measures are more specific than others in terms of identifying monitoring needs, although not as specific as the hydrologic monitoring recommendations we provide in Chapter 15 of this Opinion. Overall, the COM Plan description in the Final EIS is vague in its portrayal of the process for linking monitoring to management actions through the setting of triggers and the establishment of early warning thresholds (BLM 2012b). We believe (as does the BLM, SNWA, and others) that it is premature to set triggers for management action because additional data are needed to understand natural variation and species' response to flow reductions. However, it is important that the appropriate studies and monitoring efforts are implemented now in order to obtain the information needed to set initial triggers that will be sufficiently protective of listed species and critical habitat prior to future tiered ESA analyses. The BLM addresses the need to collect additional baseline data within the Final EIS (Chapter 3.20 in BLM 2012b), and we have provided suggestions for additional monitoring and studies to fill information gaps, both as a cooperating agency in the NEPA process and through this consultation (see Chapter 15).

For our programmatic-level analyses, where ACMs or BLM mitigation measures are either nonspecific or provide a list of options that *may* be implemented if certain unspecified triggers arise, those measures were not considered at a specific level for this consultation. However, we do assume that programmatic ACMs and mitigation measures will be developed in detail and included in the future tiered consultations, and that decision-making triggers will be identified through the COM Plan process (as described in BLM 2012b). Where BLM mitigation measures for future groundwater pumping are fairly specific (e.g., the requirement to maintain flow from artesian wells to Shoshone ponds in Spring Valley [measure **GW-WR-5]**), we considered these in a more specific manner in our analyses.

We recognize that some of the predicted effects to listed species and critical habitat may be minimized or even avoided by implementing programmatic ACMs and BLM mitigation measures, as well as through the outcome of the COM Plan process. But, in the absence of site-specific project information for groundwater development and pumping, detailed mitigation, and a developed COM Plan to evaluate the effects of programmatic activities (e.g., groundwater withdrawal), we cannot be assured that adverse effects to federally listed species and critical habitat will be avoided and we cannot know the extent to which effects may be minimized by implementing nonspecific programmatic measures. In fact, the Final EIS (BLM 2012b) indicates that it may not be feasible to effectively mitigate all impacts; that adequate mitigation may not be available for all locations; and that specific adaptive management measures may not successfully mitigate impacts (BLM 2012b, p. 3.3-130, as referenced for Alternative F on pp. 3.3-179 and 3.3-188).

The ACMs include measures agreed upon through the SNWA–Department of Interior Stipulated Agreements for Spring Valley and Delamar, Dry Lake, and Cave valleys (Stipulations). The Stipulations are legally binding agreements, and there are specific commitments by SNWA included in the Stipulations. However, not all commitments in the Stipulations are absolute, some are subject to a consensus process. For example, many provisions of the Stipulation monitoring and mitigation plans are adaptable, which means that initial commitments may be revised over the course of the GWD Project. As a party to the Stipulations, the Service will have input on revisions; however, as stated above, the process is based on consensus decision-making. Therefore, while the Stipulations are included as part of the proposed federal action (both within the project description in the Biological Assessment and as ACMs associated with future groundwater development), and we considered them as such, where these commitments are either nonspecific (e.g., reduction or cessation of groundwater withdrawals) and/or subject to change through the consensus-driven process, they were not considered at a specific level in this consultation.

Similar to the Stipulation process, the Service can provide input on the COM Plan as one of the agencies that the BLM has committed to coordinate with, but the BLM is the ultimate decision maker regarding the contents of the plan.

Also, any future BLM (or Nevada State Engineer [NSE]) decision to implement mitigation actions, including orders requiring the temporary suspension of pumping, will be based in part on BLM (or NSE) determinations that the GWD Project is the likely cause or has contributed to actual or predicted impacts. Determining probable causal factors for the condition of aquatic systems could be very difficult where these systems are affected by numerous stressors acting at different spatial and temporal scales (as reviewed by Bunn et al. 2010); where response of biota are non-linear and/or impacts of past disturbances continue to influence environmental conditions (legacy effects) (Allan 2004); and/or where pumping is distant from the site of interest and considerable time lags are associated with propagation of impacts (Bredehoeft 2011).

Additionally, once proposed mitigation measures are implemented, up to and including the possible cessation of pumping, there will likely be a lag time for the system to respond and potentially recover (that is, if irreversible change has not occurred; Davis et al. 2010). This lag time could be quite pronounced at sites located far from production wells (Bredehoeft 2011). In fact, hydrologic (and potentially biological) impacts could worsen for some period of time before any sign of recovery as groundwater drawdown continues to propagate through the system (Bredehoeft and Durbin 2009). The CCRP Model simulations provided to the Service in support of this consultation also showed this to be the case.

While the BLM, Service, and project applicant recognize these complicating factors, we feel the need to point out the difficulties that could arise with designing and implementing effective monitoring and mitigation for a project of this scope and complexity. These difficulties create considerable uncertainty in our opinion about the level of impact that could result to listed species and their habitats, despite the intent to implement timely and effective mitigation. Therefore, we have taken a conservative approach to our analysis of the potential impacts of project pumping, erring on the side of the species where uncertainties exist.

5.3 POTENTIAL INDIRECT EFFECTS FROM POPULATION GROWTH

5.3.1 *Population Growth*

The SNWA is a wholesale water provider for seven agencies that provide water and wastewater services to residents in the cities of Boulder City, Henderson, Las Vegas and North Las Vegas and unincorporated areas in Clark County. Part of SNWA's responsibility is to acquire and manage long-term water resources for southern Nevada. In order to ensure adequate water resources to meet future needs, SNWA prepares a Water Resource Plan (Plan) that is reviewed annually and updated as needed. The Plan provides a comprehensive overview of water resources and demands for southern Nevada and the SNWA's approach to demand forecasting that includes population projections and expected water conservation efforts. Although the recent economic conditions have resulted in a near-term leveling of population growth, most forecasts agree that this trend is temporary (SNWA 2009b). Recent population forecasts predict that Clark County, the most populous county (approximately 2 million) in southern Nevada, will reach a population of approximately 2.85 million and 3.3 million by 2035 and 2050, respectively (UNLV 2012).

In order to meet the water-resource needs for southern Nevada, SNWA relies on a resource portfolio of options that includes a variety of Colorado River resources, reclaimed water resources, and Las Vegas Valley and other in-state groundwater resources. SNWA's Water Resource Plan 09 (SNWA 2009b) anticipates that projected population growth in Southern Nevada will exceed the capacity of existing water resources and necessitate the need for additional groundwater from the proposed project by the year 2020 to meet demand forecasts.

We have considered whether the availability of water from the proposed GWD Project constitutes an indirect effect and will induce growth in the Las Vegas Valley and other parts of Lincoln and Clark counties, Nevada. We agree with the BLM's assessment presented in the Final EIS (BLM 2012b) that the long-term production and conveyance of water to these areas may indirectly enable future population growth, but the availability of water does not cause or induce growth. Therefore, we consider urban/suburban growth in the Las Vegas Valley and other parts of Lincoln and Clark Counties to be a potential indirect effect of the federal action rather than an interrelated-interdependent activity (i.e., it doesn’t satisfy the “but for” criteria above; see additional discussion in Chapter 5).

5.3.1.1 Desert Tortoise

Desert tortoises that occur within Clark County and portions of Lincoln County could be indirectly affected by additional population growth resulting from implementation of this project. Potential indirect effects include loss, degradation and fragmentation of desert tortoise habitat from urban development activities and associated infrastructure such as roads and utilities. Desert tortoises may also be adversely affected by the anticipated increase in human populations in the area, resulting in an overall increase in use of surrounding undisturbed public lands, which may lead to compacted soils, crushed or destroyed vegetation, removal of vegetation, increased soil erosion, altered hydrology, and increased nonpoint source pollution that may result in harm to the desert tortoise through habitat loss or degradation.

Future population growth of urban/suburban areas may result in an increase in human use of adjacent undisturbed public lands for recreational activities, resulting in additional loss, degradation, and/or fragmentation of tortoise habitat. Recreational activity on surrounding land may increase with the greatest and most frequent impacts likely occurring close to the development (i.e. urban/suburban areas). Illegal routes will likely proliferate as more people begin using the land. Additional desert tortoise mortality and fragmentation of its habitat may result from increased off-highway vehicle (OHV) use or other recreational uses on adjacent public lands. OHV use in the desert, which has greatly increased over the years and is the single greatest recreational use of public lands in southern Nevada (RECON 2000), can result in a significant cumulative loss of tortoise habitat and a significant impact on tortoise abundance and distribution (50 FR 5820).

Additionally, tortoises may be inadvertently affected by human recreation through accidental trampling and/or vehicle collisions. The primary impact of human recreation on tortoises will likely be temporary disruption of activity and modification of behavior resulting from human–tortoise encounters, whether intentional or unintentional (Service 2001). Desert tortoises have excellent vision and audio acuity and can detect an approaching person even from within burrows and shelter sites. When disturbed, wild tortoises commonly remain inactive for many minutes afterward. This change in behavior can cause tortoises to cease feeding, seeking shelter, or interacting with other tortoises; ultimately increasing stress levels, exposure to extreme temperatures, and/or altering mating or nesting behavior (Service 2001).

5.3.1.2 Southwestern Willow Flycatcher

Because southwestern willow flycatchers are generally restricted to desert riparian areas associated with flowing water or moist soils, potential indirect effects to flycatchers would be limited to urban development and associated infrastructure and utilities occurring in riparian areas mainly along the Muddy and Virgin rivers and Meadow Valley Wash in Clark and Lincoln counties. Development activities may result in a short term loss or long term loss of riparian vegetation that may be suitable as nesting or foraging habitat for southwestern willow flycatchers. Construction activities also may result in harassment of individuals caused by increased noise and human presence, and loss of nests with eggs or young if conducted in suitable habitat during the flycatcher breeding season.

Future population growth of urban/suburban areas may result in an increase in human use of riparian areas for recreational activities. Recreational activities, such OHV use of existing roads and trails within or adjacent to the river or wash system, may increase and result in an increase in erosion and crushing of riparian vegetation that are used by southwestern willow flycatchers. An increase of OHV use of roads in or adjacent to suitable or potentially suitable flycatcher habitat during the breeding season may result in an increase in the harassment of southwestern willow flycatchers and loss of nests with eggs or chicks. In addition, using roads during the breeding season also may result in indirect effects from increased noise and human disturbance, dispersal of invasive weeds, and dust effects associated with travel on unpaved roads and trails. Camping or other recreational activities that occur in southwestern willow flycatchers habitat may lead to trampling of vegetation, and may cause birds to flush from breeding or foraging sites during the breeding season.

5.3.2 *Clark County*

5.3.2.1 Desert Tortoise

Since the Mojave population of the desert tortoise was first listed under the Act in 1989, three regional-level habitat conservation plans (HCPs) have been implemented, primarily for developing desert tortoise habitat in Clark County, Nevada. Since 89% of Clark County consisted of public lands administered by the federal government, little opportunity existed for mitigating the loss of desert tortoise habitat under an HCP on nonfederal lands. However, funds collected under HCPs are spent to implement conservation and recovery actions on federal lands as mitigation for impacts that occur on nonfederal lands. Lands managed by the BLM are provided mitigation funds to promote recovery of the desert tortoise. Actions taken in relation to the HCPs mentioned here are/were taken in areas that overlap the action area addressed in this Opinion.

On November 22, 2000, the Service issued an incidental take permit (TE-034927) to Clark County, Nevada, including cities within the County and Nevada Department of Transportation (NDOT). The incidental take permit allows incidental take of species covered in the Clark County Multiple Species Habitat Conservation Plan (MSHCP), including the desert tortoise, for 30 years on 58,649 hectares (ha)(145,000 acres) of nonfederal land in Clark County and within NDOT ROWs, south of the 38th parallel and below 5,000 feet in elevation within Clark County. The MSHCP and environmental impact statement (RECON 2000) serve as the permittees' HCP and detail proposed measures to minimize, mitigate, and monitor the effects of covered activities. Permittees covered under the plan include Clark County; the Cities of Las Vegas, North Las Vegas, Boulder City, Mesquite and Henderson; and the NDOT who collect a development fee and issue permits on the disturbance of nonfederal property within their jurisdiction to cover the cost to implement the MSHCP.

5.3.2.2 Southwestern Willow Flycatcher

The southwestern willow flycatchers was included in the Clark County Multiple Species Habitat Conservation Plan to ensure no net unmitigated loss or fragmentation of occupied habitat; however, take for southwestern willow flycatchers was conditioned in the incidental take permit (TE-034927) because a large proportion (estimated 36% of total riparian habitat in Clark County) occurs on private land or land controlled by local governments where conservation actions to ensure adequate protection for riparian birds were not in place. Subsequent actions to meet the conditions of the permit are in process, but have yet to be fulfilled so consultation with Service is currently required if take of southwestern willow flycatchers or destruction of critical habitat is reasonably anticipated on these lands in Clark County. Any actions occurring on federal lands or those constituting a federal action where take or destruction of critical habitat were reasonably certain to occur would require additional section 7 consultations with the Service.

5.3.3 *Lincoln County*

Additional pipeline capacity of approximately 21,700 afy is reserved for use by Lincoln County in the GWD Project. According to the Biological Assessment prepared by the BLM (BLM 2012a):

> No water source has been identified for this capacity, nor has the county identified any timeline for development and use. Water sources may include potential transfer of existing agricultural rights or new appropriations in other groundwater basins in the area. Such transfers or new appropriations have not yet been requested by Lincoln County, and the specific quantity and source basins cannot be reasonably forecast at this time.

A portion of the additional pipeline capacity water may allow the transport of up to 11,300 afy existing agricultural water rights in Lake Valley currently held by Tuffy Ranch Properties, LLC for municipal use in Coyote Spring Valley. Growth that could be served by this additional water include areas covered by the Coyote Springs Investment MSHCP and the Southeastern Lincoln County HCP (ENTRIX 2008a; ENTRIX 2010a). The Coyote Springs Investment MSHCP covers approximately 3,054 ha (7,548 acres) in the eastern portion of Coyote Springs Valley straddling the Pahranagat Wash and the Kane Springs Wash in Southern Lincoln County. The Southeastern Lincoln County HCP encompasses approximately 720,397 ha (1,780,140 acres) of private land and adjacent federal lands administered by the BLM where the HCP Conservation Measures are anticipated to occur. The Mohave population of the desert tortoise is covered by both of these plans while the southwestern willow flycatchers is only covered by the Southeastern Lincoln County HCP since it does not occur within the covered area for the Coyote Springs Investment MSHCP. The covered activities for both plans include activities necessary to allow for orderly growth and development.

On October 24, 2008, the Service issued an incidental take permit (TE-186844-0) to Coyote Springs Investment, LLC. The incidental take permit allows incidental take of the desert tortoise, for a period of 40 years on 5,571 ha (13,767 acres) of non-federal land in Lincoln and Clark Counties (approximately 3,054 ha [7,548 acres] in Lincoln County and 2,516 ha (6,219 acres) in Clark County). The MSHCP and EIS (ENTRIX 2008a,b), serve as the permittee’s HCP and detail their proposed measures to minimize, mitigate, and monitor the effects of covered activities.

On May 5, 2010, the Service issued incidental take permits to Lincoln County (TE-09163A-0), the City of Caliente (TE-09173A-0), and the Union Pacific Railroad (TE-09177A-0). The incidental take permits allow incidental take of desert tortoise and southwestern willow flycatcher for a period of 30 years within 12,413 ha (30,673.5 acres) as described and specified in section 5 of the HCP for Lincoln County and the Union Pacific Railroad. The City of Caliente is only authorized for the take of southwestern willow flycatcher within this same area and time period. The HCP and EIS (ENTRIX 2010a,b), serve as the permittees' HCP and details their proposed measures to minimize, mitigate, and monitor the effects of covered activities.

All of the above HCPs and MSHCPs and associated take permits will expire prior to the expiration of this Opinion (estimated to be 2125, which is 75 years after full build out). Upon expiration of existing plans, it is reasonably anticipated that any future growth on private lands covered under current plans in Clark and Lincoln counties with the potential to impact listed species would require additional ESA consultation and the amendment or development of new HCPs to address potential impacts to listed species prior to any develop occurring.

If there are other areas within Lincoln County where additional growth may occur outside of the areas covered by the Coyote Springs Investment MSHCP or the Southeastern Lincoln County HCP would be required to tie existing or future Lincoln County water rights into the GWD Project because the majority of the GWD Project is located on federal lands. These actions would require additional federal ROW and associated federal authorizations to develop and/or convey future water supplies. Therefore, should Lincoln County pursue the use of the GWD Project capacity through development of future water resource projects, those projects and the facilities they would require would be subject to individual ESA section 7 consultations. According to the Biological Assessment developed for the GWD Project, the BLM anticipates that when SNWA applies for additional ROWs for future facilities, the BLM and Service will engage in additional ESA consultation, tiered to this programmatic consultation. This additional ESA consultation will include an incidental take statement, as appropriate, for such groundwater development, as well as jeopardy and/or adverse modification evaluations for both the proposed development activities and the GWD Project as a whole (BLM 2012a).

5.4 CUMULATIVE EFFECTS

For our cumulative effects analysis, we considered information provided to us by the BLM regarding reasonably foreseeable future actions and baseline groundwater uses (BLM 2012a–b and other information provided in support of this consultation), as well as other available information. The BLM did not identify any reasonably foreseeable future actions, as defined under ESA (i.e., future State, tribal, local, or private actions that are "reasonably certain to occur") for any of the three primary GWD Project components (Tier 1 ROWs, Subsequent Tier ROWs, and Groundwater Pumping).

In its BA (BLM 2012a), the BLM provided us with a list of groundwater uses within the action area that they considered to be reasonably foreseeable future uses under NEPA. However, these future groundwater uses were considered by the BLM to be environmental baseline under ESA section 7 regulations. These future groundwater uses are either existing rights that are reasonably expected to be developed on private lands prior to the start of groundwater pumping under the federal action, or are rights or applications that have undergone previous section 7 consultations.

A review of Table 5-1 (Reasonably Foreseeable Future Groundwater Uses) in the BA indicates that some of the groundwater uses considered by the BLM to be baseline under ESA probably should have been categorized as reasonably foreseeable future uses because they are 1) not developed yet, but are reasonably certain to be; 2) associated with private lands/actions; and 3) have not undergone section 7 consultation (BLM 2012a). Based on this, we have found that there are reasonably foreseeable future groundwater uses within the action area, including in the following valleys (taken from Table 5-1, BLM 2012a): Spring, Steptoe, Panaca, Clover, Lower, and Pahranagat valleys and Meadow Valley Wash.

Additionally, we anticipate the continuation of current consumptive groundwater use within the action area into the foreseeable future, some of which we presume to be associated with private, State, tribal, or local lands. The BLM considered these to be reasonably foreseeable future actions under NEPA, but baseline under ESA. We find that some of this future groundwater use may actually be more appropriately characterized as "cumulative" under ESA because it is associated with private, State, local, or tribal actions that have not been subject to section 7 consultation.

While we differ from the BLM in terms of how we differentiated the above-mentioned groundwater uses (i.e., baseline versus cumulative), this particular point has no bearing on our overall effects conclusions (i.e., our jeopardy and adverse modification determinations). As required under section 7, we based our overall effects conclusions on the ***aggregate*** effects of the factors analyzed under "environmental baseline," "effects of the action," and "cumulative effects." The BLM provided us with an aggregate effects analysis in support of this consultation, which included results of groundwater flow model (CCRP Model) simulations for their "baseline-plus-proposed action" scenario. All of the groundwater uses mentioned above were considered by the BLM in their aggregate effects analysis (as baseline), and we considered the results of this analysis in coming to our overall effects conclusions in this Opinion.

At this time, we are unaware of additional groundwater uses that should be considered reasonably certain to occur. If we later find that we did not consider an action as reasonably foreseeable when we should have, then the BLM should request reinitiation of consultation if it results in effects to federally listed species and/or critical habitats not considered in this Opinion.

5.5 CLIMATE CHANGE

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). The term "climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a).

In Chapter 8 of this Opinion, we present projected changes in temperature, precipitation, and moisture availability for the action area. We generally discuss the subsequent potential impacts of these changes in climate to groundwater-dependent ecosystems (GDEs) within the action area on which the species subject to this consultation depend.

The potential effects of climate change to the desert tortoise and its Mojave desert scrub habitat, which is a nongroundwater dependent terrestrial ecosystem, is discussed separately in Chapter 6. We do not anticipate impacts to the tortoise from groundwater pumping, only from construction, operation, and maintenance of the Tier 1 infrastructure.

5.5.1 *Climate Change Projections*

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system and substantial increases in precipitation in some regions of the world and decreases in other regions. (For these and other examples, see IPCC 2007a; and Solomon et al. 2007). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is “very likely” (defined by the IPCC as 90% or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007a; Solomon et al. 2007). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011), who concluded it is extremely likely that approximately 75% of global warming since 1950 has been caused by human activities.

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl et al. 2007; Ganguly et al. 2009; Prinn et al. 2011). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007a; Meehl et al. 2007; Ganguly et al. 2009; Prinn et al. 2011). See IPCC (2007b) for a summary of other global projections of climate-related changes, such as frequency of heat waves and changes in precipitation. Also see IPCC (2011) for a summary of observations and projections of extreme climate events.

Various changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007b). Identifying likely effects often involves aspects of climate change vulnerability analysis. Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, magnitude, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2007a; see also Glick et al. 2011). No single method exists for conducting analyses that apply to all situations (Glick et al. 2011). We use our expert judgment and appropriate analytical approaches to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (e.g., IPCC 2007a). Therefore, we use “downscaled” projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick et al. (2011) for a discussion of downscaling). With regard to our analysis for this Opinion, downscaled projections are available.

5.5.2 *Down-scaled Projections*

We referenced several sources for downscaled projections specific to our action area; however, each is limited to a range of time that does not extend beyond 2099. Yet, the timeframe of the analysis for our Opinion extends to the year 2125 and beyond to include a "recovery" period (see Chapter 1). Consequently, we acknowledge that the projections we reference are limited and lead us to an analysis that stops short of the full range of potential future climate change effects.

At the request of SNWA, Dr. Kelly Redmond of the Desert Research Institute summarized current knowledge on climate conditions and climate change in the Great Basin region of Nevada over the course of the current century (Redmond 2009). This discussion focused on potential future climate variability in Spring Valley based on a commonly used emissions scenario where rates are not significantly curtailed until later in the 21st century (A1B) and upon a baseline period of 1971–2000. Spring Valley is part of the Great Basin Desert ecoregion and projections for this valley likely represent potential conditions across the northern two-thirds of the project area. Climate change projections for Spring Valley, however, are not representative of the southern one-third of the project area within the Mojave Desert ecoregion.

To incorporate other sources of downscaled climate change projections and ensure we considered the Mojave Desert ecoregion, we referenced the Climate Wizard (*http://climatewizard.org*), which was developed through collaboration between The Nature Conservancy, the University of Washington, and the University of Southern Mississippi (Girvetz et al. 2009). The program enables the user to define a relatively small geographic area of interest and conduct site-specific analyses, an attribute useful in the evaluation of potential differences between the northern and southern parts of the action area (i.e. the Great Basin Desert ecoregion and the Mojave Desert ecoregion). Climate Wizard uses both historical data and possible future conditions that are based on low (B1), moderate (A1B), and high (A2) carbon emissions scenarios (albeit not the highest emissions scenarios modeled by IPCC in 2007). Because the B1 and A1B emissions scenarios were unavailable to us during the time period we accessed Climate Wizard, our resulting downscaled projections represent the high carbon emissions scenario (A2). Recent literature suggests that it may be too early to determine whether any particular emissions scenario is more plausible than any other (Betts et al. 2011), including those with higher emissions scenarios and subsequently greater projections for temperature increases. Although scenario A1B represents a more conservative emissions scenario than A2, neither represents an extreme end of the emissions scenario spectrum. Recent literature suggests that it may be too early to determine whether any particular emissions scenario is more plausible than any other (Betts et al. 2011), including those with higher emissions scenarios and subsequently greater projections for temperature increases. Although scenario A1B represents a more conservative emissions scenario than A2, neither represents an extreme end of the emissions scenario spectrum.

Climate Wizard makes 16 general circulation models (GCMs) available to the user in acknowledgement that there is not one time-series of climate, but rather many future projections from different GCMs. The user can therefore access a range of possible climate change projections and a comparative analysis to a baseline time period of 1961–1990. For the user interested in models demonstrating general agreement, Climate Wizard recommends the “ensemble” option which combines the analyses of multiple GCMs and quantifies the range of possibilities for future climates under different emissions scenarios. It specifically displays the 50th percentile or medial prediction of all 16 GCMs listed (Girvetz et al. 2009). Accordingly, we used this “ensemble” option in our analysis.

In addition to temperature and precipitation variables used to provide a source of downscaled temperature and precipitation predictions, the program also provides various other climate variables that are useful when making predictions of moisture availability. Moisture availability, rather than precipitation per se, is a critical resource for plants and animals (Young et al. 2011). Climate Wizard bases its moisture metrics (aridity index, climate moisture surplus, and climate moisture deficit) on potential evapotranspiration, or the balance between precipitation and the amount of water that an ecosystem could potentially use through evaporation and transpiration (Girvetz et al. 2009).

The authors of Climate Wizard provide a number of caveats for consideration when using the program (Girvetz et al. 2009). We previously described how we chose to address the availability of multiple GCMs where the outcomes may disagree with one another. In addition, it is important to recognize that the data used in the Climate Wizard analyses have been statistically “downscaled” from GCMs that were originally run at 2.5–3.5 degree resolutions. While these downscaling techniques better estimate the actual projected temperature or amount of precipitation in a specific grid cell, they still only represent coarse scale global climate processes, and do not include regional or fine scale. Therefore, it is ultimately important to remember that future climate simulations are projections of future climate, not accurate predictions of future climate change for any particular location or specific moment in time (Girvetz et al. 2009). Finally, the authors of Climate Wizard warn against examining a single year for meaningful statistical representations of modeled future climate predictions. To most accurately describe predicted conditions for the end of the century (2100), Climate Wizard recommends analyzing data from the period 2070–2099 (Girvetz et al. 2009).

We ran two separate custom analyses through Climate Wizard to focus on the action area within the Great Basin Desert ecoregion and the Mojave Desert ecoregion. We consider that the transitional area between these two regions is located in Delamar Valley and southern Dry Lake Valley (BLM 2012b). Climatic differences between these two regions are described in Chapter 4 of this Opinion.

As a final source of downscaled climate projections, we referenced the 2012 draft Nevada Wildlife Action Plan (WAP) (Wildlife Action Plan Team 2012)developed by the NDOW for its analysis of climate change across the state, specifically in those key habitats that are included in our action area and will be impacted by groundwater pumping for development purposes. While the WAP is not in itself a model of predicted climate change for the future, it is a useful resource for our analysis in that it applies current climate change projections to aquatic environments in the action area.

5.5.3 *Species Sensitivity Analyses*

As discussed previously in this chapter, vulnerability analyses represent an integral component in understanding how individual species will respond to projected climate change. We referenced the Climate Change Vulnerability Index (CCVI) (Young et al. 2011) and its application by NDOW (Wildlife Action Plan Team 2012) to Nevada species for the purpose of identifying key sensitivity factors for species in this Opinion (an exception is Ute ladies'-tresses because NDOW did not perform an analysis for this species). The authors of the CCVI stress the importance of using comparable timeframes for the assessment of species vulnerability and climate change projections in order to ensure the thresholds separating the different CCVI categories are appropriate (Young et al. 2009). In this case, NDOW applied a time scale through 2050 for its analysis, whereas our climate change analysis extends beyond that time to 2099. Because the timeframes for analysis are different (50 years), we do not rely on NDOW's CCVI scores for each species; however, we found that reviewing the various Index categories were useful in understanding what life history factors may contribute to increased climate change sensitivity. In subsequent chapters of this Opinion, we therefore consider those life history factors in our effects analysis for each species.

5.5.4 *Use of Climate Change Analysis in this Biological Opinion*

As described in the Executive Summary of the Final EIS (BLM 2012b), Secretarial Order No. 3289 establishes a Department-wide approach for applying scientific tools to increase understanding of climate change and to *coordinate an effective response to its impacts on tribes and the land, surface and subsurface waters, fish and wildlife, and cultural heritage resources that the Department manages* (emphasis added). We conclude, therefore, that we not only have a responsibility to disclose and analyze the potential effects of climate change, but to aggressively manage for it as we strive to avoid adverse impacts to species listed under the Act.

Where species exhibit life histories vulnerable to climate change, it must be considered as a potential stressor that will act in combination with other stressors on the species and its habitat over the timeframe of our analysis. Consequently, the additional threat represented by climate change is considered for each species in the conclusion section of Chapters 9–14. It may also be reflected in the extent and scope of our conservation recommendations:

- The development of avoidance, minimization and compensatory mitigation
- The development of monitoring and adaptive management plans
- Analyzing the combined impacts of climate change and pumping

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SECTION ONE

ANALYSES FOR SPECIES LIKELY TO BE ADVERSELY AFFECTED BY TIER 1 ROWS

INCLUDES INCIDENTAL TAKE STATEMENT FOR DESERT TORTOISE

Chapter 6
DESERT TORTOISE

6.1 ANALYSIS AREA AND PROJECT COMPONENTS

The Mojave desert tortoise (*Gopherus agassizii*) analysis area includes tortoise habitat within the species' range that would be affected, directly and indirectly, by construction, operation, and maintenance of the main and lateral pipelines and associated facilities of the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) (see Figure 6-1). The specific highlights illustrate most of the major activities described in the Status of Tortoise Habitat in the Analysis Area section (6.2.3).

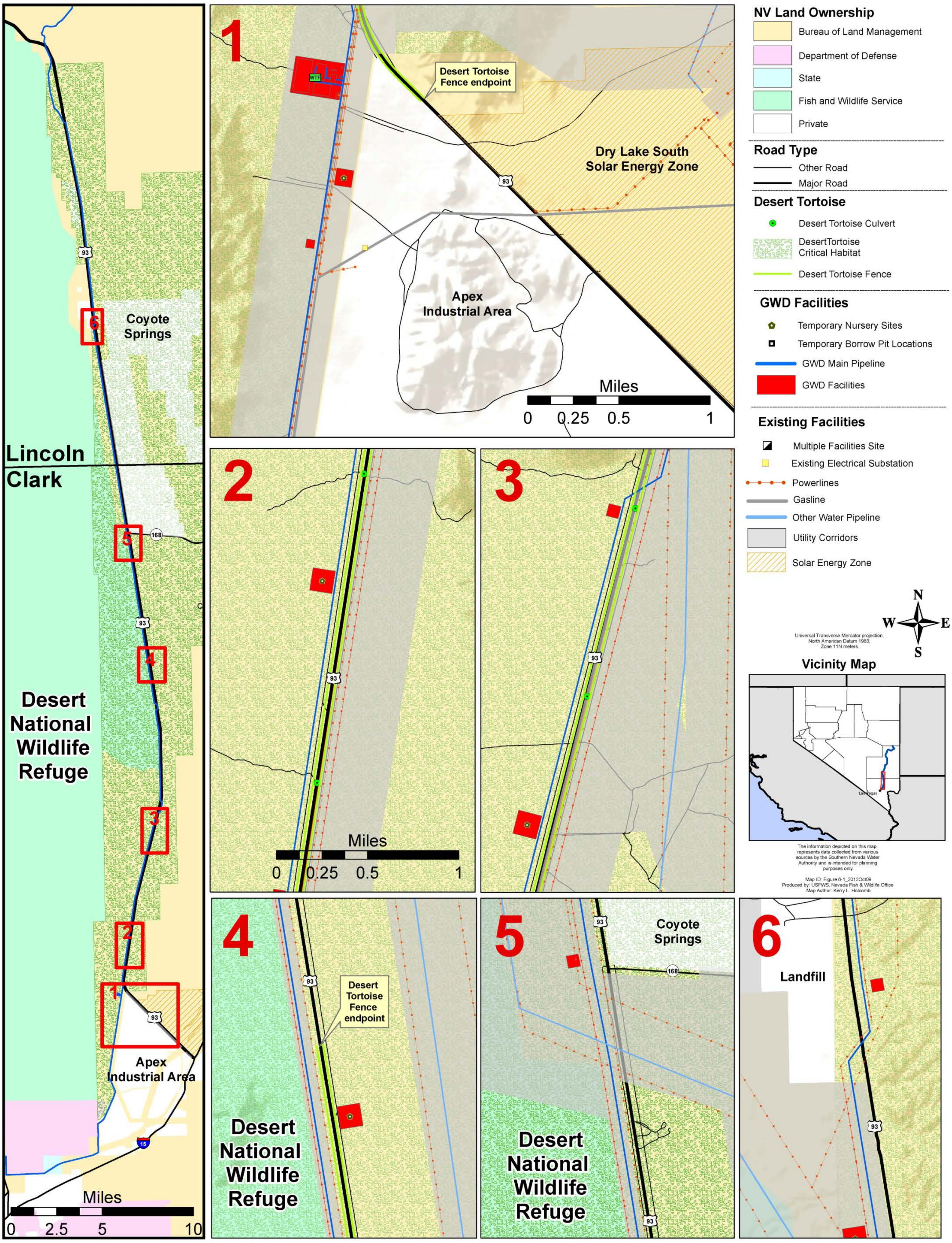
6.1.1 *Tier 1*

The Mojave desert tortoise analysis area is 20,985 hectares (ha) (51,857 acres) and includes the proposed 113 kilometers (km) (70 miles) of the buried main and lateral pipelines; 113 km (70 miles) of the electrical power transmission and distribution lines; and all access roads within desert tortoise habitat, buffered at 0.8 km (0.5 miles) either side of center for a total width of 1.6 km (1 mile). This buffer distance was chosen so as to increase the likelihood of intersecting the home ranges of desert tortoises inhabiting the vicinity of the proposed right-of-way (ROW), based on the assumption that the home range of a desert tortoise is approximately 2 square kilometer (km^2) (0.77 square miles [mi^2]) (BLM 2012a); however, the lifetime home range of a desert tortoise is 3.9 sq. km (1.5 mi^2) (USFWS 1994a). The analysis area is predominantly located on Bureau of Land Management (BLM)-administered lands and primarily within designated utility corridors near the far western edge of the Mormon Mesa Critical Habitat Unit (CHU) along U.S. Highway 93 (U.S. 93).

Areas within the analysis area would be disturbed during construction, operation, and maintenance of the GWD Project. The U.S. Fish and Wildlife Service (USFWS or Service) currently refers to any surface disturbance that would not return to preconstruction condition within 10 years as permanent disturbance (Hastey et al. 1991). Consequently, in this Biological and Conference Opinion (Opinion), the Service uses the term "permanent disturbance" exclusively since no surface disturbance associated with the GWD Project would return to preconstruction condition within 10 years.

6.1.2 *Subsequent Tiers*

Mojave desert tortoise habitat does not occur within the groundwater development areas or within the simulated groundwater drawdown area at 75 years after full build-out and 100 years of groundwater recovery (BLM 2012a). Thus, desert tortoises would be unaffected by groundwater pumping.



Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters.

The information depicted on this map, represents data collected from various sources by the Southern Nevada Water Authority and is intended for planning purposes only.

Map ID: Figure 6-1_2012Oct09
Produced by: USFWS, Nevada Fish & Wildlife Office
Map Author: Kerry L. Holcomb

Figure 6-1. Delineation of the analysis area for desert tortoise and major projects

6.1.3 *Specific Project Components That Will Affect the Desert Tortoise*

Project components that would affect the desert tortoise include construction, operation, and maintenance of the Tier 1 primary water and power conveyance system.

6.1.4 *Applicant-Committed Measures*

The Southern Nevada Water Authority (SNWA) commits to the following measures to ensure that they and their contractors avoid or minimize effects to the Mojave desert tortoise and its habitat:

- Developing and implementing a fire prevention and response plan, blasting plan, erosion control plan, and weed management plan (Applicant Committed Measure [ACM] A.1.1)
- Documenting vegetation conditions of the ROW and adjacent reference site locations prior to construction to establish pre-project baseline conditions for post-construction restoration goals (ACM A.1.70)
- Preparing a detailed restoration plan and submitting it to the BLM for approval prior to the start of construction. The portion of the plan pertaining to restoring listed species or technical assistance species habitat would also be submitted to the Service for approval. The restoration plan would describe reclamation and rehabilitation objectives and methods, species of plants and/or seed mixture to be used, time of planting, success standards, and follow-up monitoring (ACM A.1.69)
- Providing an environmental awareness program to construction personnel (ACM A.1.5)
- Where appropriate, restricting permitted activities from March 1 through October 31 within desert tortoise habitat (ACM A.5.29)
- Requiring biological monitors on-site during construction (ACM A.5.30)
- Conducting clearance surveys for desert tortoises prior to construction activity (ACM A.5.18 and ACM A.5.20)
- Handling desert tortoises using Service guidance (ACM A.5.25)
- Keeping all construction vehicles within the project area (ACM A.1.11)
- Installing temporary desert tortoise exclusion fencing to enclose active pipeline, staging, and facility site construction areas (ACM A.1.14)
- Enforcing a speed limit of 40 kilometers per hour (kph) (25 miles per hour [mph]) within the project area (ACM A.1.29)
- Disposing of food-related trash in predator-proof containers to discourage opportunistic desert tortoise predators such as desert kit fox (*Vulpes macrotis)*, coyotes (*Canis latrans)*, and ravens (*Corvus corvax)* from entering the area (ACM A.1.40)
- Conducting proper vehicle maintenance to prevent potential soil contamination from leaking liquid petroleum products (ACM A.1.43)

- Installing perch-discouraging devices on power poles to reduce the risk of predation from raptors and ravens (ACM A.5.8)

A detailed description of the applicant-committed measures is hereby incorporated by reference and is available in the biological assessment (BLM 2012a); Appendix E of BLM's Final Environmental Impact Statement (FEIS)—SNWA's Conceptual Plan of Development—Applicant Environmental Protection Measures (BLM 2012b); and Service files.

6.1.5 *Bureau of Land Management-proposed Measures*

The BLM proposes the following measures to ensure that the SNWA and their contractors minimize potential adverse effects from the proposed project on the Mojave desert tortoise and its habitat on BLM-administered lands:

- Reviewing and approving SNWA's POD(s) prior to notice to proceed for any surface disturbance activity, and coordinating with other agencies (Nevada Department of Wildlife [NDOW], Service), as relevant to their agency responsibilities (ACM A.1.1)
- Green stripping revegetation to mitigate risk of weed invasion and wildfire (BLM ROW-VEG-1)
- Applying an adaptive management approach to control and mitigation measures established for the project in the POD (Appendix D-General-3)
- Keeping removal and disturbance of vegetation to a minimum through construction site management (e.g., using previously disturbed areas and existing easements, limiting equipment/materials storage and staging area sites) (Appendix D-Vegetation-3)
- Generally, conducting reclamation with native seeds that are representative of the indigenous species present in the adjacent habitat and documenting rationale for potential seeding with selected nonnative species (possible exceptions would include use of nonnative species for a temporary cover crop to outcompete weeds) (Appendix D-Vegetation-4)
- Requiring remuneration fees and other measures to offset residual impacts to desert tortoises from permanent removal of their habitat (BLM 2008)
- Requiring that structures be inspected annually for nesting ravens (BLM RMP BO Term and Condition 3.k.)

Remuneration fees would be used for management actions expected to promote recovery of the desert tortoise over time. Actions may include habitat acquisition, population or habitat enhancement, research to increase knowledge of the species' biological requirements, surveys to monitor and document the species' status and trend, and additional measures to preserve individuals and distinct population attributes (Hastey et al. 1991; BLM and USFWS 2010).

A portion of the proposed remuneration fees may be used to support the Service's Desert Tortoise Recovery Office (DTRO). The DTRO is an essential element of our regulatory responsibility to identify, track, and ultimately improve the environmental baseline of the species and action area for the proposed action. Desert tortoise population data collected by the DTRO and its contract biologists provide estimates of tortoise population sizes and trends for the recovery and CHUs affected by the proposed action. Monitoring the effectiveness of conservation measures and changes in the environmental baseline of the action area is a collaborative process involving the BLM, Service field offices, and DTRO.

A detailed description of the BLM's proposed mitigation measures is hereby incorporated by reference and is available in Chapter 3.20 and Appendix D of the FEIS (BLM 2012b); the Ely Resource Management Plan (RMP) (BLM 2008); documented discussions between the Service and BLM; and Service files.

6.1.6 *Status of the Species and Critical Habitat Rangewide*

The rangewide status of the Mojave desert tortoise and its critical habitat is provided in our 5-year review (USFWS 2010a), in the Revised Recovery Plan for the Mojave Population of the Desert Tortoise (USFWS 2011), and on the internet at http://www.fws.gov/nevada/desert_tortoise/dt_life.html.

The website write-up consists of information on desert tortoise listing history, species biology, recovery plan, recovery and CHUs, distribution, reproduction, and population estimates. The Nevada Fish and Wildlife Office in Las Vegas (702-515-5230) can also provide this information if given the project file number and the administrative date of February 9, 2012.

6.2 ENVIRONMENTAL BASELINE

6.2.1 *Description of Affected Habitat*

The vegetation community at higher elevations is characterized as an intermediate zone between the Great Basin Desert scrub, in higher elevations in Delamar Valley, and Mojave Desert scrub—creosote bursage in the lower elevations of southern Pahranagat, Coyote Springs, Hidden, Garnet, and Las Vegas valleys. These plant communities occupy areas characterized by gravelly bajadas (alluvial fans) and inconspicuous low plains. The vegetation community is dominated by creosote bush–white bursage (*Larrea tridentata–Ambrosia dumosa*). Other vegetation types within the project area include saltbush scrub, blackbrush scrub, blackbrush and Joshua tree (*Yucca brevifolia*) woodland, and desert wash. Saltbush scrub consists of members of the genus *Atriplex* and other salt-tolerant species. Blackbrush scrub dominated by blackbrush (*Coleogyne ramosissima*) is common at the upper elevations of the project. Some of this community is codominant with Joshua trees, indicative of Joshua tree woodland. Desert wash habitat occurs in many of the incised washes throughout the action area and consists of ephedra (*Ephedra* spp.), cheesebush (*Ambrosia salsola*), and sweetbush (*Bebbia juncea*), with widely scattered catclaw acacia (*Acacia greggii*).

For more detail, see Chapter 4 of this Opinion.

6.2.2 *Status of the Species in the Analysis Area*

6.2.2.1 Adult and subadult desert tortoise estimates

Within the analysis area, several subset areas totaling 1,358 ha (3,355 acres) of Mojave desert tortoise habitat were surveyed using belt transect method and total corrected sign (Karl 1983) over the past several years (BLM 2012a). Based on the results of surveys discussed in the biological assessment (BLM 2012a), densities of desert tortoise within the surveyed area are 4.5 adult and subadult desert tortoises per km^2 (11.8 tortoises per mi^2), suggesting that the habitat in the analysis area (20,985 ha) (51,857 acres) could support 956 (494 to 1,885) adult and subadult desert tortoises (BLM 2012a). Using this same data, the area of direct disturbance from construction and operation (952 ha) (2,352 acres) could support 62 (32 to 122) adult and subadult desert tortoises (BLM 2012a).

Despite the fact that belt transects have been used to calculate tortoise density, transects offer only a general idea of the abundance of tortoises in an area. They are only appropriate for estimating regional densities and thereby identifying critical areas to be more closely investigated during land usage decisions. They cannot reliably provide a number of tortoises (i.e., density), due to numerous statistical and biological difficulties with the method (Karl 2000). This uncertainty also applies to extrapolating density estimates to surrounding areas. The advantage of transects over plots is that transects sample broad areas, but results are primarily qualitative. However, the survey information above provides the best available data and establishes a baseline for analysis in this Opinion.

The Service expects 62 adult and subadult desert tortoises to occur in the construction and operation area (952 ha) (2,352 acres) and 956 adult and subadult desert tortoises in the analysis area (20,985 ha [51,857 acres]). However, up to 122 adult and subadult desert tortoises may occur in the construction and operation area and 1,885 adult and subadult desert tortoises in the analysis area, given the estimated 95% confidence interval.

We use the higher end of the 95% confidence interval for our estimate because estimating the number of desert tortoises inhabiting long, linear project areas is challenging. We recognize that the survey data used for these estimates represent a single point in time and the number of individuals in these areas would change in response to environmental conditions. Variables that affect the number of tortoises that may occur or enter the ROW include habitat quality, season, temperature, and precipitation; some desert tortoises may die, and others may leave the proposed project area before construction commences; other desert tortoises may move onto the site before construction begins; and hatchling desert tortoises may emerge from undetected nests on, or adjacent to, the ROW. However, the survey information above provides the best available data and establishes a baseline for analysis in this Opinion.

In general, the highest densities of tortoise sign were observed from Hidden Valley south to Las Vegas Valley (BLM 2012a); however, the area just north of Kane Springs Road continuing south to the Apex area near Las Vegas has exceptionally high densities (Service File No. 84320-2011-F-0024) (see Figure 6-1).

Although desert tortoises have a patchy distribution and localized areas may have higher densities, the densities observed in the above surveys suggest that the analysis area is important to the rangewide population of the desert tortoise. As a comparison, the density in the Mormon Mesa CHU, which encompasses the analysis area, is also 4.5 adult and subadult tortoises per sq. km (11.8 desert tortoises per square miles), and the average density of the broader Northeastern Mojave Recovery Unit is 3.2 adult and subadult desert tortoises per sq. km (8.3 desert tortoises per square miles) (USFWS 2010b). Densities within the analysis area are 42% higher than the average density of the entire Northeastern Mojave Recovery Unit.

6.2.2.2 Juvenile, hatchling, and desert tortoise egg estimates

The amount of juveniles, hatchlings, and eggs is presently unknown. Few studies have been conducted (Turner et al. 1984, Turner et al. 1987; Bjurlin and Bissonette 2004), but these studies have limited value. Unknown factors that make determining the number of juveniles and hatchlings in the analysis area difficult are 1) the number of eggs laid; 2) natural mortality rates of eggs, hatchlings, and juveniles; and 3) predation rates of eggs, hatchlings, and juveniles. In the absence of site-specific surveys, we base our estimate on the 2010 population density estimate for the Northeastern Mojave Recovery Unit (USFWS 2010b). The 2010 data estimates two sub-adult/adult desert tortoises for every one hatchling/juvenile.

Since we expect 62 adult and subadult desert tortoises to occur in the construction and operation area 956 adult and subadult desert tortoises in the analysis area, the Service expects 31 juvenile and hatchling desert tortoises to occur in the construction and operation area 478 juvenile and hatchling desert tortoises in the analysis area

For eggs, we use the size of disturbance as a surrogate for desert tortoise eggs. Unknown factors that make determining the number of eggs in the analysis area difficult are 1) the sex ratio (males to females); 2) environmental and habitat conditions; 3) physiological and health conditions of adult female desert tortoises; 3) natural mortality rates of eggs; and 4) egg predation rates. Further, not all reproductive females produce eggs every year, the number of eggs is dependent on the time of the year, and the size of female desert tortoise territories varies.

6.2.3 *Status of Tortoise Habitat in the Analysis Area*

Within the area of proposed direct disturbance for the pipeline, 2% of the land has already been permanently disturbed and is no longer suitable for desert tortoise (23 ha of 957 ha [58 acres of 2,352 acres]); the BLM administers 97% of the total land area (924 ha of 952 ha [2,269 acres of 2,352 acres]) (BLM 2012a) (Table 6-1).

Table 6-1. Proposed direct surface disturbance from construction and operation of the pipeline and aboveground facilities

Disturbance Area (acres)[a]	Bureau of Land Management		State		Private		Total
	Critical	Non-critical	Critical	Non-critical	Critical	Non-critical	
Permanent[b]	1,741	584.1	0	25.2	39.9	19.5	2,409.7
Previously Disturbed[c]	-20.2	-35.1	0	-2.7	0	-0.1	-58.1
Total	**1,720.8**	**549**	**0**	**22.5**	**39.9**	**19.4**	**2351.6**
	2,269.8		**22.5**		**59.3**		

[a] Taken from Tables 5-2 and 5-3 (BLM 2012a).
[b] Disturbance that would not return to preconstruction condition within 10 years.
[c] Land permanently disturbed prior to construction of the GWD Project.

Within the analysis area, approximately 6% of the Mojave desert tortoise habitat has been permanently disturbed and is no longer suitable for desert tortoise (1,344 ha of 20,986 ha [3,322 acres of 51,857 acres]) (BLM 2012a). Disturbances within the analysis area include a railroad, a fenced highway (U.S. 93), many unpaved roads, several high-voltage transmission lines with substations, 4 buried fiber-optic lines, mining and sand-and-gravel pits, a utility-scale solar development area, and a landfill. Additionally, portions of the analysis area are degraded from casual off-highway vehicle (OHV) use, hunting, camping, garbage dumping, shooting, past wild horse and burro grazing, and past livestock grazing.

These disturbances reduce the quality and quantity of forage available to desert tortoise. They also result in the establishment of invasive weeds and nonnative grasses, which reduce the desert plants that are used as forage for the desert tortoise, and provide fuel for wildfires. Past wildfires in the area have reduced diversity and quantity of forage available. Historic grazing compacted the soil, reducing water infiltration rates over the long term; with less water available, forage plant growth suffers, potentially leading to surface erosion (Avery 1998). The project is within a major utility corridor for transmission lines and pipelines that runs the entire 113 km (70 miles) of the analysis area (see Figure 6-1).

Additionally, several major activities in the analysis area that would permanently disturb lands have been approved, but have not started construction. Under our regulations, we must evaluate these activities as having disturbed the maximum amount of area that was approved, unless the project was formally withdrawn. Areas that are no longer accessible to desert tortoises are considered to be completely disturbed; highway ROWs that are fenced on both sides are one example (see Figure 6-1).

6.2.4 *Major Activities Authorized under Section 7 (Federally Administered Lands)*

Major activities are projects that cover vast expanses of land (usually greater than1 square mile), have exempted take of large numbers of desert tortoises, are ongoing, and have landscape-scale effects due to their spatial arrangement, such as long linear disturbances that parallel the proposed ROW. The activities summarized below augment the major activities discussed in *Status of the Species and Critical Habitat Rangewide* and Figure 6-1.

6.2.4.1.1 Biological Opinions for the Las Vegas Bureau of Land Management in Clark County

On September 26, 1991, the Service issued a biological opinion to the BLM for implementation of their 1984 Management Framework Plan (Service File No. 1-5-91-F-112). The action area was 106,540 ha (263,267 acres) within the boundaries of Clark County’s incidental take permit (Permit No. PRT-756260) in the Las Vegas Valley. The Service anticipated up to 6,720 desert tortoises would be harmed or harassed and up to 17,094 ha (42,240 acres) of BLM-administered land would be developed for residential, industrial, commercial, and public infrastructure projects. This consultation was in effect for 5 years; during that time, an estimated 694 desert tortoises were harmed and harassed, and 18,671 ha (46,136 acres) of BLM-administered lands were sold and developed for residential, industrial, commercial, and public infrastructure projects under this biological opinion.

On April 11, 1996, the Service issued a biological opinion to the BLM for increasing the amount of BLM-administered land that would be developed for residential, industrial, commercial, and public infrastructure projects from 17,094 ha to 50,586 ha (42,240 ac to 125,000 acres) (Service File No. 1-5-96-23). The action area is 153,358 ha (378,956 acres) in the Las Vegas Valley. This consultation was in effect for 8 years and was reinitiated in 2004. Approximately 31,686 ha (78,299 acres) of BLM-administered lands were sold and developed under this biological opinion. Take under this opinion was covered under an incidental take permit issued to Clark County (Permit No. PRT-801045; Service File No. 1-5-95-FW-233).

On November 25, 1997, the Service issued a biological opinion to the BLM for implementation of several land management programs within the Las Vegas District planning area outside the

Las Vegas Valley (Service File No. 1-5-97-F-251). The action area covered approximately 0.9 million ha (2.2 million acres) of BLM-administered lands in Clark County and excluded desert tortoise critical habitat and Areas of Critical Environmental Concern (ACECs). Programmatic activities that may affect the desert tortoise include the issuance of ROWs, Recreation and Public Purposes leases, mining, and land sales. The Service anticipated that up to 4,047 ha (10,000 acres) of BLM-administered land outside the Las Vegas Valley would be disturbed and 5,923 ha (14,637 acres) would be sold and developed for residential, industrial, commercial, and public infrastructure projects. The Service anticipated that up to 120 desert tortoises may be killed or injured and up to 500 desert tortoises may be incidentally taken. The biological opinion covered a 5-year period that ended in November 2002; however, the Service and BLM agreed to allow activities to continue under the biological opinion if the activity was determined to be within the scope and effects analysis. As of May 2012, 1 desert tortoise had been reported killed; 3 tortoises had been reported to have been moved from harm's way; desert tortoise critical habitat has not been disturbed, but 2,556 ha (6,315 acres) of noncritical habitat on BLM-administered lands have been disturbed.

On June 18, 1998, the Service issued a biological opinion to the BLM for implementation of additional land management programs within the Las Vegas planning area that were not discussed in the 1997 biological opinion. The action area covers approximately all 1.2 million ha (2.9 million acres) of BLM-administered lands in Clark County (including those in the Las Vegas Valley, desert tortoise critical habitat, and ACECs) (Service File No. 1-5-98-F-053). Programmatic activities that may affect the desert tortoise include recreation; designation of utility corridors; sand-and-gravel pits along U.S. 93; and designation of the Coyote Springs, Mormon Mesa, and Gold Butte desert tortoise ACECs. The biological opinion covered a 10-year period that ended in June 2008; however, the Service and BLM agreed to allow activities to continue under the biological opinion if the activity was determined to be within the scope and effects analysis. To date, 3 desert tortoises have been reported killed; zero tortoises have been moved from harm's way; desert tortoise critical habitat has not been disturbed, but 1,214 ha (3,000 acres) of noncritical habitat have been disturbed.

On December 20, 2004, the Service updated the April 11, 1996, biological opinion (Service File No. 1-5-96-F-023R.3). The action area covers 80,937 ha (200,000 acres) within the urbanized Las Vegas Valley. This consultation will remain in effect until a comprehensive biological opinion (combining the 1997, 1998, and 2004 biological opinions) is completed. The Service anticipated that the remaining 16,788 ha (41,484 acres) from the 1996 biological opinion could be disturbed and 1,723 desert tortoises incidentally taken. The BLM anticipates that up to 1,821 ha (4,500 acres) would be sold and developed for residential, industrial, commercial, and public infrastructure projects through 2015. To date, 1 desert tortoise has been reported killed; 4 tortoises have been moved from harm's way; desert tortoise critical habitat has not been disturbed, but 3,630 ha (8,970 acres) of noncritical habitat have been sold and developed under this biological opinion.

6.2.4.1.2 Programmatic Biological Opinions for the Ely Bureau of Land Management in Lincoln County

On March 3, 2000, the Service issued a programmatic biological opinion to the BLM for potential effects to the desert tortoise from implementation of various land management programs in the Caliente Management Framework Plan Amendment area (Service File No. 1-5-99-F-450). The action area covered 305,376 ha (754,600 acres) of BLM-administered lands in southern Lincoln County. The Service anticipated that up to 3,094 ha (7,645 acres) of noncritical desert tortoise habitat and 384 ha (950 acres) of critical desert tortoise habitat would be disturbed; in addition, up to 6,850 ha (16,926 acres) of BLM-administered lands would be sold and developed for residential, industrial, commercial, and public infrastructure projects. This opinion has been replaced by a programmatic biological opinion issued to the BLM's Ely District Office in 2008. No desert tortoises were killed, injured, or moved from harm's way, and no desert tortoise critical habitat was disturbed; however, 197 ha (488 acres) of noncritical habitat were disturbed.

On July 10, 2008, the Service issued a programmatic biological opinion to the BLM for potential effects to the desert tortoise, and 4 other listed species, from implementation of various land management programs in the Ely District (Service File No. 84320-2008-F-0078). The action area covers 5.6 million ha (13.9 million acres), but only 305,133 ha (754,000 acres) in southern Lincoln County are in desert tortoise habitat. The programmatic biological opinion has a 10-year term ending in 2018. The Service anticipated that up to 24,028 ha (59,375 acres) of desert tortoise critical habitat and up to 44,410 ha (109,740 acres) of noncritical desert tortoise habitat would be affected from the proposed action; 9,156 ha (22,624 acres) of desert tortoise critical habitat and up to 15,099 ha (37,311 acres) of noncritical desert tortoise habitat were expected to be permanently disturbed. We exempted take of 47 desert tortoises through injury or mortality and 972 to be moved from harm's way. To date, no desert tortoises have been reported killed or injured; 1 tortoise has been moved from harm's way; and 115 ha (284 acres) of desert tortoise critical habitat and 57 ha (142 acres) of noncritical habitat have been disturbed.

6.2.4.1.3 Apex Land Transfer

On March 5, 1993, the Service issued a biological opinion to the BLM for transfer of 4,064 ha (10,042 acres) of BLM-administered land in the Apex Valley to Clark County (Service File No. 1-5-92-F-373). This area is between U.S. 93 and Interstate 15 (I-15) about 32 km (20 miles) north of Las Vegas. The Service anticipated that up to 706 adult and subadult desert tortoises occurred within this area. As of 1993, 62 desert tortoises had been moved from the project site. No information is available regarding the number of desert tortoises that have been killed or moved from harm's way since the land was transferred in 1993.

6.2.4.1.4 Fiber-Optic Lines along U.S. Highway 93

On May 15, 1995, the Service issued a biological opinion to the BLM for the issuance of a ROW to install 4 proposed fiber-optic lines in Clark and Lincoln counties (Service File Nos. 1-5-94-F-035, 334, 335, and 336). The projects moved an estimated 15 desert tortoises from harm's way and disturbed 45 ha (110 acres) of desert tortoise habitat along 69 km (43 miles) of U.S. 93 outside the Nevada Department of Transportation (NDOT) ROW.

On December 8, 1999, the Service issued a biological opinion to the BLM for issuance of a ROW for the Nevada segment of the Las Vegas to Salt Lake City Long-haul Fiber-optic Project

(Service File No. 1-5-99-F-411). The project moved an estimated 5 desert tortoises from harm's way, caused 1 mortality, and disturbed 105 ha (260 acres) of desert tortoise habitat along U.S. 93 outside the NDOT ROW.

6.2.4.1.5 Southwest Intertie Transmission Line Project

On December 20, 2007, the Service issued a biological opinion to the BLM to grant a ROW 1.2 km (0.75 miles) wide to LS Power for construction, operation, and maintenance of the Southwest Intertie Transmission Line Project (SWIP South) (Service File Nos. 1-5-93-F-91, 1-5-94-F-28R, and 84320-2008-F-0066). This is a 370-kilometer (230-miles) single-circuit, overhead 500 kilovolt (kV) transmission line that runs from Las Vegas to Ely, Nevada. The scope of this biological opinion is limited to the 113-km (70-mile) range of the desert tortoise within southern Nevada. The Service anticipated up to 151 ha (375 acres) of desert tortoise critical habitat and up to 122 ha (301 acres) of noncritical desert tortoise habitat would be disturbed as a result of the project. The Service exempted incidental take of 2 desert tortoises through injury or mortality and 45 to be moved from harm's way. This project is currently being constructed under the name "ON Line." As of October 15, 2012, no desert tortoises had been reported killed or injured, and 25 tortoises had been moved from harm's way (NV Energy 2012).

One Nevada Transmission Line Project

On January 20, 2011, the Service issued a biological opinion to the BLM to grant a 1.2-km (0.75-miles) wide ROW to Nevada Energy (NV Energy) for the construction, operation, and maintenance of the proposed One Nevada Transmission Line Project (ON Line) (Service File No. 84320-2011-F-0024). This would be a single-circuit, overhead 500 kV transmission line that would run 300 feet west and parallel to the SWIP South project from Las Vegas to Ely, Nevada. The scope of this biological opinion is limited to the 113-km (70-mile) range of the desert tortoise within southern Nevada. The Service anticipated that up to 125 ha (310 acres) of desert tortoise critical habitat and up to 153 ha (377 acres) of noncritical desert tortoise habitat would be disturbed as a result of the project. The Service exempted incidental take of 2 desert tortoises through injury or mortality and 100 to be moved from harm's way. This project has not started construction; rather, NV Energy and LS Power are jointly constructing the SWIP South project under the name "ON Line."

6.2.4.1.6 Dry Lake South Solar Energy Zone

The BLM designated 2,314 ha (5,717 acres) of BLM-administered land in the Apex Valley as the Dry Lake South Solar Energy Zone (SEZ) (BLM and DOE 2012). This area is between U.S. 93 and I-15 about 32 km (20 miles) north of Las Vegas, just north of the Apex land transfer area. SEZ is a priority area on BLM-administered lands open to solar energy development that is best suited for utility-scale production of solar energy in accordance with the requirements of the Energy Policy Act of 2005 (BLM and DOE 2010). Of this acreage, the BLM anticipates that 75%, or 1,735 ha (4,288 acres), would be permanently disturbed (BLM and DOE 2012).

6.2.5 *Major Activities Authorized under Section 10 (Private Lands)*

Major activities are projects that cover vast expanses of land (usually greater than 1 square mile), have exempted take of large numbers of desert tortoises, are ongoing, and have landscape effects due to their spatial arrangement, such as long linear disturbances that parallel the proposed ROW.

6.2.5.1.1 Clark County Habitat Conservation Plan

On May 23, 1991, the Service issued a 3-year incidental take permit to Clark County (Permit No. PRT-756260; Service File No. 1-5-91-FW-40). The Service permitted incidental take of 3,710 desert tortoises on up to 9,046 ha (22,352 acres) within the Las Vegas Valley and Boulder City in Clark County, Nevada. On July 29, 1994, the Service extended the term by 1 year and added 3,237 ha (8,000 acres) to the incidental take permit (Service File No. 1-5-94-FW-237). An estimated 1,300 desert tortoises were harmed or harassed, and 12,141 ha (30,000 acres) of habitat were disturbed under this permit.

On July 14, 1995, the Service issued an incidental take permit to Clark County and the NDOT (Permit No. PRT-801045; Service File No. 1-5-95-FW-233). The action area covered 143,663 ha (355,000 acres) in Clark, Lincoln, Esmeralda, Mineral, and Nye counties. The Service permitted take of all desert tortoises on 44,920 ha (111,000 acres) of nonfederal land in Clark County and an additional 1,174 ha (2,900 acres) associated with NDOT activities in desert tortoise habitat in the other counties.

On November 22, 2000, the Service issued a 30-year incidental take permit to Clark County and NDOT that supersedes the previous permit (Permit No. TE-034927; Service File No. 1-5-00-FW-575). The Service permitted incidental take of all desert tortoises on 58,679 ha (145,000 acres) in addition to the 44,920 ha (111,000 acres) in the 1995 permit within Clark County, Nevada.

6.2.5.1.2 Southeast Lincoln County Habitat Conservation Plan

On April 23, 2010, the Service issued a 30-year incidental take permit to Lincoln County, the City of Caliente, and Union Pacific Railroad (Permit Nos. TE-09163A, TE-09173A, TE-09177A; Service File No. 84320-2009-FW-0431). The action area covers 12,413 ha (30,674 acres) of nonfederal land in southeastern Lincoln County. The Service permitted take of 220 desert tortoises on up to 8,029 ha (19,840 acres) within Lincoln County, Nevada.

6.2.5.1.3 Coyote Springs Habitat Conservation Plan

On October 22, 2008, the Service issued a 40-year incidental take permit to Coyote Springs Investment, LLC (Permit No. TE-186844-0; Service File No. 84320-2008-F-0113). The Service permitted take of 450 desert tortoises, and allowed disturbance of 99 ha (244 acres) of desert tortoise critical habitat and 8,682 ha (21,454 acres) of noncritical desert tortoise habitat within the proposed housing development in Lincoln County, Nevada. To date, 526 ha (1,300 acres) of noncritical habitat have been disturbed for a golf course.

6.2.6 *Delineation of Analysis Area for Desert Tortoise Critical Habitat*

There are 5 designated recovery units for the desert tortoise (USFWS 2011). Recovery units are special units that are geographically identifiable and are essential to the recovery of the entire listed population. They are based on rangewide behavioral, ecological, genetic, morphological, and physiological differences in desert tortoises across their range, which likely mirror biotic and abiotic variability (USFWS 2011).

The proposed project occurs in the Northeastern Mojave Recovery Unit. This recovery unit occurs primarily in Nevada, but it also extends into southwestern Utah and northwestern Arizona. The east end of the unit extends south from the Beaver Dam Mountains, across the north end of the Virgin Mountains, down to the Colorado River. From the Colorado River at Las Vegas Bay, the southern boundary extends west generally along Las Vegas Wash through the city of Las Vegas to the Spring Mountains. From here, the western boundary extends north up the Sheep Mountains. This recovery unit includes the Beaver Dam Slope, Gold Butte-Pakoon, and Mormon Mesa CHUs.

The Service designated 12 CHUs in portions of California, Nevada, Arizona, and Utah, which are intended to provide for viable populations of desert tortoises representing different physical and behavioral adaptations (USFWS 1994b). The Service designates critical habitat in order to identify the key biological and physical needs of the species and key areas for recovery, and to focus conservation actions on those areas. Critical habitat is specific geographic areas that contain the biological and physical features essential to the species' conservation and that may require special management considerations or protection. These features—which include space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats—are called the primary constituent elements (PCEs).

The PCEs of desert tortoise critical habitat include l) sufficient space to support viable populations within each recovery unit and to provide for movement, dispersal, and gene flow; 2) sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; 3) suitable substrates for burrowing, nesting, and overwintering; 4) burrows, caliche caves, and other shelter sites; 5) sufficient vegetation for shelter from temperature extremes and predators; and 6) habitat protected from disturbance and human-caused mortality.

The proposed project occurs in the Mormon Mesa CHU. The designation of the Mormon Mesa CHU was based on the draft Desert Tortoise Recovery Plan (USFWS 1993), which characterized the proposed Mormon Mesa Desert Wildlife Management Area (DWMA) as an area with much habitat degradation; the level of degradation was such that it necessitated a large DWMA to achieve a sustainable tortoise population size. The Desert Tortoise Recovery Plan Assessment (Tracy et al. 2004) indicates that the number of threats in the Mormon Mesa area has increased since 1994. One of the most significant threats to the Mormon Mesa CHU stems from urbanization and the resulting loss, fragmentation, and degradation of tortoise habitat.

Under our regulations, delineation of the analysis area for desert tortoise critical habitat focuses first on the Tier 1 analysis area. Then, if the analysis area contains a significant amount of critical habitat, the focus shifts to the entire CHU (see *Adverse Modification Analysis* and Figure 6-2).

Within the Tier 1 analysis area, critical habitat comprises 71% of the analysis area (14,937 ha of 20,986 ha [36,911 acres of 51,857 acres]) (BLM 2012a) (see Figure 6-1). As of 2010, 7% of the critical habitat in the analysis area was permanently disturbed (985 ha of 14,937 ha [2,434 acres of 36,911 acres]) (BLM 2012a). Most of this disturbance is from the 90-meter-wide (300-foot-wide) fenced ROW for U.S. 93. This road parallels the proposed pipeline for 80 km (50 miles). Additionally, several 4- to 7-meter-wide (12- to 20-foot-wide), unpaved maintenance roads for power lines and pipelines parallel the proposed pipeline route for 113 km (70 miles).

Because a large portion (71%) of the analysis area contains critical habitat, the next section examines the entire CHU.

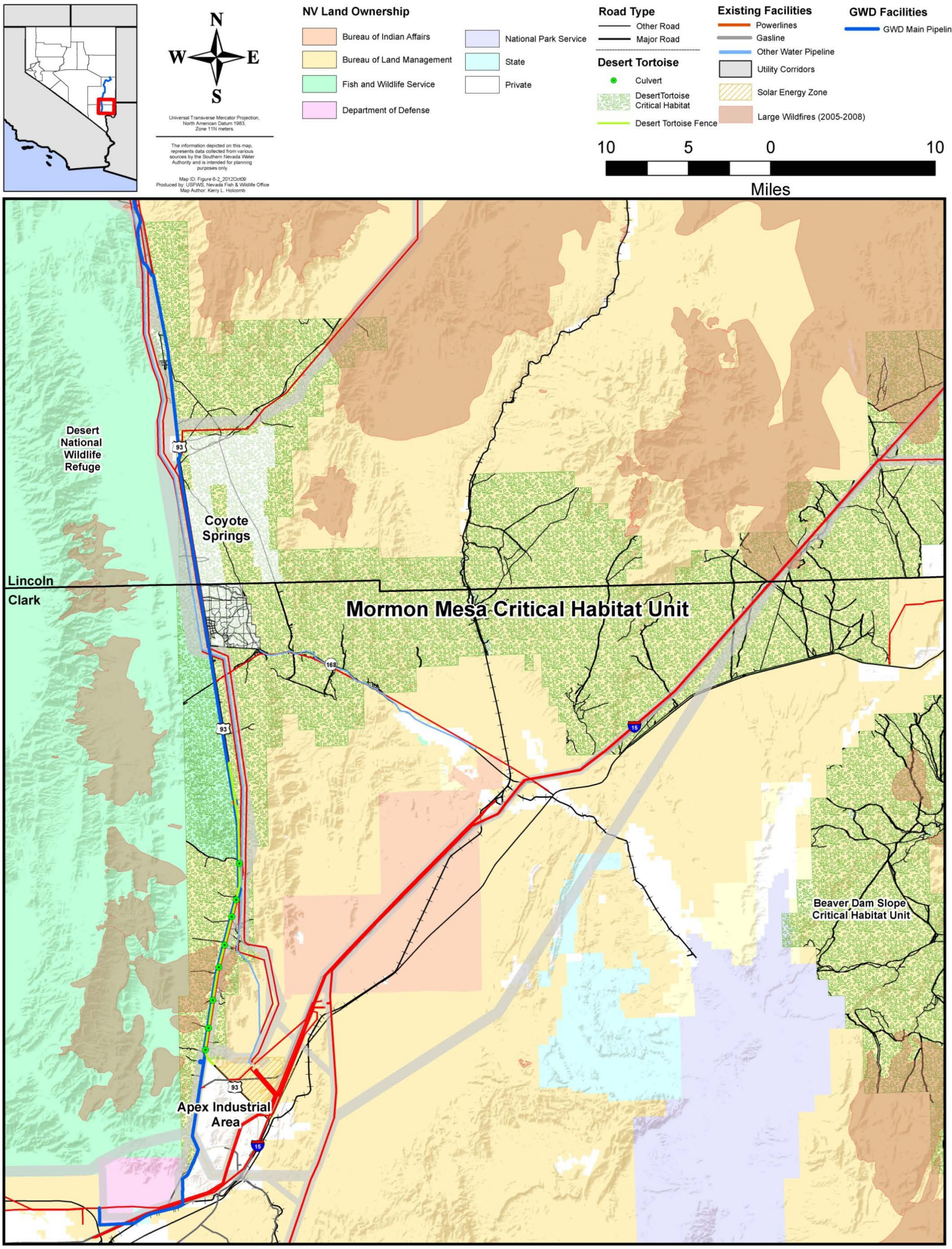


Figure 6-2. Status of the Mormon Mesa Critical Habitat Unit

6.2.6.1 *Status of the Desert Tortoise in the Mormon Mesa Critical Habitat Unit*

Our 5-year review discusses the various methods by which researchers have attempted to determine the abundance of desert tortoises; the review also examines the strengths and weaknesses of those methods (USFWS 2010b). At the local level, desert tortoises have been surveyed for since 1976. The survey data indicate appreciable declines in many local areas. When coupled with other survey results, the local declines suggest that declines may have occurred more broadly (USFWS 2010b).

The desert tortoise densities in the Mormon Mesa CHU fluctuate significantly (USFWS 2009b, 2010b, 2010c); however, much of the difference in densities from year to year is due to variability in sampling. Rangewide tortoise population monitoring began in 2001 and is conducted annually. Rangewide sampling is the most comprehensive study to detect long-term population trends (USFWS 2009b). However, data gathered by the current rangewide monitoring program cannot be reliably compared to information from previous surveys (USFWS 2010b), due to differences in the amount of area covered and the nonrepresentative nature of earlier sample sites. Density estimates from this brief period (i.e., 2001 to 2010) would be expected to detect only catastrophic declines or remarkable population increases, because desert tortoises are long-lived and reproduce slowly. Therefore, the short-term goal is not to document trends, but to gather information on baseline densities and on variability from year to year and recovery unit to recovery unit.

A population viability analysis and recommendations in the 1994 recovery plan (USFWS 1994a) suggest that the current estimated number of desert tortoises in the CHU is insufficient to maintain genetic diversity for long-term evolutionary potential and population viability within the CHU. According to the 1994 recommendations, for desert tortoises to maintain sufficient genetic diversity for long-term evolutionary potential and population viability within each CHU, the following conditions must be present: 3.8 tortoises per sq. km (10 tortoises per square mile) within reserves of 258,999 ha (640,000 acres) or larger, for a total population of at least 10,000 tortoises (USFWS 1994a). The current estimated density in the CHU is 4.5 adult and subadult tortoises per sq. km (11.8 tortoises per square mile) (USFWS 2010b) within a 151,263 ha (373,760 acres) CHU, for a total estimated population of 6,891 tortoises.

This total population estimate assumes desert tortoises are uniformly distributed throughout the CHU. However, desert tortoises are patchily distributed, and the true population is unknown. While we cannot calculate a precise number of desert tortoises within the CHU, we use a population estimate, which constitutes the best available information, for the analysis contained in this biological opinion.

Although our regulations require us to focus only within the CHU, the CHU is in fact connected to adjacent areas that functionally support a larger desert tortoise population. Although these adjacent areas are unprotected, they provide linkages between the CHU and other protected areas, such as ACECs, National Wildlife Refuges (NWRs), and Wilderness Areas. These linkages may help buffer genetic diversity of the desert tortoise population for long-term evolutionary potential and population viability within the Mormon Mesa CHU (USFWS 2012a). Preserving these broad linkages is essential in order to provide adequate long-term protection to the desert tortoise and increase our chances of maintaining viable populations versus a single reserve or an isolated reserve (USFWS 2012a).

6.2.6.2 Status of the Habitat in the Mormon Mesa Critical Habitat Unit

The CHU includes expansive bajadas (alluvial fans), which provide the best tortoise habitat. The CHU serves as an east-west corridor for movement of tortoises between Nevada, Utah, and Arizona (Hagerty et al. 2011) (see Figure 6-2).

Below are the specific PCEs of critical habitat and their status in the Mormon Mesa CHU.

1. **PCE: Sufficient space to support viable populations within the critical habitat unit, and to provide for movement, dispersal, and gene flow**

Status: The amount of space within the CHU is likely insufficient to support a long-term viable population of the desert tortoise. Reserves smaller than 258,999 ha (640,000 acres) may not provide sufficient buffering from demographic, stochastic, and limited genetic exchange (USFWS 1994a).

The area designated as the Mormon Mesa CHU is 33% smaller than the recommended size for a desert tortoise reserve (173,167 ha of 258,999 ha [427,900 acres of 640,000 acres]). Furthermore, only 95% of the designated area is suitable desert tortoise habitat (164,869 ha of 173,167 ha [407,041 acres of 427,900 acres]); elevations in the remaining 5% of the area do not match the most favorable elevations for desert tortoise habitat, which range from 305 to 914 meter (m) (1,000 to 3,000 feet) (USFWS 2010a). Within the suitable habitat in the CHU, 8% has been permanently disturbed by large-scale disturbances—such as mining pits, urban development, and roads—and is no longer suitable for desert tortoise (13,460 ha of 164,869 ha) (33,261 acres of 407,041 acres) (USFWS 2012b). Therefore, only 87% of the CHU provides space for the desert tortoise (151,263 ha of 173,167 ha [373,780 acres of 427,900 acres]), and the CHU is essentially only 58% of the recommended size (151,263 ha of 258,999 ha [373,780 acres of 640,000 acres]).

Although regulations require the Service to focus only within the CHU, the CHU is in fact part of a larger recovery unit and adjacent to other areas managed either directly or indirectly for desert tortoise conservation, including the Desert NWR, and the Beaver Dam Slope CHU (USFWS 2011) (see Figure 6-2). The Desert NWR and the Beaver Dam Slope CHU may help buffer the desert tortoise population in the Mormon Mesa CHU from stochastic events that could change population demographics and reduce genetic exchange.

The Desert NWR is located just west of U.S. 93 and is managed by the Service. The Desert NWR contains approximately 323,623 ha (799,691 acres) of desert tortoise habitat (USFWS 2012c). Critical habitat for the desert tortoise was not designated in the Desert NWR, because land management practices were determined to provide sufficient protection for the tortoise (USFWS 1994b). However, the Desert NWR is somewhat isolated due to a fenced highway (U.S. 93) that lies between the NWR and most of the Mormon Mesa CHU (see Figure 6-2). Running under the fenced 81-km (50-mile) portion of the highway are 8 culverts, spaced 1.6–3.6 km (1–2.25 miles) apart, which allow some level of genetic exchange. The Beaver Dam Slope CHU has 86,657 ha (204,250 acres) of desert tortoise habitat and is contiguous with the Mormon Mesa CHU (USFWS 2012c).

Habitat fragmentation resulting from infrastructure associated with urbanization (such as residential fencing, roads, and railroad tracks) can greatly inhibit desert tortoise movements and may genetically isolate populations (Latch et al. 2011; USFWS 2011). Several of the large-scale disturbances in the Mormon Mesa CHU are major linear projects. Approximately 941 km

(585 miles) of highways and paved roads, 120 km (75 miles) of vehicle trails, and 240 km (149 miles) of utility lines (and their associated maintenance roads) lie within the CHU (USFWS 2010a).

Latch et al. (2011) detected a low-level, but statistically significant, genetic differentiation between desert tortoises on different sides of an unpaved dirt road with low traffic volume (similar to bands of bare ground created by pipeline installation and maintenance roads) within 40 years (2 tortoise generations) after establishment of the road. Over time, genetic differentiation can create small genetically isolated populations (Latch et al. 2011), which are then more susceptible to extinction (Wilcox and Murphy 1985).

Some desert tortoise populations may already be starting to genetically differentiate due to some of these linear disturbances, especially U.S. 93. Even though 81 km (50 miles) of U.S. 93 has been fenced and provided with 8 underpasses (culverts) to alleviate this fragmentation, the culverts are spaced far apart (1.6 to 3.6 km [1 to 2.25 miles]), and we are unable to determine to what degree they are used. However, it is likely that the amount of genetic exchange is less than if the road and fence were not in place, and U.S. 93 may already be effectively isolating the portion of the CHU west of the highway, which totals approximately 14% of the CHU (21,842 ha of 151,263 ha [53,972 acres of 373,780 acres]) (USFWS 2012c).

2. **PCE: Sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species**

Status: This PCE addresses the ability of critical habitat to provide adequate nutrition to desert tortoises. During activity periods, desert tortoises eat a wide variety of herbaceous vegetation, particularly grasses and the flowers of native annual plants (USFWS 2010a).

Undisturbed areas provide forage and proper soil conditions for growth of forage for desert tortoises. However, few areas in the CHU are truly undisturbed. As discussed above, 13% of the designated CHU is not available to desert tortoises for forage (5% is not suitable desert tortoise habitat, and 8% has been lost from major disturbances). Another 3% of the suitable habitat in the CHU has been burned by wildfire (5,241 ha of 164,724 ha [12,951 ac of 407,041 ac]) (USFWS 2011), which has reduced vegetation by 16 percent in burned areas (USGS unpublished report available in the project record). The remaining lands have been subject to livestock grazing since the mid-1800s.

Grazing, historical fire, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stress of nutritional compromise. Poor grazing management prior to 1994 has reduced the quantity and diversity of forage species, compacts soil, and introduces/distributes weeds and invasive grasses that outcompete native species and provide fuel for wildfires (Avery 1998; USFWS 2011). Compacted soils have a lower infiltration rate, the capacity of the soil to absorb water. A lower infiltration rate means less water would be available for plants and more surface erosion may occur (Gifford and Hawkins 1978). Illegal OHV use (travel off established roads, trails, and dry washes [BLM 1998, 2008]) also compacts and redistributes soil, destroys live vegetation, and introduces/distributes weeds and invasive grasses. Because paved and unpaved roads are so widespread through critical habitat, we expect that this threat has, to some degree, compromised the conservation value and function of critical habitat throughout the range of the desert tortoise.

Other than anecdotal descriptions of “healthy” tortoises in several pre-project survey reports (Service File Nos. 84320-2008-F-0113 and 84320-2011-F-0024), we have no information on body growth trends of desert tortoises in the area.

3. PCE: Suitable substrates for burrowing, nesting, and overwintering

Status: Throughout most of the Mojave Desert, tortoises occur most commonly on gently sloping terrain with sandy-gravel soils and in areas featuring a sparse cover of low-growing shrubs (USFWS 2011). Soils must be friable (easily crumbled) enough for digging burrows, but firm enough so that burrows do not collapse (USFWS 2011).

Surface disturbance, OHV use, unpaved roads, grazing, historical fire, wildfire, altered hydrology, and climate change lead to shifts in habitat composition. Storms and flooding can alter substrates to the extent that they are no longer suitable for burrowing, nesting, and overwintering. Erosion caused by these activities can alter washes to the extent that desert tortoise burrows placed along the edge of a wash (a preferred location for burrows) could be destroyed.

OHV use has damaged some parts of the critical habitat to the extent that substrates are no longer suitable for desert tortoise activity. However, we expect that the area thus affected is relatively small in relation to the area that desert tortoises have available for burrowing, nesting, and overwintering. Consequently, we expect that OHV use does not have a substantial effect on this PCE.

Grazing can compact substrates to the extent that they become unsuitable for burrowing, nesting, and overwintering, but only in areas of concentrated use, such as around watering areas and corrals (Avery 1998). Soil conditions may also be degraded locally, particularly in areas of livestock concentration. Although grazing was removed in 59% of the CHU around 1998, impacts from grazing can remain 30 years after grazing has been discontinued (Avery 1998). Because a relatively small portion of the substrates are in areas of livestock concentration, we expect that suitable substrates for burrowing, nesting, and overwintering remain throughout most of the CHU.

4. PCE: Burrows, caliche caves, and other shelter sites

Status: Desert tortoises are well adapted to living in a highly variable and often harsh desert environment. They spend much of their lives in burrows, even during their seasons of activity. During the winter, tortoises will opportunistically use burrows of various lengths, deep caves, rock and caliche crevices, or overhangs for cover (USFWS 2011). We expect that human-caused effects to burrows, caliche caves, and other shelter sites likely occur at a similar rate as effects to substrates for burrowing, nesting, and overwintering, for the same general reasons described in the section above. Consequently, we expect that sufficient burrows, caliche caves, and other shelter sites remain throughout most of the CHU.

5. PCE: Sufficient vegetation for shelter from temperature extremes and predators

Status: Undisturbed areas provide vegetation that gives desert tortoises shelter from temperature extremes and visual cover for protection against predators. In areas where large fires have occurred in critical habitat, many of the shrubs that provide shelter from temperature extremes and predators have been destroyed; in such areas, cover sites may be a limiting factor.

The proliferation of invasive plants poses a threat to shrub cover throughout critical habitat as the potential for larger wildfires increases. The remaining vegetation in the CHU is of less quantity, less density, and less species diversity than what would occur if the habitat was in an undisturbed condition. Although 13% of the CHU is not available to desert tortoises for shelter and another 3% was burned during wildfires in 2005 and 2006 (USFWS 2010a), we cannot quantify precisely the extent to which these disturbances disrupt the function and value of the CHU, because of the patchiness of tortoise distribution across the CHU. However, the forage in the Mormon Mesa CHU is currently degraded, so the vegetation used for shelter is likely also degraded.

Desert tortoises that cross or attempt to cross bare areas, particularly near power lines (perch sites), are highly visible to predators. The common raven preys upon desert tortoises, especially hatchlings and juveniles along power lines. The steel towers associated with many electrical energy transmission corridors provide nest sites and hunting perches for ravens. Common raven populations have increased 1,500% from 1968 to 1988 in response to expanding human use of the desert (Boarman 2002). Since ravens were scarce in the Mojave Desert prior to 1940, the current level of raven predation on juvenile desert tortoises is considered to be a threat to desert tortoises (BLM 1990; USFWS 2011).

6. **PCE: Habitat protected from disturbance and human-caused mortality**

Status: In general, the federal agencies that manage lands within the boundaries of critical habitat have adopted land management plans that include implementation of some or all of the recommendations contained in the original recovery plan for the desert tortoise. To at least some degree, the adoption of these plans has resulted in the implementation of management actions that are likely to reduce the disturbance and human-caused mortality of desert tortoises. For example, the BLM designated approximately 90% of the CHU as ACECs for the conservation of desert tortoise (BLM 1998, 2008). This designation protects the land from being transferred to private ownership and subsequent development; it also prohibits large site-type ROWs (e.g., solar power plants), mining, livestock grazing, and high-speed OHV racing in the designated area.

Despite the implementation of these actions, disturbance and human-caused mortality continue to occur throughout the CHU to the extent that the conservation value and function of critical habitat is compromised. Ongoing BLM-permitted activities—such as sand-and-gravel mining adjacent to county roads and long linear utility projects with roads—continue to remove and degrade habitat for desert tortoises in the ACECs. Grazing also continues in 41% of the CHU (USFWS 2010a). Additionally, 151 designated utility corridors totaling 151 km (94 miles) in length and 1,067 m (3,500 feet) in width comprise 11% of the CHU (16,138 ha of 151,263 ha [39,878 acres of 373,780 acres]) (BLM 1998, 2008, 2009). The BLM encourages long linear projects to be located in these designated corridors; thus these corridors have little protection from disturbance.

6.3 EFFECTS OF THE PROPOSED ACTION

6.3.1 *Desert Tortoise and Its Recovery*

Although desert tortoises have a patchy distribution and localized areas may have higher densities, the estimated density in the analysis area is 42% higher than the average rest of the

Northeastern Mojave Recovery Unit. This population density indicates the analysis area is important to the rangewide population of the desert tortoise. Although impacts would be lessened through implementation of minimization measures, not all impacts would be eliminated (see Table 6-2).

The following measures are expected to minimize the the impacts listed in Table 6-2: 1) restrict activities during the more active season for desert tortoises (generally March 1 to October 31); 2) provide an environmental awareness program to construction personnel; 3) have biological monitors on-site during construction; 4) conduct clearance surveys for desert tortoise prior to construction activity; 5) install temporary desert tortoise exclusion fencing to enclose active pipeline, staging area, and facility site construction areas; and 6) enforce a speed limit of 40 kph (25 mph) within the project area. Additionally, the BLM would require the SNWA to pay remuneration fees to offset residual impacts.

<u>Remuneration fees</u>—Remuneration fees would be used for management actions expected to promote recovery of the desert tortoise over time, including management and recovery of desert tortoise in Nevada. Actions may involve acquiring habitat, enhancing population or habitat, conducting increasing knowledge of the species' biological requirements, reducing loss of individual animals, documenting the species' status and trend, and preserving distinct population attributes. Fees would be used to fund the highest priority recovery actions for desert tortoises in Nevada.

<u>Habitat disturbance</u>—Studies suggest that differences in the magnitude of the threat to desert tortoises are related to the scale of the project, the ability of crews to avoid disturbing burrows, and the timing of construction (Boarman 2002). The proposed project is expected to result in permanent disturbance of 957 ha (2,364 acres) of desert tortoise habitat over a 4-year period.

Table 6-2. Impacts to the desert tortoise and Applicant-Committed Measures and BLM measures to minimize these impacts

Impact		Restrict Activities during the Desert Tortoise Active Season (March to October)	Conduct Environmental Awareness Training	Employ Biological Monitors	Conduct Clearance Surveys	Handle Desert Tortoises using Service Protocols	Restrict Construction Vehicles to Designated Areas	Install Temporary Desert Tortoise Exclusion Fence around Work Areas	Enforce a 25-mph Speed Limit	Require Personnel to Check Underneath Vehicles Prior to Moving Them	Pay Remuneration Fees to Promote Recovery	Use Noise Control Devices (mufflers, etc.)	Avoid Throttling and Idling Engines	Conduct Proper Vehicle Maintenance	Restrict Personnel from Bringing Pets On-Site	Install Perch-Discouraging Devices on Tall Structures	Develop and Implement a Hydrostatic Discharge Plan	Develop and Implement a Blasting Plan	Develop and Implement a Litter Control Plan	Develop and Implement a Fire Management Plan	Develop and Implement a Weed Management Plan	Develop and Implement an Erosion Control Plan	Develop and Implement a Travel Management Plan	Develop and Implement a Restoration Plan
Desert Tortoise	Crushing	X	X	X	X		X	X	X	X													X	
	Suffocation from Entrapment	X	X	X	X	X	X	X									X	X				X		
	Stress from Noise	X	X		X		X	X	X			X	X					X					X	
	Predation from Coyotes, Ravens, Collection, and Pets	X	X	X	X	X									X	X\			X					
	Dehydration from Voiding Bladder	X	X	X	X	X																		
	Drowning from Hydrostatic Water	X	X		X												X							
	Choking on Trash	X	X		X														X					

Vehicles—The greatest potential threats for incidental take of desert tortoises from the proposed action are construction vehicles driving over and crushing desert tortoises and desert tortoise entrapment in trenches. Incidental death and injury of desert tortoises could result from crushing during excavation activities such as clearing, grubbing of vegetation, and trenching activities; entrapment in open trenches and pipes; and crushing by vehicles or heavy equipment (including instances when individuals take shelter under parked vehicles and are then killed or injured when vehicles are moved). Tortoises could be incidentally killed or injured by motor vehicles outside the project area, including vehicles driven by workers commuting to and from the project area. Any tortoise on an access road during project hours would be highly vulnerable. Project equipment or vehicles that stray from designated areas or widen existing access roads may incidentally crush desert tortoises (aboveground or in their burrows) and damage habitat outside the project area. Tortoises that wander into the construction work area and are not located before project activities commence could be incidentally killed or injured. Additional committed measures by the applicant to keep all construction vehicles within the project area and check under vehicles prior to moving them are expected to minimize these effects.

Noise—Noise during construction activities could temporarily disturb desert tortoises near construction areas. Desert tortoises are known to come out of their burrows when the roof and entrance of their burrows are tapped (Medica et al. 1986). Brattstrom and Bondello (1983) demonstrated that OHV use in the Mojave Desert caused noise levels that resulted in hearing loss in animals such as kangaroo rats, desert iguanas, and fringe-toed lizards; interfered with the ability of kangaroo rats to detect predators such as rattlesnakes; and caused unnatural emergence of spadefoot toads that were estivating, a potentially fatal disruption for the individuals involved. The 1994 recovery plan cited noise and vibration as having potentially significant effects on the desert tortoise's behavior, communication, and hearing apparatus. Very limited additional data have been obtained specific to this potential. To minimize these effects, the applicant would implement additional committed measures; specifically, the applicant would 1) ensure all equipment is equipped with manufacturer's standard noise control devices (e.g., mufflers, acoustical lagging, and/or engine enclosures); 2) not throttle engines excessively and keep engine speed as low as possible; and 3) not leave equipment running or idling needlessly.

Predation/collection—Project personnel could illegally collect tortoises (intending to keep or sell them as pets) or bring dogs to the project area. The additional committed measure by the applicant to restrict construction personnel from bringing pets to the project area are expected to minimize these effects.

Litter and predation—Project activities may produce food-related trash and litter that attracts tortoise predators such as ravens, kit foxes, and coyotes (BLM 1990; Boarman and Berry 1995). Natural predation in undisturbed, healthy ecosystems is generally not an issue of concern. However, predation rates may be altered when natural habitats are disturbed or modified. Ravens use power poles and other tall structures as nest sites; their presence threatens small tortoises in the area surrounding the nest site (Boarman 2002). The majority of raven predation occurs during the spring and is most likely accomplished by breeding birds (Boarman 2002). Raven populations in some areas of the Mojave Desert have increased 1,500% from 1968 to 1988 in response to expanding human use of the desert (Boarman 1992). Since ravens were scarce in this area prior to 1940, the current level of raven predation on juvenile desert tortoises is considered an unnatural occurrence (BLM 1990). To minimize litter and predation effects, the applicant would implement additional committed measures; specifically, the applicant would 1) dispose of food-related trash in predator-proof containers; 2) install perch-discouraging devices on power poles; and 3) monitor nesting of ravens.

Tortoises may ingest some forms of trash or become entangled in trash or litter; either situation can result in their injury or death. The additional committed measure by the applicant to dispose of trash in predator-proof containers would minimize these effects.

Capture and relocation—Tortoises that are physically moved out of project areas to prevent mortality or injury could be inadvertently harmed if not handled properly. The tortoises' large urine bladder enables them to consume large quantities of free water when available and to use that water to maintain hydration during periods when free water or succulent plants are not available. Urine and large amounts of urates may be voided during handling and may represent a severe water loss, particularly to juveniles (Averill-Murray 2002). Overheating can occur if tortoises are not placed in the shade when ambient temperatures equal or exceed temperature maximums for the species (USFWS 2010b). The additional committed measures by the applicant to handle desert tortoises using the most current Service-approved guidance would minimize these effects.

Blasting—The use of blasting may result in take of desert tortoises through noise and ground vibration. Open excavations may result in tortoise falls and entrapment. The additional committed measure by the applicant to develop and implement a blasting plan would minimize these effects.

Hydrostatic testing—Discharge of hydrostatic test water during construction could potentially flood desert tortoise burrows. It could also create a water source that may result in further spread of weeds and nonnative grasses. The additional committed measure by the applicant to develop and implement a hydrostatic discharge plan and weed management plan would minimize these effects.

Conclusion

The Service reviewed the best currently available information, including reported take for biological opinions issued in the action area (see *Environmental Baseline*) and biological opinions issued for similar types of actions (power lines and pipelines). We adjusted the densities of desert tortoises in their action areas to be comparable to densities observed along the GWD Project action area. We also adjusted for the acreage of direct disturbance and the time of year. These modifications allowed us to more accurately estimate take for the GWD Project. This is the best currently available information.

LS Power and NV Energy are currently constructing the SWIP South power line project. This ROW parallels the GWD Project ROW (File No. 84320-2008-F-0066), and desert tortoise densities are comparable to those in the GWD Project action area (4.5 desert tortoises per sq. km (11.8 desert tortoises per square mile). Construction started in 2011. As of October 2012, 276 ha (676 acres) had been disturbed (NV Energy 2012). No desert tortoises had been killed, and 25 had been moved from harm's way (NV Energy 2012).

Kern River Gas Transmission Company constructed a 91 centimeter (cm) (36-inch) gas pipeline along 188 km (117 miles) of desert tortoise habitat from Las Vegas to Wyoming (File No. 1-1-87-F-36R). About 30% of the pipeline occurs in the Mormon Mesa CHU, in desert tortoise habitat. Construction started in 1991 and was completed several years later. The Service did not have reliable protocols for estimating densities of desert tortoise along the pipeline ROW at that time, but the best information estimates densities of about 76 desert tortoises per square mile (File No. 6-UT-09-F-023). As of October 2011, 526 ha (1,300 acre) of desert tortoise habitat had been disturbed, 24 desert tortoises had been killed, and 253 desert tortoises had been moved from harm's way (USFWS 2012d). Most of the mortalities and incidental movement of desert tortoises occurred during the active season (April to October). Only 1 of the desert tortoises was killed from maintenance activities, in June 2011 (File No. 1-5-02-F-476).

Kern River constructed a second 36-inch gas pipeline along the same ROW in 2003 (File No. 1-5-02-F-476). The desert tortoise densities were the same as those estimated for the Kern River pipeline described above (76 desert tortoises per square miles). As of June 2011, 1,524 ha (3,765 acres) of desert tortoise habitat had been disturbed, 1 desert tortoise had been killed, and 840 desert tortoises had been moved from harm's way (USFWS 2012d). Kern River constructed the pipeline during the desert tortoises' less-active season, which is the main reason fewer desert tortoises were killed than in the first Kern River project.

UNEV constructed a 36-inch gas pipeline in 2011, along the same ROW as the Kern River gas pipelines (File No. 6-UT-09-F-023R4). The desert tortoise densities were estimated to be the same as those for the other Kern River projects (76 desert tortoises per square miles). Construction in Nevada began in 2011. As of September 2011, 295 ha (731 acres) of desert tortoise habitat had been disturbed, 5 desert tortoises had been killed, and 87 desert tortoises had been moved from harm's way. All of these desert tortoises were encountered during the desert tortoise active season (File No. 6-UT-09-F-023R5).

Using this information to assess the entire project footprint (including BLM-administered, private, and state land), the Service estimates that no more than 7 adult and subadult and 31 juvenile and hatchling desert tortoises will be killed or injured; no more than 122 adult and subadult and all juvenile and hatchling desert tortoises will be taken through harassment via capture and relocation; and no more than 1,885 adult and subadult desert tortoises will be affected through loss of forage or shelter and movement. For eggs, we use the size of disturbance as a surrogate for desert tortoise eggs. This estimate is based on pre-project survey data and data gathered from previous actions within the action area (see *Status of the Desert Tortoise in Analysis Area*).

6.3.2 *Effects to the Habitat of the Mormon Mesa Critical Habitat Unit*

The critical habitat analysis for this project will review its impacts on several levels, each going to higher levels if effects are likely substantial at lower levels. First, we analyze the impacts for the project area within the CHU; then, as necessary, we consider the entire CHU. Each CHU has a specific function and role both locally and rangewide, and the loss of a single unit may significantly reduce the ability of critical habitat to contribute to the recovery of the species (USFWS 1994a). Then, if the impacts to the individual CHU are substantial, we analyze the impacts to the subset of CHUs that are within the recovery unit in which the affected CHU resides. Then, we analyze the impacts to the entire recovery unit, and finally rangewide if necessary. Because a large portion (71%) of the analysis area contains critical habitat, we are examining the entire Mormon Mesa CHU.

The evaluation of actions that may affect critical habitat for desert tortoise must consider the effects the actions have on habitat PCEs. The PCEs of desert tortoise critical habitat include l) sufficient space to support viable populations within each recovery unit and to provide for movement, dispersal, and gene flow; 2) sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species; 3) suitable substrates for burrowing, nesting, and overwintering; 4) burrows, caliche caves, and other shelter sites; 5) sufficient vegetation for shelter from temperature extremes and predators; and 6) habitat protected from disturbance and human-caused mortality (see Table 6-3).

The Service currently refers to any surface disturbance that will not return to preconstruction condition within 10 years as permanent disturbance (Hastey et al.1991). Natural recovery of vegetation in the desert can take decades or longer (Abella 2010), so active revegetation using human intervention is necessary to quickly return disturbed areas to pre-project conditions (Abella et al. 2007). Based on a review of 47 studies evaluating postdisturbance plant recovery and success in the Mojave and Sonoran deserts, Abella (2010) found that reestablishment of perennial shrub cover (to amounts found on undisturbed areas) generally occurred within 100 years but no sooner than 40 years. Webb (2002) determined that absent active restoration, soils in the Mojave Desert could take between 92 and 124 years to recover. Other studies have shown that recovery of plant cover and biomass in the Mojave Desert could require 50–300 years in the absence of restoration efforts (Lovich and Bainbridge 1999).

1. PCE: Sufficient space to support viable populations within each critical habitat unit, and to provide for movement, dispersal, and gene flow

As discussed in the *Status of the Habitat in the Mormon Mesa Critical Habitat Unit* section, the current amount of space within the Mormon Mesa CHU is likely insufficient to support a viable population of desert tortoises, but adjacent linkage and conservation areas buffer the population. Additionally, U.S. 93 effectively isolates the western 9.7 km (6 miles) (14%) of the CHU. This project would remove an additional 713 ha (1,761 acres) adjacent to U.S. 93, representing 0.5% of the CHU that is available to desert tortoises (713 ha of 151,263 ha [1,761 acres of 373,780 acres]). The relatively small amount of acreage involved and its location near an existing barrier mean that this loss will not have an appreciable impact to the function of the CHU.

To minimize project effects, the applicant would implement certain committed measures; specifically, the applicant would 1) develop and implement a restoration plan; 2) keep all construction vehicles within the project area; and 3) drive over vegetation within the ROW rather than removing it by blading. Additionally, the BLM would require the SNWA to coordinate with the Service and NDOW on restoration activities and pay remuneration fees.

Table 6-3. Impacts to desert tortoise critical habitat and Applicant-Committed Measures and BLM measures to minimize the impacts

Impacts		Restrict Activities during the Desert Tortoise Active Season (March to October)	Conduct Environmental Awareness Training	Employ Biological Monitors	Conduct Clearance Surveys	Handle Desert Tortoises Using Service Protocols	Restrict Construction Vehicles to Designated Areas	Drive Over Vegetation within the ROW Rather Than Blading	Install Temporary Desert Tortoise Exclusion Fence around Work Areas	Enforce a 25-mph Speed Limit	Require Personnel to Check underneath Vehicles prior to Moving Them	Suspend Construction Activities During High Winds	Pay Remuneration Fees to Promote Recovery	Use Noise Control Devices (mufflers, etc.)	Avoid Throttling and Idling Engines	Conduct Proper Vehicle Maintenance	Restrict Personnel from Bringing Pets On-Site	Install Perch- Discouraging Devices on Tall Structures	Develop and Implement a Hydrostatic Discharge Plan	Develop and Implement a Blasting Plan	Develop and Implement a Litter Control Plan	Develop and Implement a Fire Management Plan	Develop and Implement a Weed Management Plan	Develop and Implement an Erosion Control Plan	Develop and Implement a Travel Management Plan	Develop and Implement a Restoration Plan
Desert Tortoise Critical Habitat	Removing Habitat Space		X				X	X					X											X		X
	Preventing Movement and Gene Flow		X				X	X					X					X				X	X	X	X	X
	Removing Forage		X				X	X				X	X			X			X			X	X	X	X	X
	Altering Soil Conditions Such That Forage Won’t Grow		X				X	X				X	X			X			X			X		X	X	X
	Removing Burrow and Shelter Sites		X				X	X					X						X					X	X	X
	Removing Vegetation Used for Shelter and Cover		X				X	X				X	X			X			X			X	X	X	X	X
	Endangering Habitat from Human-caused Mortality		X				X	X				X	X									X			X	X

Remuneration fees would be used for management actions expected to promote recovery of the desert tortoise over time, including management and recovery of desert tortoise in Nevada. Actions may involve habitat acquisition, population or habitat enhancement, research to increase knowledge of the species' biological requirements, reducing loss of individual animals, documenting the species' status and trend, and preserving distinct population attributes. Fees would be used to fund the highest-priority recovery actions for desert tortoises in Nevada.

2. **PCE: Sufficient quality and quantity of forage species and the proper soil conditions to provide for the growth of these species**

As discussed in *Status of the Habitat in the Mormon Mesa Critical Habitat Unit*, the forage in the Mormon Mesa CHU is degraded. This project would remove forage for desert tortoises through construction of access routes for project vehicles and equipment, work sites, pipeline trench, spoil pile, power pole pads, and wire pulling and tensioning sites. Also, removing forage would provide a corridor for dispersal (Craig et al. 2010); illegal OHV use may increase due to new materials could be spilled poisoning vegetation and sterilizing soil; dust generated by construction activities could impair plant photosynthesis and reduce the quantity and quality of forage for desert tortoises; welding may be an ignition source for wildfires, which burn vegetation and potentially sterilize the soil; earthmoving equipment and repeated operations on unvegetated maintenance roads may increase the spread of invasive weeds and nonnative grasses. Invasive weeds outcompete forage vegetation and reduce its quantity (Brooks 2000). The project would directly remove an additional 713 ha (1,761acres) of forage adjacent to U.S. 93, representing 0.5% of the CHU that is available to desert tortoises (713 ha of 151,263 ha) (1,761 acres of 373,780 acres). The relatively small amount of acreage involved and its location near an existing barrier mean that this loss will not have an appreciable impact to the function of the CHU.

To minimize these effects, the applicant would implement additional committed measures; specifically, the applicant would 1) provide an environmental awareness program to construction and maintenance personnel; 2) develop and implement weed, fire, and dust management plans; fuel spill prevention, control, and countermeasure plans; and a restoration plan; 3) keep all construction vehicles within the project area; 4) conduct proper vehicle maintenance; 5) use a Service-approved dust suppressant; and 6) suspend construction activities during high winds. Additionally, the BLM would require SNWA to coordinate with the Service and NDOW on restoration activities and pay remuneration fees.

3. **PCE: Suitable substrates for burrowing, nesting, and overwintering**

As discussed in *Status of the Habitat in the Mormon Mesa Critical Habitat Unit*, suitable substrates for burrowing, nesting, and overwintering are expected to remain throughout most of the CHU. The proposed project would disturb substrates through construction of access routes for project vehicles and equipment, work sites, pipeline trench, spoil pile, power pole pads, and wire pulling and tensioning sites. Most of these soils would not return to preconstruction condition. The project would directly disturb an additional 713 ha (1,761 acres) of substrate adjacent to U.S. 93, representing 0.5% of the CHU that is available to desert tortoises (713 ha of 151,263 ha) (1,761 acres of 373,780 acres). The relatively small amount of acreage involved and its location near an existing barrier mean that this loss will not have an appreciable impact to the function of the CHU.

Committed measures by the applicant to develop and implement a restoration plan and keep all construction vehicles within the project area are expected to minimize these effects. Additionally, the BLM would require the SNWA to coordinate with the Service and NDOW on restoration activities and pay remuneration fees.

4. PCE: Burrows, caliche caves, and other shelter sites

As discussed in *Status of the Habitat in the Mormon Mesa Critical Habitat Unit*, sufficient burrows, caliche caves, and other shelter sites are expected to remain throughout most of the CHU. The proposed project could destroy burrows that desert tortoises use for shelter and nesting through construction of access routes for project vehicles and equipment, work sites, pipeline trench, spoil pile, power pole pads, and wire pulling and tensioning sites. The project would directly disturb an additional 713 ha (1,761 acres) of substrate adjacent to U.S. 93, representing 0.5% of the CHU that is available to desert tortoises (713 ha of 151,263 ha) (1,761 acres of 373,780 acres). However, caliche caves and other shelter sites, such as rock overhangs, may not be as susceptible to crushing as burrows are; this advantage is due to their typical, relatively protected locations in incised washes and steeper slopes, Where wheeled or tracked vehicles drive over the banks of washes, however, caliche caves and other shelter sites may collapse. Because of the relatively small amount of acreage involved and its location near an existing barrier, impacts to burrows, caliche caves, and other shelter sites are not likely to have an appreciable impact to the function of the CHU.

Committed measures by the applicant to develop and implement a restoration plan and keep all construction vehicles within the project area are expected to minimize these effects. Additionally, the BLM would require the SNWA to coordinate with the Service and NDOW on restoration activities and pay remuneration fees.

5. PCE: Sufficient vegetation for shelter from temperature extremes and predators

As discussed in *Status of the Habitat in the Mormon Mesa Critical Habitat Unit*_vi._Status_of_1, the vegetation in the Mormon Mesa CHU is degraded. The proposed project would remove vegetation through construction of access routes for project vehicles and equipment, work sites, pipeline trench, spoil pile, power pole pads, and wire pulling and tensioning sites. The project would directly disturb an additional 713 ha (1,761 acres) of substrate adjacent to U.S. 93, representing 0.5% of the CHU that is available to desert tortoises (713 ha of 151,263 ha) (1,761 acres of 373,780 acres). Removing vegetation and compacting soil eliminates shelter for desert tortoises and reduces the ability of plants to grow (Perkins 2004). Because of the relatively small amount of acreage involved and its location near an existing barrier, removal of this forage is not likely to have an appreciable impact to the function of the CHU.

Intensive active restoration would be required to return disturbed habitat to its preconstruction condition (Abella 2010). To minimize project effects, the applicant would implement additional committed measures; specifically, the applicant would 1) develop and implement weed, fire, and dust management plans; fuel spill prevention, control, and countermeasure plans; and a restoration plan; 2) keep all construction vehicles within the project area; and 3) conduct proper vehicle maintenance. Additionally, the BLM would require the SNWA to coordinate with the Service and NDOW on restoration activities and pay remuneration fees. The BLM would also require green stripping of revegetation to mitigate risk of fire.

6. **PCE: Habitat protected from disturbance and human-caused mortality**

As discussed in *Status of the Habitat in the Analysis Area*, the conservation value and function of critical habitat is, to some degree, compromised from ongoing activities and the designated utility corridors. After construction of the proposed project, the public may use project access roads, which could result in adverse effects to tortoise populations. This project would introduce approximately 113 km (70 miles) of new access routes in the CHU.

To minimize these effects, the applicant would implement committed measures; specifically, the applicant would 1) develop and implement a restoration plan; 2) keep all construction vehicles within the project area; and 3) control unauthorized access to the area.

Conclusion

The project would directly impact 0.5% of the CHU adjacent to U.S. 93. Considering the acreage involved and its location, we do not expect this impact to substantially impact the PCEs of the CHU. Therefore, potential impacts at higher levels (the subset of CHUs within the Northeast Mojave Recovery Unit, the entire recovery unit, and rangewide) do not require analysis.

6.3.3 *Cumulative Effects*

Cumulative effects are those effects of future nonfederal (State, local government, or private) activities that are reasonably certain to occur in the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Endangered Species Act (Act).

We are not aware of any future nonfederal actions within the analysis area.

Global climate change and drought are potentially important long-term considerations with respect to recovery of the desert tortoise. While little is known regarding specific direct effects of climate change on the desert tortoise or its habitat, predictions can be made about how global and regional precipitation regimes may be altered and about the consequences of these changes. Global climate change models project that precipitation will decrease in the southwestern United States (IPCC 2007).

Generally, predictions for the geographic range of the desert tortoise's listed population suggest an increase of 3.5 to 4.0 degrees Celsius (°C) (6.3 to 7.2 degrees Fahrenheit [°F]) in annual mean temperature (Christensen et al. 2007). Precipitation will likely decrease by 5%–15% annually within the range of the desert tortoise, with winter precipitation decreasing up to 20% (Christensen et al. 2007). Site-specific models project temperatures in southern Nevada will increase as much as 2 °C (5 °F) by the 2050s (TNC 2012).

Barrows (2011) concluded that a temperature increase of 2 °C (5 °F) near Joshua Tree National Park would result in a 66% decrease of suitable habitat for desert tortoises in that area. The high temperatures and extended droughts that characterize habitat for desert reptiles may already approach their physiological tolerances; therefore, climate change (increasing temperatures) could put them at risk.

Because germination of the desert tortoise's food plants is highly dependent on cool-season rains, the forage base could be reduced due to increasing temperatures and decreasing precipitation in winter. Although drought occurs fairly routinely in the Mojave Desert, extended periods of drought have the potential to affect desert tortoises and their habitats through physiological effects to individuals (*i.e.*, stress) and limited forage availability. To place the consequences of long-term drought in perspective, Longshore et al. (2003) demonstrated that even short-term drought can result in elevated levels of mortality of desert tortoises; therefore, long-term drought is likely to have even further reaching effects, particularly given that the current fragmented nature of desert tortoise habitat (*e.g.*, urban and agricultural development, highways, freeways, military training areas) will make recolonization of extirpated areas difficult, if not impossible

Other activities that may impact the desert tortoise include nonmotorized recreation such as camping, hunting, target shooting, rock collecting, hiking, horseback riding, biking, and sightseeing. Another potential threat facing the desert tortoise is the unauthorized release or escape of pet tortoises to the wild. Captive releases have the potential to introduce disease into wild populations of desert tortoises (USFWS 2011).

6.4 JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Based on the best available information regarding the entire project footprint (including BLM-administered, private, and state land), the Service estimates that no more than 7 adult and subadult and 31 juvenile and hatchling desert tortoises will be killed or injured; no more than 122 adult and subadult and all juvenile and hatchling desert tortoises will be taken through harassment via capture and relocation; and no more than 1,885 adult and subadult desert tortoises will be affected through loss of forage or shelter and movement. For eggs, we use the size of disturbance as a surrogate for desert tortoise eggs.

The project will directly remove an additional 0.5% of the habitat in the CHU adjacent to an effectively isolated area along the portion of the CHU west of U.S. 93. The amount of acreage involved and its location near an existing barrier (a fenced U.S. highway) mean that removal of this habitat is not likely to cause an appreciable amount of habitat loss in the CHU.

After reviewing the effects of the proposed project, and the cumulative effects, against the current status of the desert tortoise, its critical habitat, and the environmental baseline for the analysis area, it is the Service’s biological opinion that the project, as proposed and analyzed, is not likely to jeopardize the continued existence of the threatened Mojave desert tortoise and is not likely to adversely modify its critical habitat. These conclusions are based on the following assumptions:

- The SNWA and their contractors will implement all the applicant-committed measures, as modified by the BLM, and the terms and conditions of the BLM ROW grant, including those in the Ely RMP (BLM 2008).
- Surface-disturbing activities will be restricted, as appropriate, during the desert tortoise active season (typically March 1 to October 31).
- Intense clearance surveys for desert tortoise will locate all adult and subadult desert tortoises within the areas to be disturbed.
- For desert tortoises not located during clearance surveys, a qualified biologist will be on-site and will halt nonemergency construction activities for a desert tortoise in harm’s

way, and activities that are not in compliance with the applicant-committed environmental protection measures.

- Desert tortoises that are moved out of harm's way and placed within their home range will remain in the wild with no long-term effects to survival and reproduction.
- Perch-discouraging devices installed on new power lines will decrease the risk of predation to desert tortoises from raptors and ravens.
- The proposed action will 1) not kill or injure more than 7 adult and subadult and 31 juvenile and hatchling desert tortoises;2) harass no more than 122 adult and subadult and all juvenile and hatchling via capture and relocation; 3) affect no more than 1,885 adult and subadult desert tortoises through loss of forage or shelter and movement; and 4) this number, based on the best currently available information, will not result in a level of take of desert tortoises that would significantly affect the rangewide number, distribution, or reproduction of the species.
- Juvenile and hatchling desert tortoise and desert tortoise egg have a lower conservation value than sub-adult and adult desert tortoises because younger age classes have a naturally high mortality rate (up to 99 percent) and do not reproduce until sexual maturity (15 to 20 years old) (USFWS 1994a).
- The proposed project will not result in permanent loss of more than 952 ha (2,352 acres) of desert tortoise habitat, of which no more than 713 ha (1,761 acres) will be desert tortoise critical habitat.

6.5 INCIDENTAL TAKE STATEMENT

Section 9 of the Act, as amended, prohibits take (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. "Harm" is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering (50 CFR § 17.3). "Harass" is defined as an action that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR § 17.3). Incidental take is any take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant. Under the terms of sections 7(b)(4) and 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the Terms and Conditions of this incidental take statement.

The BLM and other jurisdictional federal agencies as appropriate have a continuing duty to regulate the activity that is covered by this incidental take statement. If the BLM and other jurisdictional federal agencies as appropriate fail to adhere to the Terms and Conditions of the Incidental Take Statement through enforceable terms that are added to permits or grant documents, and/or fail to retain oversight to ensure compliance with these Terms and Conditions, the protective coverage of section 7(o)(2) will lapse.

6.5.1 *Amount or Extent of Take Exempted*

Considering the analysis of effects provided above and anticipated project duration, the Service anticipates that the take shown in Table 6-4 could occur from the proposed action on BLM-administered lands.

Table 6-4. Amount or extent of take exempted

Activity	**Exempted Mortality, Injury, and Destruction**			**Exempted Harassment: Capture and Removal**			**Anticipated Habitat Loss (acres)**	
	Adults/ Subadults	**Juveniles/ Hatchlings**	**Eggs**	**Adults/ Subadults**	**Juveniles/ Hatchlings**	**Eggs**	**Critical**	**Noncritical**
Construction	5	31	See Habitat Loss	122	Unknown		1,721	549
Operation and Maintenance	2	Unknown		All in Harm's Way				
Predation	Unknown			0	Unknown			

Should any desert tortoise be killed or injured in association with the proposed action, the desert tortoise shall be handled in accordance with the Terms and Conditions and the appropriate reporting requirements outlined in this biological opinion.

6.5.2 *Effect of Take and Recovery of Desert Tortoise*

In this Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy or adversely modify desert tortoise critical habitat. These determinations are based in part on the implementation of minimization measures proposed by the applicant and the BLM.

6.5.3 *Reasonable and Prudent Measures with Terms and Conditions*

The Reasonable and Prudent Measures (RPMs) are intended to clarify or supplement the protective measures that were proposed by the BLM as part of the proposed action. The RPMs, with their implementing Terms and Conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is reached or exceeded, such incidental take represents new information, requiring reinitiation of consultation and review of the RPMs provided. The BLM and SNWA must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the RPMs.

The Terms and Conditions may include 1) restating measures committed by the applicant and proposed by the BLM; 2) modifying the measures proposed; or 3) specifying additional measures considered necessary by the Service. Where these Terms and Conditions vary from or contradict the minimization measures proposed under Chapter 2 *Description of the Proposed Action* and discussed in the biological assessment (BLM 2012b), the specifications in these Terms and Conditions shall apply.

In order for the exemption in section 7(o)(2) to apply, the measures described below are nondiscretionary and must be implemented by the BLM and other jurisdictional federal agencies so that they become binding conditions of any project, contract, grant, or permit issued by the BLM and any other jurisdictional federal agencies as appropriate.

RPM 1: Impacts to Desert Tortoises—The BLM, and other jurisdictional Federal agencies as appropriate, shall ensure their agency personnel, the SNWA, and their contractors implement the following measures to minimize injury and mortality of desert tortoises due to project-related construction, operation, and minor maintenance activities, including blasting operations, use of heavy equipment, and minimize entrapment of desert tortoises in excavation sites and open trenches:

Terms and Conditions:

1.a. Applicant-committed measures—The BLM shall ensure that the SNWA and their contractors implement all the applicant-committed measures, as modified by the Service and BLM, and the BLM terms and conditions of the ROW grant, including those required in the Ely RMP (BLM 2008).

1.b. Timing of construction—The BLM shall ensure that when possible, the SNWA schedules and conducts construction, operation, and maintenance activities within desert tortoise habitat during the less-active season (generally October 31 to March 1) and during periods of reduced desert tortoise activity (typically when ambient temperatures are less than 15.5 or greater than 35 °C °C [less than 60 or greater than 95 °F]).

All vehicles and equipment that are not in areas enclosed by desert tortoise exclusion fencing will stop activities in desert tortoise habitat during rainfall events in the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days. The Field Contact Representative (FCR) or designee will determine, in coordination with the BLM and Service, when it is appropriate for project activities to continue.

1.c. Field Contact Representative—The BLM shall ensure an FCR (also called a Compliance Inspection Contractor, or CIC) is designated for each contiguous stretch of construction activity. The FCR will serve as an agent of the BLM and the Service to ensure that all instances of noncompliance or incidental take are reported. The BLM has discretion over approval of potential FCRs; however, those who will also be acting as authorized desert tortoise biologists must also be approved by the Service (see Term and Condition 1.d.).

The FCR and authorized desert tortoise biologist (see Term and Condition 1.d.) shall have a copy of all stipulations when work is being conducted on the site and will be responsible for overseeing compliance with terms and conditions of the ROW grant, including those for listed species. The BLM shall ensure the FCR and authorized desert tortoise biologists have authority to halt any activity that is in violation of the stipulations. The FCR shall be on-site year-round during all project activities.

Within 3 days of employment or assignment, the SNWA and BLM shall provide the Service with the names of FCRs.

1.d. Authorized desert tortoise biologist— In accordance with *Procedures for Endangered Species Act Compliance for the Mojave Desert Tortoise* (USFWS 2009a), an authorized desert tortoise biologist shall possess a bachelor's degree in biology, ecology, wildlife biology, herpetology, or a closely related field. The biologist must have demonstrated prior field experience using accepted resource agency techniques to survey for desert tortoises and desert tortoise sign. In addition, the biologist shall have the ability to recognize and accurately record survey results. Potential authorized desert tortoise biologists must submit their statement of qualifications to the Service's Nevada Fish and Wildlife Office for approval, allowing a minimum of 30 days for Service response. The statement form is available on the Internet at http://www.fws.gov/nevada/desert_tortoise/auth_dt_form.htm.

During the desert tortoise more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, an authorized desert tortoise biologist shall be on-site. He/she will be assigned to each piece/group of large equipment (e.g., front-end loader, backhoe, excavator, water truck) engaged in activities that may result in take of desert tortoises (e.g., clearing, watering roads, blasting, grading, lowering in pipe, hydrostatic testing, backfilling, recontouring, and reclamation activities).

An authorized desert tortoise biologist and FCR (see Term and Condition 1.c.) shall be responsible for 1) conducting and supervising desert tortoise clearance surveys; 2) enforcing the litter-control program; 3) ensuring that desert tortoise habitat disturbance is restricted to authorized areas; 4) ensuring that all equipment and materials are stored within the boundaries of the construction zone or within the boundaries of previously disturbed areas or designated areas; 5) ensuring that all vehicles associated with construction activities remain within the proposed construction zones; and 6) ensuring compliance with the conservation measures of this biological opinion and reporting actual take (see RPM 4).

An authorized desert tortoise biologist will serve as a mentor to train desert tortoise monitors (see Term and Condition 1.e.) and shall approve monitors to conduct specific activities based on the monitor's demonstrated skills, knowledge, and qualifications. An authorized desert tortoise biologist is responsible for errors committed by desert tortoise monitors.

Biologists and monitors shall be visibly identifiable on the project site, wearing, for example, a uniquely designated hard hat color or safety vest color.

1.e. Desert tortoise monitor—Desert tortoise monitors assist an authorized desert tortoise biologist during surveys and serve as apprentices to acquire experience. Desert tortoise monitors assist on project activities to ensure proper implementation of protective measures, and record and report desert tortoises and sign observations in accordance with Term and Condition 1.d. They will report incidents of noncompliance in accordance with RPM 4.

If a desert tortoise is immediately in harm's way (e.g., certain to immediately be crushed by equipment), desert tortoise monitors will move the desert tortoise and place it in a designated safe area until an authorized desert tortoise biologist assumes care of the animal.

Desert tortoise monitors will not conduct field or clearance surveys or other specialized duties of an authorized desert tortoise biologist unless directly supervised by an authorized desert tortoise biologist; "directly supervised" means an authorized desert tortoise biologist has unaided direct sight of and unaided voice contact with the desert tortoise monitor.

Within 3 days of employment or assignment, the SNWA and the BLM shall provide the Service with the names of desert tortoise monitors who will assist an authorized desert tortoise biologist.

1.f. Desert tortoise education program—A desert tortoise education program shall be presented by an authorized desert tortoise biologist to all personnel on-site during construction activities. The Service, BLM, and appropriate State agencies shall approve the program. At a minimum, the program shall cover desert-specific Leave-No-Trace guidelines, the distribution of desert tortoises, general behavior and ecology of this species, sensitivity to human activities, threats including introduction of exotic plants and animals, legal protection, penalties for violation of State and federal laws, reporting requirements, and the project measures presented in this Opinion. All field workers shall be instructed that activities must be confined to locations within the approved areas; they shall also be informed of their obligation to walk around and check underneath vehicles and equipment before moving them. In addition, the program shall include fire prevention measures to be implemented by employees during project activities. The program shall instruct participants to report all observations of desert tortoise and their sign during construction activities to the FCR and authorized desert tortoise biologist.

1.g. Vehicle travel—Project personnel shall exercise vigilance when commuting to the project area to minimize risk for inadvertent injury or mortality of all wildlife species encountered on paved and unpaved roads leading to and from the project site. Speed limits will be clearly marked, and all workers will be made aware of these limits. On-site, personnel shall carpool to the greatest extent possible.

During the desert tortoise less-active season, vehicle speed on project-related access roads and in the work area will not exceed 40 kph (25 mph). All vehicles and construction equipment will be tightly grouped.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, vehicle speed on project-related access roads and in the work area will not exceed 24 kph (15 mph). All vehicles and construction equipment will operate in groups of no more than 3 vehicles. An authorized desert tortoise biologist and desert tortoise monitor will escort or clear ahead of vehicles and equipment for ROW travel. The escort will be on foot and clear the area of tortoises in front of each traveling construction equipment group (see Term and Condition 1.i.). The escort will use a recreational/nonpassenger vehicle with ground visibility (e.g., UTV); however, at least 1 authorized desert tortoise biologist and 1 desert tortoise monitor must ride together and survey both sides of the vehicle. The speed/pace will be determined by an authorized desert tortoise biologist. The speed shall be slow enough to ensure adequate inspection.

New access road and spur road locations will be sited to avoid potentially active tortoise burrows to the maximum extent practicable.

1.h. Unauthorized access—The BLM shall ensure that unauthorized personnel, including off-duty project personnel, do not travel on project-created access roads.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, project- and nonproject-related activities on all access roads that intersect the ROW will be monitored and logged. During construction, the ROW will be fenced at public roads that intersect the ROW. Signs will say that access on the ROW is strictly prohibited except by authorized personnel and that violators will be prosecuted.

1.i. Desert tortoise clearance—Prior to surface-disturbing activities, an authorized desert tortoise biologist, potentially assisted by desert tortoise monitors, shall conduct a clearance survey to locate and remove all desert tortoises from harm’s way or from areas to be disturbed (including areas of hydrostatic testing), using techniques that provide full coverage of all areas (USFWS 2009a). No surface-disturbing activities shall begin until 2 consecutive surveys yield no individuals.

During the less-active season, clearance surveys will be conducted within 7 days prior to any surface-disturbing activity.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, clearance surveys will be conducted the day of any surface-disturbing activity.

An authorized biologist shall excavate all burrows that have characteristics of potentially containing desert tortoises in the area to be disturbed, with the goal of locating and removing all desert tortoises and desert tortoise eggs. During clearance surveys, all handling of desert tortoises and their eggs and excavation of burrows shall be conducted solely by an authorized desert tortoise biologist in accordance with the most current Service-approved guidance. If any tortoise active nests are encountered, the Service must be contacted immediately, prior to removal of any tortoises or eggs from those burrows, to determine the most appropriate course of action. Unoccupied burrows shall be collapsed or blocked to prevent desert tortoise re-entry. Outside of unfenced construction work areas, all potential desert tortoise burrows and pallets within 15 m (50 feet) of the edge of the construction work area shall be flagged. If the burrow is occupied by a desert tortoise, the tortoise shall be temporarily penned (see Term and Condition 1.l.). No stakes or flagging shall be placed on the berm or in the opening of a desert tortoise burrow. Desert tortoise burrows shall not be marked in a manner that facilitates poaching. Avoidance flagging shall be designed to be easily distinguished from access route or other flagging, and shall be designed in consultation with experienced construction personnel and authorized biologists. All flagging shall be removed following construction activities.

An authorized desert tortoise biologist will inspect areas to be backfilled immediately prior to backfilling.

1.j. Desert tortoise in harm's way—Any project-related activity that may endanger a desert tortoise shall cease if a desert tortoise is found on the project site. Project activities may resume after an authorized desert tortoise biologist or desert tortoise monitor (see restrictions in Term and Condition 1.e.) removes the desert tortoise from danger or after the desert tortoise has moved to a safe area on its own.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, at least 1 monitor shall be assigned to observe spoil piles prior to excavation and covering.

1.k. Handling of desert tortoises— Desert tortoises shall only be moved by an authorized desert tortoise biologist or desert tortoise monitor (see restrictions in Term and Condition 1.e**.**) solely for the purpose of moving the tortoises out of harm's way. During construction, operation, and maintenance, an authorized desert tortoise biologist shall pen, capture, handle, and relocate desert tortoises from harm's way in accordance with the most current Service-approved guidance.

Desert tortoises that occur aboveground and need to be moved from harm's way shall be placed in the shade of a shrub, 50 to 100 m (150 to 300 feet) from the point of encounter. If desert tortoises need to be moved at a time of day when ambient temperatures could harm them (less than 5 °C [40 °F] or greater than 35 °C [95 °F]), they shall be held overnight in a clean cardboard box. These desert tortoises shall be kept in the care of an authorized biologist under appropriate controlled temperatures and released the following day when temperatures are favorable. All cardboard boxes shall be discarded after 1 use and never hold more than 1 tortoise at a time. If any tortoise active nests are encountered, the Service must be contacted immediately, prior to removal of any tortoises or eggs from those burrows, to determine the most appropriate course of action.

During the less-active season (typically October 31 to March 1), desert tortoises located in the project area sheltering in a burrow will be temporarily penned at the discretion of an authorized biologist. Desert tortoises shall not be penned in areas of moderate-to-heavy public use; rather, they shall be moved from harm's way in accordance with the most current Service-approved guidance.

Equipment that contacts desert tortoises shall be sterilized or changed before contacting another tortoise to prevent the spread of disease. If a tortoise contacts clothing, those clothes shall be washed before coming into contact with another desert tortoise. All tortoises shall be handled using disposable surgical gloves, and each pair of gloves shall be disposed of after handling 1 tortoise. An authorized biologist shall document each tortoise handling with the following information: 1) narrative describing circumstances; 2) vegetation type; 3) dates of observations; 4) general conditions and health; 5) any apparent injuries and state of healing; 6) if the tortoise was moved, the GPS location where it was captured and the location where it was released; 7) maps; 8) whether animals voided their bladders; and 9) diagnostic markings (e.g., identification numbers marked on lateral scutes).

1.l. <u>Penning</u>—Penning shall be accomplished by installing a circular fence, approximately 7 m (20 feet) in diameter, to enclose and surround the tortoise burrow. The pen shall be constructed with 5-cm (2-inche) hardware cloth or 3-cm (1-inch) horizontal by 5-cm (2-inche) vertical, galvanized welded wire. Steel T-posts or rebar 0.5 to 1 m (2 to 3 feet) high shall be placed every 1.5 to 2 m (5 to 6 feet) to support the pen material. Pen material will extend 0.5 m (18 inches) aboveground. The bottom of the enclosure will be buried 15 to 30 cm (6 to 12 inches) deep or bent toward the burrow, with soil mounded along the base, and other measures implemented to ensure zero ground clearance. Care shall be taken to minimize public visibility of the pen. An authorized desert tortoise biologist or desert tortoise monitor shall check the pen at least daily and ensure that 1) the desert tortoise is in the burrow or pen, 2) the tortoise is healthy, and 3) the pen is intact. Because this is a new technique, all instances of penning or issues associated with penning shall be reported to the Service within 3 days.

1.m. <u>Temporary tortoise-proof fencing</u>—All construction areas, including open pipeline trenches, hydrostatic testing locations, and tie-in work, shall be fenced with temporary tortoise-proof fencing (e.g., silt fencing) or inspected by an authorized desert tortoise biologist periodically throughout the day, at the end of the day, and immediately the next morning.

Fencing will be designed in a manner that reduces the potential for desert tortoises and hatchlings to access the construction areas. Thus, the lower 15 to 30 cm (6 to 12 inches) of fencing will be folded outward (i.e., away from the construction area) and covered with enough soil, rocks, and staking to maintain zero ground clearance and secure the bottom section of material. After the fencing is erected and secure, the work area inside the fencing will be cleared by an authorized biologist. The fencing must remain closed during any construction activities.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, an authorized biologist will check the integrity of the fencing every 2 hours to ensure that no breaches in the fencing have occurred and no desert tortoises are pacing the fence.

1.n. Permanent tortoise-proof fencing—Tortoise-proof fencing shall be installed around the boundary of permanent aboveground facilities that require regular monitoring and maintenance. Fence specifications will be consistent with those approved by the Service (USFWS 2009a). Tortoise guards shall be placed at all road access points, where desert tortoise-proof fencing is interrupted, to exclude desert tortoises from the facility. Gates shall provide minimal ground clearance to deter ingress by desert tortoises. Permanent tortoise-proof fencing along the project area shall be appropriately constructed, monitored, and maintained.

During the desert tortoise less-active period and after major storm events, fencing will be checked at least monthly.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, fencing will be checked at least once per day during construction activities to ensure that tortoises are not pacing the fence, litter and sediment has not piled up, breaches or holes have not occurred in the fence, and no tortoises are caught in the fence.

Following project construction, the fence, tortoise guards, and gates shall be inspected at least quarterly unless the timing is modified by the Service. Maintenance shall include regular removal of trash and sediment accumulation and restoration of zero ground clearance between the ground and the bottom of the fence, including re-covering the bent portion of the fence if it is no longer buried.

During the desert tortoise less-active period repairs to damaged fence or gates will be completed within 7 days.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, repairs to damaged fence or gates will be completed within 72 hours.

1.o. Open trenches—Earthen plugs, with wildlife escape ramps on either side of each plug, will be provided in open trench segments at intervals of no more than 0.8 km (0.5 miles). These distances will be reduced if the FCR and authorized desert tortoise biologist determine that the plug/escape ramp spacing is insufficient to facilitate animal escape from the trench. Any tortoise that is found in a trench or excavation shall be promptly removed by an authorized desert tortoise biologist in accordance with the most current Service-approved guidance. If the authorized desert tortoise biologist is not allowed to enter the trench for safety reasons, the alternative method of removal must have prior approval by the Service.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, the amount of open trench, at any one time, will not exceed 5 km (3 miles). An authorized desert tortoise biologist or desert tortoise monitor will be responsible for monitoring each 1,000-foot section of open trench (on both sides) during daylight hours. In sections of the project where the desert tortoise observations increase, the FCR will appropriately increase the number of monitors and authorized desert tortoise biologists. Adjacent to open trenches, an authorized desert tortoise biologist or desert tortoise monitor will thoroughly check under sections of propped pipeline to inspect for tortoises that may be taking advantage of the shade.

1.p. <u>Dust control</u>—Water applied to the construction ROW and topsoil piles for dust control shall not be allowed to pool outside tortoise-proof fencing areas, because it can attract desert tortoises. Similarly, leaks on water trucks and water tanks will be repaired to prevent pooling water.

During the more-active season (generally March 1 to October 31), and if temperatures are above 15.5 but below 35 °C (above 60 but below 95 °F) for more than 7 consecutive days, an authorized biologist will be assigned to patrol each area being watered, both immediately after the water is applied and at approximate 60-minute intervals, until the ground is no longer wet enough to attract tortoises.

1.q. <u>Blasting</u>—If blasting is required in desert tortoise habitat, detonation shall only occur after the area has been surveyed and cleared by an authorized desert tortoise biologist. A 61-meter (200-foot) radius area around the blasting site shall be surveyed, and all desert tortoises aboveground within this 61-meter (200-foot) radius of the blasting site shall be moved 150 meter (500 foot) from the blasting site, placed in unoccupied burrows, and temporarily penned (see Term and Condition 1.l.) to prevent tortoises from returning to the site. Tortoises in burrows will be left in their burrows. All burrows, regardless of occupied status, will be stuffed with newspapers, flagged, and recorded using a GPS unit. Immediately after blasting, newspaper and flagging will be removed. If a burrow or coversite has collapsed and there is a possibility that it could be occupied, it shall be excavated to ensure that no tortoises have been buried and are in danger of suffocation.

RPM 2: Predator Control—The BLM, and other jurisdictional Federal agencies as appropriate, shall ensure their agency personnel, the SNWA, and their contractors implement the following measures to minimize injury to desert tortoises as a result of predators drawn to the project area from construction, operation, and minor maintenance activities:

<u>Terms and Conditions</u>:

2.a. <u>Litter control</u>—A litter-control program shall be implemented to reduce the attractiveness of the area to opportunistic predators such as desert kit foxes, coyotes, and common ravens. Trash and food items will be disposed of properly in predator-proof containers with predator-proof lids. Trash containers will be emptied and construction waste will be removed daily from the project area and disposed of in an approved landfill.

2.b. Deterrence—The applicant will implement best management practices (BMPs) to discourage the presence of predators on-site (coyotes, ravens, etc.). Measures will include eliminating available water sources, designing structures to discourage potential nest sites, and using hazing to discourage raven presence.

2.c. Monitoring and predator control—The applicant will inspect structures annually for nesting ravens and report observations of raven nests to the Service. If sign of predation is found under a nest, a control plan will be implemented. All raven nests will be removed from the transmission line by authorized personnel when desert tortoises are least active, and the nesting material will be disposed of.

2.d. Pets—Dogs will be prohibited in all project work areas.

RPM 3: Impacts to Desert Tortoise Habitat—The BLM, and other jurisdictional Federal agencies as appropriate, shall ensure their agency personnel, the SNWA, and their contractors implement the following measures to minimize loss and long-term degradation and fragmentation of desert tortoise habitat, such as soil compaction, erosion, crushed vegetation, and introduction of weeds or contaminants from construction, operation, and minor maintenance activities:

Terms and Conditions:

3.a. Habitat protection plans—The BLM shall ensure that the applicant develop and implement an approved fire prevention and response plan, an erosion control plan, and a weed management plan.

3.b. Interim reclamation and restoration plan—The BLM shall ensure that the applicant develop and implement a restoration plan. The plan will adaptively manage the area to restore the physical or biological features essential to the conservation of the species (PCEs). The plan must be approved by the Service. The plan will describe objectives and methods to be used, species of plants and/or seed mixture to be used, time of planting, success standards, and follow-up monitoring. The plan will be prepared within 60 days following completion of the surface disturbance phase of the project. Reclamation will be addressed on a case-by-case basis.

3.c. Minimizing new disturbance—Cross-country travel and travel outside designated areas shall be prohibited. All equipment, vehicles, and construction materials shall be restricted to the ROW, and new disturbance will be restricted to the minimum necessary to complete the task (e.g., construction of 1-lane access roads with passing turnouts every mile rather than a wider, 2-lane road).

All work area boundaries shall be conspicuously staked, flagged, or otherwise marked to minimize surface disturbance activities.

3.d. Weed prevention—Vehicles and equipment shall be cleaned with a high-pressure washer prior to arrival on the ROW and prior to departure from areas of known invasive weed and nonnative grass infestations to prevent or at least minimize the introduction or spread of these species.

3.e. Chemical spills—Hazardous and toxic materials such as fuels, solvents, lubricants, and acids used during construction will be controlled to prevent accidental spills. Any leak or accidental release of hazardous and toxic materials will be stopped immediately and cleaned up at the time of occurrence. Contaminated soils will be removed and disposed of at an approved landfill site.

3.f. Residual impacts from disturbance—The BLM shall ensure remuneration fees are paid to offset residual impacts to desert tortoises from project-related disturbance to desert tortoise habitat.

Remuneration fees will be used for management actions expected to promote recovery of the desert tortoise over time, including management and recovery of desert tortoise in Nevada. Actions may involve habitat acquisition, population or habitat enhancement, research to increase knowledge of the species' biological requirements, reducing loss of individual animals, documenting the species' status and trend, and preserving distinct population attributes. Fees will be used to fund the highest-priority recovery actions for desert tortoises in Nevada.

The current rate is $810 per acre of disturbance, as indexed for inflation. The fee rate will be indexed for inflation based on the Bureau of Labor Statistics Consumer Price Index for All Urban Consumers (CPI-U) on January 31 of each year. Fees assessed or collected for projects covered under this biological opinion will be adjusted based on the current CPI-U for the year they are collected. Information on the CPI-U can be found on the Internet at http://stats.bls.gov/news.release/cpi.nws.htm.

3.g. Green stripping—BLM shall avoid using crested wheatgrass (*Agropyron cristatum*) and forage kochia (*c*) as reclamation candidates for degraded habitats and green stripping. In emergency circumstances, such as severe erosion and headcutting, the BLM may use crested wheatgrass and forage kochia to stabilize soil. A detailed rationale for potential seeding with selected nonnative species must be submitted to the BLM and approved by the Service. Once the soil is stabilized, the BLM shall overseed with native seed.

RPM 4: Compliance and Reporting—The BLM, and other jurisdictional Federal agencies as appropriate, shall ensure their agency personnel, the SNWA, and their contractors implement the following measures to comply with the RPMs, terms and conditions, reporting requirements, and reinitiation requirements contained in this biological opinion:

Terms and Conditions:

4.a. Desert tortoise deaths— The deaths of desert tortoises shall be investigated as thoroughly as possible to determine the cause of death. The Service and appropriate State wildlife agency must be informed immediately verbally and within 5 business days in writing (electronic mail is sufficient). See *Care for Dead or Injured Desert Tortoises* and Table 6-5.

4.b. Noncompliance—Any incident occurring during project activities that was considered by the FCR, authorized desert tortoise biologist, or desert tortoise monitor to be in noncompliance with this Opinion shall be immediately documented by an authorized desert tortoise biologist and immediately reported to the BLM and the Service at (702) 515-5230.

4.c. Fence inspection—Quarterly reports for monitoring and repair of tortoise-proof fencing shall be submitted to the Service's Nevada Fish and Wildlife Office in Las Vegas. Reports are due within the first 10 days of the beginning of each quarter.

4.d. Phase completion—Within 60 days following completion of each phase of construction, a written assessment report shall be submitted to the Service, outlining the schedule that was followed for implementing the minimization measures. The report shall also include biological observations and the general success of each of the minimization measures and the maintenance activities that occurred over that phase of construction. The following information will be included in the report: location (GIS shapefile); date and time of observation; documentation of desert tortoise handling (see Terms and Conditions 1.d. and 1.k.); any actions taken to protect the desert tortoise, such as penning or temporarily holding; unique physical characteristics of each desert tortoise; raven and predator monitoring; fence monitoring; reports of noncompliance; chemical spills; unauthorized access; GIS shapefiles; acreage of final habitat disturbance; and any other information useful to the Service.

Table 6-5. Example compliance reporting table

Activity	**Actual Mortality, Injury, and Destruction**			**Actual Harassment: Capture and Removal**			**Actual Habitat Loss (acres)**	
	Adults / Subadults	**Juveniles / Hatchlings**	**Eggs**	**Adults / Subadults**	**Juveniles / Hatchlings**	**Eggs**	**Critical**	**Noncritical**
Construction								
Operation and Maintenance								
Predation								
Minimization Measures Implemented		**Effectiveness and Recommendations**						

4.e. Construction completion—A comprehensive final construction report shall be submitted to the Service's Nevada Fish and Wildlife Office in Las Vegas within 90 days of completion of construction of all phases of the project.

4.f. Operation—A written assessment report shall be submitted to the Service, outlining the maintenance activities that occurred over the past year. It will include frequency of implementation of minimization measures, biological observations, general success of each of the minimization measures and Terms and Conditions, and recommendations for future minimization measures. All deaths, injuries, and illnesses of endangered or threatened species within the project area, whether associated with project activities or not, will be summarized in the annual report, which is due April 1 of each year.

We recognize that the procedures we are likely to develop in the future, in close cooperation with the BLM and SNWA, will include a more efficient way of collecting this information; we welcome recommendations to improve the reporting method, provided that any new method meets the requirements of the implementing regulations for section 7(a)(2) of the Act (50 CFR 402.14(i)(3)).

6.5.4 *Care for Dead or Injured Desert Tortoises*

If any project-related personnel locate a dead or injured desert tortoise, they shall immediately notify the designated FCR, the authorized desert tortoise biologist, and the Service at **(702) 515-5230**.

Care shall be taken in handling sick or injured endangered or threatened species to ensure effective treatment. Care shall also be taken when handling dead specimens to preserve biological material in the best possible state for later analysis. In conjunction with the care of injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by the Service to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

The following actions shall be taken for injured or dead tortoises as directed by the Service:

- Injured desert tortoises shall be delivered to a qualified veterinarian for appropriate treatment or disposal. The proponent shall bear the cost of any required treatment of desert tortoises injured from the project, euthanasia of sick desert tortoises, and cremation of desert tortoises that die during treatment. Should sick or injured desert tortoises be treated by a veterinarian and survive, they will be transferred as directed by the Service.
- Dead desert tortoises suitable for preparation as museum specimens shall be frozen immediately and provided to an institution holding appropriate federal and State permits. Should no institutions want the desert tortoise specimens, or if it is determined that they are too damaged (e.g., crushed, spoiled) for preparation as museum specimens, then they will be buried away from the project area or cremated, upon authorization by the Service.
- Dead desert tortoises that are needed for later analysis as to cause of death and for law enforcement purposes shall be frozen immediately. Carcasses must be submitted for necropsy and the cost covered by the proponent. Necropsy results must be submitted to the Service and the appropriate State wildlife agencies.

6.6 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat; to help implement recovery plans; or to develop information. In order to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

The Service hereby makes the following conservation recommendations:

1. We recommend that the BLM require all future utilities to be sited where existing development is already located, rather than creating new disturbance and further fragmenting undisturbed habitat. Additionally, we recommend the BLM require linear ROW development to remain within designated corridors.
2. We recommend BLM require a qualified botanist to document vegetation conditions of the ROW and adjacent reference site locations prior to construction to establish pre-project baseline conditions for post-construction restoration goals.
3. We recommend that the BLM adaptively manage ravens on a landscape scale to offset indirect and cumulative impacts to desert tortoise from predatory ravens subsidized by this project. Information on the regional raven management plan can be found on the internet at http://www.dmg.gov/documents/EA_Raven_Final_USFWS_033108.pdf.
4. In designated critical habitat for the desert tortoise, we recommend the BLM avoid establishment of new roads; designate existing roads as open, closed, or limited; and close nonessential, parallel, and redundant routes. We recommend the BLM identify and close roads that impact listed species. We recommend the BLM eradicate or suppress invasive weeds and revegetate degraded areas with native plants.
5. We recommend the BLM ensure restoration of desert tortoise habitat previously disturbed from existing projects, to offset the residual impacts from the permanent loss of desert tortoise habitat. Restoration for habitat loss in designated critical habitat should occur within the same CHU. Restoration for habitat loss outside of critical habitat should occur within the same recovery unit.

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SECTION TWO

ANALYSES FOR SPECIES LIKELY TO BE ADVERSELY AFFECTED BY SUBSEQUENT TIER ROWS AND GROUNDWATER PUMPING

INCLUDES HYDROLOGIC AND CLIMATE CHANGE ANALYSES FOR GROUNDWATER-DEPENDENT ECOSYSTEMS

Chapter 7
HYDROLOGIC ANALYSES

Overall, the magnitude of the proposed groundwater withdrawals is large compared to the rate of natural discharge from the project basins (combined evapotranspiration, spring and stream flows, and interbasin outflows under current conditions). The project proposes to pump as much as 83,988 acre-feet per year (afy) or 75 million gallons per day (MGD) for municipal water supply from 4 basins (Cave, Dry Lake, Delamar, and Spring valleys) over a minimum of 105 years on which the Service has been asked to consult (pumping to 75 years after full buildout), which represents approximately 65%–70% of the rate of natural discharge from the basins under current conditions[8].

In particular, the project pumping in Cave, Dry Lake, and Delamar valleys at the full proposed rates represents roughly 67% of the annual rate of natural discharge from those basins under current conditions[9]. The proposed pumping in Spring Valley represents roughly 65%–70% of the rate of natural discharge[10]. Consequently, the proposed groundwater withdrawals are likely to result in widespread and measurable declines in groundwater levels (reductions in groundwater storage), accompanied by reductions in natural discharge (capture of evapotranspiration and spring and stream flows), within and possibly beyond the project basins over time.

Capture occurs when drawdown propagates from pumped well(s) to evapotranspiration areas, surface water, or the sources of springs, changing hydraulic gradients and/or groundwater fluxes in the vicinity of the captured feature(s). The time required to transition from a state where the pumped water is supplied from groundwater storage (reductions in groundwater levels) to the capture of evapotranspiration and/or surface discharges such as springs and streams is determined by the distribution of vertical and horizontal hydraulic conductivity within the subsurface, aquifer storage coefficients, and aquifer geometry including aquifer thickness, irrespective of the rate of pumping, as long as the groundwater system responds linearly to pumping (Leake 2011). More important in the case of the current analyses, the capture of spring flow or evapotranspiration at particular locations, including the time for capture to occur, also depends on the proximity of the pumped well(s) to the spring or evapotranspiration area (Leake 2011) and rate and duration of the pumping, and may occur long in advance, or in the absence, of the establishment of a new equilibrium state wherein reductions in the rate of natural discharge (combined decreases in evapotranspiration, spring and stream flows) equal the rate of pumping (Bredehoeft 1997).

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[8] The rate of natural discharge under current conditions is an estimate using Nevada State Engineer (NSE) recognized estimates of groundwater recharge to the project basins this approach avoids the difficulty of estimating interbasin outflows, a significant form of natural discharge from the basins. The NSE estimates that groundwater recharge to Cave, Dry Lake, Delamar, and Spring valleys is 12,900 afy, 15,000 afy, 6,100 afy, and 84,000–96, 000 afy, respectively (NSE 2012a,b,c,d). Project pumping in Cave, Dry Lake, and Delamar valleys at the full proposed rates would be a total of 22,843 afy. Project pumping in Spring Valley would be 61,127 afy.

[9] Where the rate of natural discharge is approximated using the NSE-recognized estimates of groundwater recharge to Cave, Dry Lake, and Delamar valleys (NSE 2012 a,b,c).

[10] Where the rate of natural discharge is approximated using the NSE-recognized estimate of groundwater recharge to Spring Valley (NSE 2012d).

Analyses of the potential effects of the proposed groundwater withdrawals on springs, flowing artesian wells, wetlands, and riparian zones providing habitat for species with a May Affect, Likely to Adversely Affect (MALAA) determination are presented by geographic area in the following sections.

7.1 FLAG SPRINGS, WHITE RIVER VALLEY

Based on our analysis of the available Central Carbonate-Rock Province (CCRP) Model predictions of pumping-induced drawdown[11] within the regional carbonate-rock aquifer at the location of Flag Springs, our current understanding of uncertainties associated with the model predictions, and a range of other hydrogeologic considerations, potential exists for measurable impacts to the discharge of these springs, due to Cave Valley pumping at the full proposed rate and cumulative pumping. Specifically, we conclude that project pumping in Cave Valley at the full proposed rate of 5,235 afy is likely to result in an 8.5-feet or greater reduction in the driving head on the springs[12] and a 10-feet or greater reduction in the driving head on the springs in combination with existing and reasonably foreseeable pumping[13] within the timeframe of this analysis. We find that the driving head on Flag Springs is likely a maximum of several tens of feet and may be measurably less. Therefore, although it is not possible to quantify the change in spring discharge that would accompany a reduction in the driving head on Flag Springs using currently available information, we conclude that Cave Valley pumping at the full proposed rate may have a measurable impact on the discharge of the springs.

With respect to the new Cave Valley Applicant Committed Measures (ACM), we conclude that project pumping in Cave Valley at half the full proposed rate (roughly 2,617 afy or 1,620 gallons per minute) over a 5-year period of phased-in pumping, followed by pumping at three-quarters of the full proposed rate over a subsequent 5-year period of phased-in pumping, would result in a lesser impact to the driving head and discharge of Flag Springs. It is expected that the phased pumping approach, accompanied by additional monitoring provided in the new Cave Valley ACM, described in chapter 5, will help to reduce the uncertainty of potential effects from groundwater pumping and provide important additional information.

7.1.1 *Description of the Resource*

The Flag Springs Complex is located near the range-bounding fault on the eastern margin of southern White River Valley, west of the outcrop of Silurian and Upper Ordovician dolomite associated with the lower (regional) carbonate-rock aquifer (Raines et al. 2003; SNWA 2007a). Additionally, deuterium and oxygen-18 concentrations in the discharge of Flag Springs are

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[11] Drawdown defined as change in hydraulic head, typically due to pumping, where hydraulic head is defined as the sum of elevation head and pressure head. In a confined aquifer, such as the source aquifer for Flag Springs, pressure head has some positive value at a given elevation in the aquifer, and hydraulic head is the sum of pressure head and elevation head, measured as the level of water in a well completed in the aquifer at a particular elevation.

[12] Based on our conclusion that 8.5 or more feet of drawdown is likely to occur in the carbonate-rock aquifer at the location of the source of Flag Springs (on the east side of the range-bounding fault) due to project pumping in Cave Valley at the full proposed rate of 5,235 afy.

[13] Based on our conclusion that 10 or more feet of drawdown is likely to occur in the carbonate-rock aquifer at the location of the source of Flag Springs (on the east side of the range-bounding fault) due to the project pumping in Cave Valley at the full proposed rate in combination with the continuation of existing pumping in White River Valley and reasonably foreseeable future pumping (cumulative pumping).

similar to those in recharge in the southern Egan Range (Thomas and Mihevc 2011), which is predominantly comprised of rocks associated with the regional carbonate-rock aquifer. Moreover, analyses presented by the Southern Nevada Water Authority (SNWA) (2011e) and provided as testimony to the Nevada State Engineer (NSE) in the 2011 rehearing of the SNWA water right applications in Cave, Dry Lake, Delamar, and Spring valleys, as well as the findings of the State Engineer in his recent Cave Valley ruling (Ruling No. 6165, NSE 2012a), indicate that "a significant supply of the water for the cold springs [including Flag Springs] comes from Cave Valley" (NSE 2012a); that is, water discharged from the springs originates in Cave Valley through carbonate rocks of the southern Egan Range, including those associated with the regional carbonate-rock aquifer that are located immediately east of the range-bounding fault and spring orifices. Consequently, we interpret Flag Springs to be sourced in the regional carbonate-rock aquifer.

SNWA (2008a) indicated that Flag Springs discharges from Quaternary alluvial deposits, i.e., the beds of the spring pools are composed of alluvial deposits. Similarly, Pavelko (2007) and Maxey and Eakin (1949) describe the general geologic setting of Flag Springs as discharging from unconsolidated sediments along the margin of White River Valley (at the foot of the southern Egan Range). Maxey and Eakin (1949) conclude that Flag Springs and Butterfield Spring "…are probably gravity springs, and most of the water from them comes to the surface along the outcrop area of the relatively permeable water-bearing beds which overlie impermeable beds in the alluvial-fan deposits."

In contrast, we interpret the source of Flag Springs to be the regional carbonate-rock aquifer (as described above), specifically the portion of the regional carbonate-rock aquifer that is located immediately east of the spring orifices and range-bounding fault; we also conclude that discharge from the regional carbonate-rock aquifer at this location flows approximately 0.5 miles west through overlying deposits of a small alluvial fan (seen in topographic maps), just above less permeable beds in the fan deposits (as observed by Maxey and Eakin 1949), until the groundwater discharges to the surface at the locations of the spring orifices. Our basis for this conclusion rests on the following:

- The proximity of the spring orifices to the range-bounding fault at the foot of the southern Egan Range, a range largely composed of carbonate rocks associated with the regional aquifer
- The isotopic evidence of Thomas and Mihevc (2011), which suggests that the source area for the springs is the southern Egan Range and Cave Valley
- SNWA's (2011e) interpretation of the isotopic data of Thomas and Mihevc (2011), concluding that the source of the springs is local recharge in the Egan Range and Cave Valley
- The recent conclusion of the NSE in Ruling 6165 (NSE 2012a) that "a significant supply of the water for the cold springs [including Flag Springs] comes from Cave Valley," which is consistent with testimony provided by SNWA during the 2011 rehearing
- Water temperature data which suggest that discharge from the springs is somewhat warmer than ambient air temperature (discussed below), which is likely inconsistent with the hypothesis that the Flag Springs are gravity springs' sourced in the nearby alluvial fan

Available water temperature data (BIO-WEST 2007) suggest the maximum depth of circulation of discharge from North, Middle, and South Flag springs is approximately 1000, 1300, and 1800 feet below ground surface (bgs), respectively[14] which are not inconsistent with a source within the basin fill sediments. Our analysis, interprets this to be within the regional carbonate-rock aquifer on the east side of the range-bounding fault. Apart from the physical separation of the spring heads over a distance of roughly 900 feet (SNWA 2008a), the differences in water temperature suggest that each spring discharges from a distinct spring 'conduit' in the regional carbonate-rock aquifer and may be affected differently by pumping. That is, the springs are similar in their hydrogeology and thus their overall vulnerability to pumping impacts, but may respond somewhat differently to the proposed groundwater withdrawals and cumulative pumping.

Based on 30 years of intermittent measurements by the U.S. Geological Survey (USGS) (1982–2012, USGS 2012a) the mean annual discharge of North, Middle, and South Flag springs is 2.34, 2.89, and 2.14 cubic feet per second (cfs), respectively. Over the period of the available record, discharge has varied significantly at the 3 springs: North Flag Spring, 1.5–3.5 cfs; Middle Flag Spring, 2.3–3.6 cfs; and South Flag Spring, 1.2–3.7 cfs. We note that the last 30 years have been among the wettest since 1895 (NOAA 2012).

7.1.2 *Magnitude of the Proposed Pumping*

We examine the magnitude of project pumping in Cave Valley at the full proposed rate compared to the rate of natural discharge from the project basin and project subbasin as a first step in evaluating the potential impacts of the groundwater withdrawal following the period of phased-in pumping on the discharge of Flag Springs[15].

Following the period of phased-in pumping described in the new Cave Valley ACM, the project proposes to pump 5,235 afy or 4.7 MGD for municipal water supply from the southern portion of Cave Valley over a minimum of 105 years (the period for which the Service has been asked to consult, which includes pumping to 75 years after full build-out [FBO]). This amount represents approximately 40% of the current rate of natural discharge from the basin as a whole (12,900 afy)[16]. Moreover, the project pumping at the full proposed rate represents roughly 90% of an estimated 5,970 afy of natural discharge from the project subbasin (southern Cave Valley)[17], and a minimum of 90% of the interbasin outflow that currently occurs from the project subbasin[18],

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[14] Maximum depth of circulation estimated using a geothermal gradient of 1.5 ˚F per 100 feet (Mifflin 1968; as cited by SNWA 2009b).

[15] In this and subsequent sections, we examine the potential effects of project pumping in Cave Valley at the full proposed rate of 5,235 afy, for which the Service has been provided sufficient information to do an analysis.

[16] Due to the difficulty of estimating interbasin outflow from Cave Valley, a significant portion of natural discharge from the basin, we estimate total natural discharge using the NSE-recognized estimate of groundwater recharge to the basin (12,900 afy, NSE 2012a).

[17] Due to the difficulty of estimating interbasin outflow from southern Cave Valley, a significant portion of natural discharge from the subbasin, we estimate total natural discharge from the subbasin by using the NSE-recognized estimate of groundwater recharge to the basin as a whole (12,900 afy, NSE 2012a) and the proportion of recharge—46.3%— that is believed to occur in the southern portion of the basin, a figure based on a BCM (Basin Characterization Model) prediction prepared by Flint and Flint (2007) during the USGS Basin and Range Carbonate-Rock Aquifer System (BARCAS) Study (Welch et al. 2007).

[18] Calculated as the full proposed rate of project pumping in southern Cave Valley (5,235 afy) divided by a reasonable estimate of the rate of interbasin outflow from the subbasin under current conditions (approximately 5,930 afy), where the latter is calculated using the previous estimate of groundwater recharge to southern Cave Valley (5,970 afy), less the NSE-recognized estimate of groundwater evapotranspiration (0 afy, NSE 2012a), an estimate of existing (preproject) groundwater rights in the subbasin (approximately 42 afy, NDWR 2011a and 2012a), and an estimate of spring discharge from the saturated flow system (0 afy).

most of which is believed to occur to White River Valley, specifically the area of Butterfield and Flag springs (NSE 2012a)[19].

Whether interbasin outflow from southern Cave Valley occurs primarily through Shingle Pass (NSE 2012a) or through both the Pass and carbonate rocks of the southern Egan Range that separate the area of the proposed wellfield from the springs (as suggested by predevelopment groundwater levels simulated by the regional CCRP Model [SNWA 2012b]) is uncertain. Regardless, project pumping in southern Cave Valley at the full proposed rate represents a large proportion of current natural discharge from the basin as a whole (5,235 afy of approximately 12,900 afy), a substantial proportion of the current natural discharge from the project subbasin (5,235 afy out of approximately 5,970 afy), and an even larger proportion of the current interbasin outflow from the project subbasin to White River Valley and the area of Flag Springs (5,235 afy out of a maximum of approximately 5,930 afy). As a consequence, project pumping in southern Cave Valley at the full proposed rate may capture a considerable portion of interbasin outflow to southern White River Valley (the area of the springs) and have a measurable effect on hydraulic head in the regional carbonate-rock aquifer at the location of the source of the springs and the spring discharge over some period of time.

The Service has been asked to consult on the effects of project pumping to 75 years after FBO, a finite period of time (105 years in Cave, Dry Lake, and Delamar valleys). These effects depend on many factors, including the rate of propagation of drawdown and potential recovery from the proposed well fields to the resources of concern, in this case from southern Cave Valley to Flag Springs. Given the complexity of the groundwater flow system and the added challenge of accounting for the rate of propagation of drawdown and recovery, we begin our analysis with an evaluation of the available regional CCRP model predictions[20], as a starting point for additional analysis which considers uncertainties associated with the regional model and regional model predictions.

7.1.3 *Regional Central Carbonate-Rock Province Model Predictions of Drawdown*

The CCRP Model was developed by the project proponent for Bureau of Land Management (BLM) for the purpose of evaluating the effects of the proposed project pumping and cumulative pumping at a regional scale, as is appropriate per BLM for their EIS analyses (BLM 2012b). Under the Endangered Species Act (ESA) the Service is tasked with assessing the potential effects of the project on federally listed species, many of which depend on site-specific groundwater-dependent habitat (springs and flowing artesian wells that discharge from discrete locations, and wetlands and riparian habitat of limited areal extent). We use the predictions of the regional model as a starting point for our analyses (necessitated by the complexity of the hydrogeologic system and the challenge of accounting for the rate of propagation of project-induced drawdown and recovery). We then examine whether the regional model may have over-

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[19] A large proportion of the interbasin outflow from Cave Valley appears to flow west to White River Valley and the area of the springs under current conditions, as noted by the Nevada State Engineer (NSE 2012a); the bulk of which may occur as outflow through Shingle Pass, as noted by SNWA (2011e).

[20] The CCRP Model developed by SNWA for the Groundwater Development Project (with guidance from BLM) is the only groundwater flow model that has been used to date to simulate the NSE-awarded pumping rates (NSE 2012a,b,c,d)full proposed rate.

or underestimated impacts to site-specific resources (i.e., those providing or creating habitat for federally listed species).

The CCRP Model predictions provided to the Service by BLM in support of this analysis suggest that project-induced drawdown may propagate to the area of Flag Springs beneath the Egan Range through the lower carbonate unit as a result of project pumping in southern Cave Valley at the full proposed rate (5,235 afy), producing measurable drawdown in the lower (regional) carbonate-rock aquifer at the source of the springs, even if project pumping is terminated at 75 years after FBO (105 years) (SNWA 2012b)[21]. The predicted model drawdown (due to project pumping to 75 years after FBO) is <10 feet. The BLM FEIS (BLM 2012a) states that "the model does not have the level of accuracy required to predict absolute values at specific points in time (especially decades or centuries into the future)". We note that drawdown of the magnitude predicted in the high diffusivity scenario, as little as 1.5 feet, may impact discharge of the springs, as would the 2–3 feet of drawdown predicted in response to project pumping at the full proposed rate in combination with existing and any reasonably foreseeable future pumping (cumulative pumping) over the same period[22]. We note that these predictions are results from the high diffusivity scenario, which was not calibrated to observed conditions. The BLM FEIS (BLM 2012a) provides a discussion of the results from the final calibrated model for this location. The predictions from both the high diffusivity scenario and the final calibrated model cannot predict absolute numbers for a specific location at a specific point in time, but they are informative in that they show there could eventually be a change in head in the vicinity of the spring. This alone is not sufficient to conclude that significant impacts to the springs are likely, only that they are possible, since the magnitude of drawdown at the source of the springs is uncertain (subject to error at this and other magnitudes). However, the model may over or underestimates drawdown in the regional carbonate-rock aquifer at the location of the source of the, due to a number of factors, making the model predictions *a reasonable first-order approximation of the drawdown that is likely to occur at Flag Springs*, i.e., a reasonable starting point for additional analysis that considers a range of hydrogeologic information and uncertainties associated with the regional model and regional model predictions.

7.1.3.1 Potential Underestimation of Drawdown Estimates by the Central Carbonate-Rock Province Model

Based on our analysis, it appears the CCRP Model likely underestimates project-induced drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs within the timeframe of this analysis to a measurable degree due to a number of factors related to the construction and calibration of the regional model, including but not limited to the following:

- The effects of simulating "net inputs" in excess of those recognized by the NSE to Cave Valley (groundwater recharge and interbasin inflows minus groundwater evapotranspiration and preexisting groundwater rights) on the "bulk" calibration of aquifer parameters in the vicinity of Cave Valley and Flag Springs

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[21] We note that this result does not depend on day-to-day variations in the volume of project pumping. The CCRP Model simulates groundwater extraction using time steps of a year or multiple years and annual average pumping rates.

[22] Range of drawdown predicted in response to cumulative pumping based on predictions prepared using the calibrated and "high-diffusivity" versions of the CCRP Model.

- An assignment of hydraulic conductivity, and consequently transmissivity which may be lower than actual values, to carbonate rocks of the southern Egan Range that separate the area of the proposed wellfield in southern Cave Valley from the springs
- The incorporation of a discrete low-conductivity structure on the northwest side of the simulated wellfield, which limits the propagation of project-induced drawdown into Shingle Pass in the model simulations
- A model-calibration error that limits the capture of Shingle Pass underflow and propagation of drawdown through the Pass to the area of the springs in the CCRP pumping simulations
- Uncertainties concerning the value of specific yield attributed to upper valley fill in southern Cave Valley (the simulated production unit) and hydraulic diffusivity assigned to the regional carbonate-rock aquifer (particularly on the east side of the southern Egan Range), with consequences for model predictions of the rate of propagation of drawdown to the springs and the magnitude of project-induced drawdown at the springs

7.1.3.2 Calibration of Aquifer Parameters

As discussed in detail in subsequent sections, calibration data for the region were limited to 3 steady data (wells 180W902M, 180 N07 E63 14BADD1, and 180W501M in southern Cave Valley). Water level calibration data for upper valley fill in Cave Valley were limited to steady conditions. Consequently, the local calibration of aquifer parameters in the area of Cave Valley and Flag Springs was limited to the transmissivity of upper valley fill. All other aquifer parameters in the vicinity of Cave Valley and the springs (e.g., the specific yield[23] of upper valley fill in southern Cave Valley and transmissivity and storage coefficients for this portion of the regional carbonate-rock aquifer) were either assigned to the model or were the result of bulk calibration at the scale of Cave Valley, or the latter in combination with adjacent basins. Any bulk model calibration of aquifer parameters, in turn, has been affected by the simulation of “net inputs” in excess of those recognized by the NSE to Cave Valley (described below).

The CCRP Model simulates groundwater recharge and interbasin inflows, less groundwater evapotranspiration and preexisting groundwater rights (net inputs) to Cave Valley (SNWA 2009c), which exceed values recognized by the NSE (NSE 2012a) by a total of 8,350 afy, and at least 4,400 afy in southern Cave Valley (the simulated project subbasin). In particular, groundwater recharge prescribed to Cave Valley, 15,400 afy (SNWA 2009c), exceeds the NSE-recognized value of 12,900 afy by 2,500 afy, and exceeds the estimate provided by SNWA in testimony during the 2011 rehearing of 13,700 afy by 1,700 afy (NSE 2012a). Of the 15,400 afy prescribed to Cave Valley in the model, 6,323 afy is prescribed to the northern part of the basin and 9,077 afy is prescribed to the southern part of the basin (SNWA 2012b)[24]. In contrast, groundwater recharge to northern and southern Cave Valley is an estimated 6,925 afy and 5,975 afy, respectively, using the NSE-recognized estimate of recharge to the basin and Basin and Range Carbonate-Rock Aquifer System (BARCAS) Study estimates of the percentages of

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[23] Specific yield is defined as the volume of water released from storage per unit surface area per unit decline of the water table in an unconfined aquifer (Freeze and Cherry 1979), i.e., drainable porosity.

[24] Based on a subdivision of Cave Valley into northern and southern subbasins devised by SNWA and water budget information provided in support of this consultation (SNWA 2012b).

groundwater recharge that occur in northern versus southern Cave Valley (Welch et al. 2007)[25]. SNWA (2012b) delineated northern and southern Cave Valley differently than Welch et al. (2007). Specifically, the area identified by SNWA as northern Cave Valley is somewhat smaller than the area identified in the BARCAS Study, which may account for the disparity in recharge estimates for the northern subbasin. The previous discussion utilized comparisons of modeled recharge and several recent studies by the USGS, SNWA, and a decision by the NSE where the recharge volumes are less than the model simulated value. Additional information regarding the total range of uncertainty in recharge for Cave Valley, which includes values greater than what was simulated in the model, can be found in SNWA (2009a). We conclude that the 2,500 afy in excess of that recognized by the NSE of model-simulated groundwater recharge to Cave Valley has been prescribed to the southern portion of the valley, which includes the simulated wellfield as well as fractured carbonate rocks of the Shingle Pass fault zone.

The calibrated model simulates 2,600 afy of interbasin inflow from Steptoe Valley and 1,900 afy of interbasin inflow from Lake Valley into Cave Valley under current (preproject) conditions (SNWA 2009c), 4,500 afy in excess of the amount recognized by NSE (2012a). Based on model-simulated predevelopment groundwater levels provided by BLM (SNWA 2012b), the simulated inflow from Steptoe Valley is to northern Cave Valley, and simulated inflow from Lake Valley is to southern Cave Valley. Compared to NSE-recognized values, 2,600 afy and 1,900 afy of excess interbasin inflow were simulated by the regional model in the northern and southern parts of Cave Valley, respectively, during the model calibration. No groundwater evapotranspiration is simulated by the regional model in Cave Valley (SNWA 2009c); however, the estimate for groundwater evapotranspiration provided by SNWA in testimony during the 2011 rehearing and that recognized by NSE (2012a) is 1,300 afy, all of which is believed to occur in northern Cave Valley (NSE 2012a). Likewise, no preexisting (committed) groundwater rights are simulated by the model in Cave Valley, whereas the amount recognized by NSE (2012a) and NDWR (2011a) is approximately 50 afy, with roughly 15% or 8 afy located in the northern part of the basin and 85% or 42 afy in the southern part of the basin (NDWR 2012a). In total, groundwater recharge, interbasin inflow, and unaccounted for groundwater evapotranspiration and existing groundwater rights (net inputs) simulated by the CCRP Model exceed values recognized by the NSE (NSE 2012a) by approximately 3,900 afy in northern Cave Valley[26]. Groundwater recharge, interbasin inflow, and unaccounted for existing groundwater rights (net inputs) simulated by the model exceed values recognized by NSE (2012a) by at least 4,400 afy in southern Cave Valley[27].

Of the minimum 4,400 afy of excess “net inputs” simulated by the model in southern Cave Valley (the project subbasin), roughly 1,180 afy represent excess inputs to basin-fill sediments (excess runoff recharge), which is 350% more runoff recharge than the BARCAS Study estimate[28]. Despite the simulation of significant excess runoff recharge to southern Cave Valley,

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[25] Calculated as the product of the NSE-recognized value of groundwater recharge to Cave Valley, 12,900 afy (NSE 2012a), and the BARCAS Study estimate of the percentages of groundwater recharge occurring in northern versus southern Cave Valley, 53.7% and 46.3%, respectively (Welch et al. 2007).

[26] Calculated as the sum of 2,600 afy of excess interbasin inflow, 1,300 afy of unaccounted for groundwater evapotranspiration, and 8 afy of existing groundwater rights, rounded to hundreds of acre-feet per year, a total of 3,900 afy.

[27] Calculated as the sum of 2,500 afy of excess groundwater recharge, 1,900 afy of excess interbasin inflow, and 42 afy of unaccounted for existing groundwater rights, a total of 4,442 afy.

[28] Welch et al. (2007) report an estimate of runoff recharge to southern Cave Valley of 331 afy, prepared using a BCM prediction by Flint and Flint (2007) adjusted for long-term precipitation, 1895 to 2006.

the transient calibrated model simulates groundwater levels in upper valley fill that are 45– 60 feet lower than observed values under current conditions (SNWA 2012B). , which we believe may be due to the value of specific yield (0.18) assigned to upper valley fill here and elsewhere in the model domain, a value based on transient groundwater level data in a subset of basins (SNWA 2012b)[29], none in Cave Valley.

We conclude that the simulation of runoff recharge in excess of values recognized by the NSE to Cave Valley during the calibration of the CCRP Model may have contributed to the assignment of what we believe is a high value of specific yield (0.18)hydraulic conductivities to upper valley fill of the project subbasin (the simulated production unit), and may have resulted in the underestimation of drawdown of the water table in southern Cave Valley in response to project pumping in the model simulations, as well as the underestimation of drawdown in the portion of the regional carbonate-rock aquifer that underlies southern Cave Valley. Moreover, the potential underestimation of drawdown in upper valley fill of southern Cave Valley may contribute to the underestimation of drawdown in carbonate rocks of the southern Egan Range that separate the simulated production unit from Flag Springs, potential underestimation of the propagation of drawdown into the Shingle Pass fault zone, and ultimately potential underestimation of drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs.

7.1.3.3 Propagation of Drawdown through the Southern Egan Range

Values of hydraulic conductivity (0.1–0.3 feet/day) attributed to carbonate rocks of the southern Egan Range, which separate the area of the proposed wellfield in southern Cave Valley from Flag Springs (SNWA 2012b), represent the low end of the range of estimated values for carbonate rocks in the Great Basin (Dettinger et al. 1995; SNWA 2009a, 2010a, 2010b, 2011a, 2011b; Belcher et al. 2001; Belcher and Sweetkind 2010; USGS 2012b; Welch et al. 2007), including the lower carbonate-rock unit, and are consistent with minimal fracturing (secondary permeability). A hydraulic conductivity of 0.3 feet/day has been attributed to carbonate rocks on the west side of the topographic divide, resulting in a model transmissivity of approximately 4,500 square feet/day; a lower hydraulic conductivity of 0.1 feet/day has been attributed to carbonate rocks on the east side of the Egan Range, i.e., along the western margin of southern Cave Valley between the simulated project pumping and the divide, resulting in a model transmissivity of roughly 1,400 square feet/day[30]. Of the groundwater level data sources used to calibrate this portion of the CCRP Model (SNWA 2012b), only one represents conditions in the lower (regional) carbonate-rock aquifer in the area of the proposed wellfield and southern White River Valley (the area of the springs): well 180W902M, completed in the regional carbonate-rock aquifer along the southeastern margin of southern Cave Valley, east of the Cave Valley

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[29] Transient groundwater level data are required to model-calibrate values of specific yield and other aquifer storage parameters. We note that a significant number of transient groundwater level calibration data from basin-fill wells are flagged as representing a response to pumping (Flag no. 4, SNWA 2009c), notably in Snake, Spring, Steptoe, northern White River, Lake, Panaca, Dry, Rose, Eagle, southern Coyote Spring, Garnet, and Lower Moapa valleys, the Muddy River Springs Area, and portions of Lower Meadow Valley Wash. However, the information content of these transient groundwater level data sets is generally limited, and no transient groundwater level data for basin-fill wells were available or utilized during the model calibration in Cave Valley (SNWA 2012b).

[30] We note that no apparent reason exists for the assignment of a lower conductivity to carbonate rocks on the east side of the topographic divide, along the western margin of southern Cave Valley.

Fault (SNWA 2007b)[31]. No groundwater level calibration data are available in the regional carbonate-rock aquifer on the west side of this portion of the Egan Range at a useful depth[32]. In contrast, groundwater level calibration data from wells completed in basin-fill sediments in southern White River Valley are abundant (SNWA 2012b), but relatively insensitive to the transmissivity of the carbonate rocks in question. Therefore, the values of transmissivity attributed to carbonate rocks separating southern Cave Valley (the simulated wellfield) from Flag Springs are not model-calibrated, but rather assigned.

The transmissivity of 4,500 square feet/day assigned to the western side of the Egan Range is comparable to values estimated for carbonate rocks elsewhere in the Great Basin, we note that a hydraulic conductivity of 0.1 feet/day and the resulting transmissivity of 1,400 square feet/day assigned to the east side of the Range (between the simulated project pumping and topographic divide) represent the low end of the range of estimated values for carbonate rocks in the Great Basin (Dettinger et al. 1995; SNWA 2009a, 2010a, 2010b, 2011a, 2011b; Belcher et al. 2001; Belcher and Sweetkind 2010; USGS 2012b; Welch et al. 2007), including the lower carbonate-rock unit, and are consistent with minimal fracturing (secondary permeability). To the extent that a value of 1,400 square feet/day over or underestimates the transmissivity of carbonate rocks on the eastern side of the southern Egan Range, the propagation of drawdown from the simulated wellfield in southern Cave Valley to the location of the springs through the lower carbonate unit may be less than or greater than predicted by the model. For example, if the transmissivity of this portion of the Egan Range (assigned a value of 1,400 square feet/day) is underestimated twofold (a small uncertainty in an aquifer parameter that can easily vary an order of magnitude and is locally uncalibrated), drawdown at the location of the springs due to project pumping in southern Cave Valley at the full proposed rate could be 6–7 feet greater than that predicted by the model[33],

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[31] Additional calibration data are reported for 2 “carbonate” wells in southern Cave Valley, located along the northwestern margin of the subbasin. However, these wells are completed in the upper carbonate-rock aquifer (depth 460 ft) (SNWA 2012b; and USGS 2012a).

[32] One-time groundwater level calibration data are reported for 3 “carbonate” wells in southern White River Valley (SNWA, 2012b), dates unknown, but are from portions of the lower or possibly upper carbonate-rock aquifer, which in any case are too deep to provide a useful constraint on the hydraulic conductivity of carbonate rocks separating southern Cave Valley from the springs; depth to the upper carbonate-rock aquifer is a minimum of 9,000 ft, depth to the lower (regional) carbonate-rock aquifer is a minimum of 11,000 ft.

[33] Estimated using the Thiem equation for pseudosteady conditions in a confined aquifer (Thiem 1906) and calibrated CCRP Model predictions of drawdown across the eastern portion of the Egan Range between southern Cave Valley and Flag Springs in response to the proposed pumping in southern Cave Valley (project pumping to 75 years after FBO)—specifically, the proposed pumping to 75 years after FBO followed by 100 years of simulated recovery, roughly the maximum drawdown produced in the regional carbonate-rock aquifer at the location of the springs by the proposed pumping to 75 years after FBO per the calibrated model simulation. The Thiem equation for pseudosteady conditions in a confined aquifer (i.e., conditions which can be presumed to exist in the regional carbonate-rock aquifer at the location in question after more than 75 years of project pumping and 100 years of simulated recovery) describes the shape of a pseudosteady drawdown cone in a confined aquifer (in this case the regional carbonate-rock aquifer) and states (when written in terms of drawdown) that the change in drawdown from one distance to another radial distance along the drawdown cone is inversely proportional to the hydraulic conductivity (or transmissivity) of the medium, i.e., the higher the transmissivity of the medium, the “flatter” the drawdown cone. As applied to the problem in question, the Thiem equation predicts that if the calibrated CCRP Model underestimates the transmissivity of the eastern portion of the Egan Range by as little as twofold, then the model, which predicts a change in drawdown across this portion of the mountain range of 12–14 ft, underestimates drawdown at Flag Springs by 6–7 feet. That is, the drawdown cone produced by project pumping would be less steep than predicted by the calibrated model, resulting in 6 to 7 more feet of drawdown at the springs than predicted.

as much as 8.5feet due to project pumping[34] and 10 feet due to cumulative pumping[35] over the timeframe of this analysis. West- and north-trending subsidiary faults (which may be associated with enhanced fracturing and conductivity) are depicted in geologic maps prepared by USGS (Stewart and Carlson 1978; Raines et al. 2003) and SNWA (2007a) within this portion of the Egan Range but are not reflected in the assignment of aquifer parameters in the regional model. These faults include a fault trending west-southwest, which extends from southern Cave Valley to Trough Spring Canyon on the eastern margin of White River Valley, roughly 2.5 miles south of Flag Springs.

The Theim equation used above to estimate drawdown at the location of the springs due to project and cumulative pumping in southern Cave Valley at the full proposed rate makes the following assumptions which may or may not reflect actual conditions: 1) water-bearing materials have a uniform hydraulic conductivity; 2) the aquifer is not stratified; 3) aquifer thickness is constant; 4) the potentiometric surface (prior to pumping) has no slope (or gradient); and 5) drawdowns have reached equilibrium conditions.

7.1.3.4 Limitations on the Propagation of Drawdown into Shingle Pass

A discrete low-conductivity structure (horizontal flow barrier) has been incorporated in the regional CCRP Model along the northwestern margin of the simulated wellfield in southern Cave Valley (at the base of the horst block comprising the Shingle Pass fault zone), which limits the propagation of project-induced drawdown into Shingle Pass and down the Pass to the area of the springs in the CCRP Model simulations. This incorporated low-conductivity barrier coincides with an anomaly identified in a gravity (geophysical) study by Mankinen et al. (2008), the results of which have been summarized for SNWA by Rowley et al. (2011). For the purposes of constructing and calibrating the regional CCRP Model, this structure has been interpreted as extending to a depth of roughly 15,700 feet bgs (10,000 feet below mean sea level), through Cenozoic deposits (upper and lower valley fill), the upper aquitard, and upper and lower (regional) carbonate-rock aquifers. Simulating the structure as a discrete one to two order of magnitude (40- to 50-fold) reduction in hydraulic conductivity, the regional model predicts a decrease of as much as 23 feet (e.g., from 30 feet to 7 feet) in project-induced drawdown across this structure in the uppermost portion of the regional carbonate-rock aquifer within the timeframe of this analysis (SNWA 2012b). Whereas groundwater level data used to calibrated this portion of the regional model support the presence of the structure as an impediment to groundwater flow within Cenozoic deposits (basin fill), they are not adequate to verify the presence of a low-permeability structure at depth in the regional carbonate-rock aquifer, or to estimate the hydrologic properties of the fault(s) at such depths. If the structure simulated in the model is not an impediment to groundwater flow and allows propagation of drawdown through the regional carbonate-rock aquifer, or is more permeable than represented in the model, the regional model will underestimate propagation of drawdown from the simulated wellfield in

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[34] Calculated as 1.5 feet of drawdown predicted by the CCRP Model (both the calibrated and “high-diffusivity” versions), plus as much as an additional 7 feet of drawdown if only for a two-fold underestimation of the transmissivity of carbonate rocks on the east side of the Egan Range, i.e., between the simulated pumping in southern Cave Valley and Flag Springs.

[35] Calculated as up to 3 feet of drawdown predicted by the CCRP Model (based on the “high-diffusivity” simulation), plus as much as an additional 7 feet of drawdown if only for a two-fold under-estimation of the transmissivity of carbonate rocks on the east side of the Egan Range, i.e., between the simulated pumping in southern Cave Valley and Flag Springs.

Cave Valley into the more northern portion of southern Cave Valley (i.e., the Shingle Pass fault zone.

7.1.3.5 *Capture of Shingle Pass Underflow*

The calibrated CCRP Model simulates a water level of 5,811 feet above mean sea level (amsl) at the location of key carbonate-rock monitoring well 180W501M (SNWA 2012b), completed at depth in carbonate rocks of the fractured Shingle Pass fault zone near the top of the Pass, a simulated groundwater level which is some 430 feet higher than field observations[36]. As a result of this calibration , both the calibrated and "high-diffusivity" versions of the regional CCRP Model[37] simulate a hydraulic gradient through Shingle Pass that is roughly eightfold greater than the observed gradient under current (preproject) conditions[38], approximately twelvefold greater than the estimated gradient provided by SNWA in testimony during the rehearing (NSE 2012a and SNWA 2011e), accompanied by a low (compensating) assignment of transmissivity to carbonate rocks of the Shingle Pass fault zone of approximately 500–1,500 square feet/day in the southeastern and northern portions (majority) of the fault zone, which results in a model-simulated interbasin outflow of 17,100 afy through the Pass to White River Valley—more than the 11,550 afy estimated in a previous section of this analysis (and substantially more than the 3,800 afy provided in SNWA 2011e). We interpret that this would affect the model such that any drawdown simulated by the regional CCRP Model in Shingle Pass in response to project pumping would potentially produce a negligible change in the simulated hydraulic gradient, and negligible simulated capture of Shingle Pass underflow (interbasin outflow) and propagation of drawdown through the Pass to the area of the springs in the regional model simulations.

7.1.3.6 *Uncertainties Concerning Specific Yield and Hydraulic Diffusivity*

Uncertainties exist concerning the value of specific yield assigned to upper valley fill in southern Cave Valley (the simulated production unit), with potential consequences for the magnitude of drawdown simulated by the regional model in response to the project pumping. Specifically, a value of 0.18 has been assigned to the specific yield of upper valley fill in southern Cave Valley, as well as elsewhere in the model domain (roughly 20,000 square miles), based on transient calibration data in a subset of basins that do not include Cave Valley (SNWA 2012b). If 0.18 under or overestimates the specific yield of upper valley fill in the southern part of Cave Valley (assigned to a depth of approximately 1,000 feet, SNWA 2009c), the calibrated model would

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[36] Specifically, the calibrated model simulates a hydraulic head of 5,811 feet amsl in the uppermost portion of the regional carbonate-rock aquifer at the location of this key carbonate monitoring well, which corresponds roughly to the gravel-packed interval of the well, total depth 1,215 feet (SNWA 2007c). The observed water level in well 180W501M was 5,379 amsl in December 2005 (SNWA 2012b).

[37] See Chapter 5, Simulation of Production Pumping and Production Units.

[38] The actual hydraulic gradient of approximately 0.001 is estimated as the difference between the elevation of groundwater in carbonate monitoring well 180W501M near the top of the Shingle Pass fault zone (a reported maximum of 5,379 feet amsl on 12/22/2005, SNWA 2012a) and the elevation of groundwater in basin-fill well 207 N07 E62 21AC1 at the base of Shingle Pass in White River Valley (a reported 5,292 feet amsl on 10/23/2001, SNWA 2012b), divided by the distance from well 180W501M to well 207 N07 E62 21AC1, approximately 13.2 miles. The hydraulic gradient simulated by the calibrated CCRP Model under current (2005) conditions of approximately 0.008 is calculated as the difference between the simulated water table elevation at the location of carbonate monitoring well 180W501M (5,811 feet amsl) and the simulated water table elevation at basin-fill well 207 N07 E62 21AC1 (5,237 feet amsl), divided by the distance from well 180W501M to well 207 N07 E62 21AC1, approximately 13.2 miles.

over or underestimate drawdown in the simulated wellfield, as well as in the underlying regional carbonate-rock aquifer and adjacent areas, including the area of Flag Springs.

Similarly, no transient groundwater level data for the regional carbonate-rock aquifer were utilized during the calibration of this portion of the regional CCRP Model (SNWA 2012b). As a consequence, storage coefficients and hydraulic diffusivities attributed to the regional carbonate-rock aquifer in this portion of the model are assigned, rather than model-calibrated. Whereas storage coefficients assigned to the regional carbonate-rock aquifer in the vicinity of Cave and White River valleys are reasonable (on the order of 10^{-5} feet^{-1}; SNWA 2012b), transmissivities assigned to the eastern portion of the southern Egan Range and Shingle Pass appear to be low as noted earlier (1,400 square feet/day and 500–1,500 square feet/day, respectively) but are uncertain. Consequently, the hydraulic diffusivity of carbonate rocks separating the area of proposed pumping from the springs may be underestimated in both the calibrated and “high-diffusivity” versions of the model; the rate of propagation of drawdown from the simulated wellfield to the area of the springs through the regional carbonate-rock aquifer and the magnitude of drawdown at the springs in the model simulations may also be underestimated.

7.1.3.7 Magnitude of Potential Drawdown at Flag Springs

Based on an examination of the structure of the regional CCRP Model and calibration and/or assignment of aquifer parameters to the regional model in the area of Cave Valley and Flag Springs, we have identified factors that we believe may contribute to the overestimation of drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs. Of the several factors contributing to the underestimation of drawdown at the springs, the following can be quantified to some degree:

- Uncertainties concerning the assignment of specific storage to upper valley fill of southern Cave Valley, the simulated production unit
- The possible assignment of a low hydraulic conductivity, consequently low transmissivity, to carbonate rocks of the southern Egan Range that separate the area of the proposed (simulated) pumping in southern Cave Valley from the springs (specifically east of the topographic divide).

To address uncertainties associated with the assignment of specific yield to upper valley fill in southern Cave Valley (the simulated production unit), drawdown predictions produced using the “high-diffusivity” version of the regional model have been employed in this analysis, in conjunction with the predictions of the calibrated model, with the intent of bracketing differences between specific yield values for this important aquifer parameter. With respect to the effects of assigning what we believe to be a low transmissivity to carbonate rocks of the eastern portion of the southern Egan Range, we note that with only a twofold underestimation of the transmissivity of these rocks (a small amount in an aquifer parameter that can easily vary an order of magnitude and is uncalibrated in this case), drawdown in the regional carbonate-rock aquifer at the location of the springs due to project pumping in southern Cave Valley (at the full proposed rate) could be 6–7 feet greater than currently predicted by the regional model (see footnote 29), as much as 8.5 feet due to project pumping at the fully proposed rate and 10 feet due to cumulative pumping within the timeframe under consideration. If these same uncertainties occur in the other direction it may produce less drawdown at Flag Springs.

Additionally, several factors related to the construction and calibration of the regional CCRP Model may contribute to the underestimation of project-induced drawdown at Flag Springs, but cannot be quantified with currently available information, including the following:

- The effects of simulating "net inputs" in excess of those recognized by the NSE to Cave Valley (groundwater recharge and interbasin inflows, minus groundwater evapotranspiration and preexisting groundwater rights) on the "bulk" calibration of aquifer parameters in the vicinity of Cave Valley and Flag Springs
- The incorporation of a discrete low-conductivity structure that limits the propagation of simulated drawdown from the area of proposed project pumping in southern Cave Valley into Shingle Pass (and the area of the springs)
- Model-calibration that may limit the simulated capture of Shingle Pass underflow and propagation of simulated drawdown through the Pass to the area of the springs in the CCRP Model simulations

The effects of the latter factors cannot be quantified at this time, however, approximately 77% of the pumping simulated by the calibrated CCRP model in southern Cave Valley at the full proposed rate is captured from storage in the project subbasin within the timeframe of this analysis (SNWA 2012b)., a seemingly high proportion after 105 years of simulated project pumping. We interpret this is may be due to the assignment of a high value of specific yield to upper valley fill of southern Cave Valley (the simulated production unit), a low assignment of hydraulic conductivity (and thus low transmissivity) to the east side of the southern Egan Range (which separates the simulated wellfield from the springs), and the incorporation of a "horizontal flow barrier" on the northeast side of the simulated wellfield (which separates the simulated wellfield from carbonate rocks to the northwest, the Shingle Pass fault zone). In combination, we believe these features of the model may effectively limit the simulation of project-induced drawdown to the floor of southern Cave Valley over long periods of time.

We conclude that drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs may be underestimated by the CCRP Model as a result of a number of factors enumerated above. Furthermore, based on our analysis the assignment of what we believe to be a low transmissivity to carbonate rocks of the southern Egan Range that separate the proposed wellfield from the springs, drawdown in the regional carbonate-rock aquifer at the location of the source of the springs could be as much as 6–7 feet greater than that predicted by either the calibrated or "high-diffusivity" versions of the regional model (see footnote 29), as much as 8.5 feet due to project pumping in southern Cave Valley (at the full proposed rate) and 10 feet due to cumulative pumping (including the continuation of existing pumping in White River Valley) over the timeframe on which the Service has been asked to consult. This result does not depend on the presence of interbasin outflow from southern Cave Valley to White River Valley through the southernmost portion of the Egan Range under current conditions[39].

7.1.4 *Driving Head on the Springs*

We examine the driving head on Flag Springs in an effort to evaluate the potential significance of 8.5 or more feet of drawdown in the regional carbonate-rock aquifer at the location of the

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[39] That is, drawdown can propagate across a basin boundary in response to pumping where no significant interbasin flow existed before, as long as the intervening materials are not impermeable.

source of the springs due to project pumping in Cave Valley (at the full proposed rate) and 10 feet due to cumulative pumping (including the continuation of existing pumping in White River Valley).

Based on sparse available groundwater level data for the area of Flag Springs, we believe the driving head on the springs (hydraulic head in the source carbonate-rock aquifer in excess of the elevation of the spring orifices) is likely a maximum of several tens of feet. Specifically, no monitoring wells are completed in the regional carbonate-rock aquifer in the vicinity of the source of the springs (east side of the range-bounding fault); therefore, wells cannot currently be used to directly measure the driving head or to estimate the extinction head for discharge from the springs. However, the driving head on Flag Springs cannot be greater than the magnitude of hydraulic head (elevation of the water table) in the regional carbonate-rock aquifer at the location of carbonate-rock monitoring well 180W501M at the top of Shingle Pass, less the elevation of the spring orifices, a difference of 80–90 feet[40], since groundwater flows down the Pass to the vicinity of the springs through the regional carbonate-rock aquifer. Moreover, the land surface drops 700–800 feet from well 180W501M to the springs (through the Pass), so that a substantial portion of the 80–90-feet difference in hydraulic head occurs upgradient of the spring sources (i.e., down the Pass, although the loss through the Pass cannot be determined with currently available information. Notwithstanding the uncertainties concerning the driving head on Flag Springs and the pressing need for additional data collection in this regard (discussed in the next section and reiterated in our conservation recommendations, Chapter 15), we conclude that the driving head on the springs is likely significantly less than the maximum 80–90 feet, due to losses through Shingle Pass. That is, the driving head on the springs is likely a maximum of several tens of feet under current conditions.

Given that the driving head on the springs is likely a maximum of several tens of feet under current conditions (e.g., 40 feet or less), 8.5 or more feet of drawdown in the regional carbonate-rock aquifer at the location of the source of the springs due to project pumping in Cave Valley (at the full proposed rate) and 10 feet of drawdown due to cumulative pumping—that is, an 8.5–10 feet decrease in driving head—may have a measurable impact on the driving head of the springs. For example, a decrease of 8.5–10 feet would represent a 25% reduction in the driving head on the springs if the head is currently as much as 40 feet, a 50% reduction in the driving head on the springs if the head is currently 20 feet, and a 100% reduction in the driving head on the springs (zero driving head) if the head is currently 10 feet or less. Moreover, the results of the regional CCRP Model simulations suggest that drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs would reach a maximum approximately 50 years after any cessation of project pumping in Cave Valley (assuming project pumping occurs at the full proposed rate and is terminated at 75 years after FBO) and that drawdown at the source of the springs would recover roughly 2% in a subsequent 50 years (the recovery would be minimal over a significant period of time).

7.1.5 *Changes in Spring Discharge*

Any reduction in the driving head on the springs would manifest as some combination of reduced head loss along the spring conduits and reduced velocity head (the rate of discharge) at

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[40] Calculated as the difference between the elevation of groundwater in well 180W501M, 5379 to 5372 feet amsl (2005–2012), and the approximate elevation of the Flag Spring orifices, 5285 to 5294 feet amsl (SNWA 2008a).

the spring orifices, the proportions of which cannot be estimated using available analytical or numerical solutions[41]. Therefore, changes in spring discharge that would accompany an 8.5-feet or greater reduction in driving head due to project pumping in Cave Valley (at the full proposed rate) and a 10-feet or greater reduction in driving head due to cumulative pumping (including the continuation of existing pumping in White River Valley) cannot be quantified without further information[42]. However, pumping in Cave Valley at the full proposed rate (5,235 afy) may have a measurable impact on the discharge of Flag Springs given that the driving head on the springs is probably a maximum of several tens of feet according to currently available information. We note that spring flow ceases if the driving head on the spring(s) is reduced to zero, i.e., hydraulic head in the regional carbonate-rock aquifer at the location of the source of the springs is reduced to less than the elevation of the spring orifices. Moreover, the driving head on the springs, and consequently the potential for impacts to spring discharge, likely varies somewhat from one spring to another within the Flag Springs Complex due to differences in the elevation of the spring orifices (SNWA 2011c)[43] and depths and locations of the spring sources within the regional carbonate-rock aquifer.

We further note that the addition of a monitoring well in the regional carbonate-rock aquifer roughly 2 miles south of Flag Springs (north of Trough Spring Canyon) on the east side of the range-bounding fault, in conjunction with the timely installation of an analogous carbonate-rock monitoring well 2 miles north of the springs (which is planned but not yet installed under the stipulated hydrologic monitoring program), would facilitate future analyses by providing the following:

- An improved estimate of the driving head on the springs
- Near-field monitoring of the propagation of project-related drawdown to the area of the springs from either the north or south
- Continuous data collection at the above wells in combination with continuous discharge measurements at North, Middle, and South Flag springs, would be required over a range of wet and dry years in advance of the development of empirical relationships between hydraulic head (drawdown) in the source carbonate-rock aquifer and the discharge of the springs (which may facilitate future analyses of the effects of various amounts of drawdown on the discharge of the individual springs, including the extinction head for the individual spring discharges)

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[41] Specifically, the Bernoulli equation (published in *Hydrodynamica* in 1738) and available CCRP Model predictions. We note that the CCRP Model predictions of changes in spring discharge have not been utilized in this analysis due to the high degree of uncertainty associated with those model predictions as indicated by 1) the inability of the calibrated model to reproduce current rates of spring discharge at many locations, including Flag Springs, 2) the absence of transient spring/stream discharge data from the calibration data set, 3) the nonuniqueness of 'conductances' assigned to simulated spring conduits, and 4) simulation of spring conduits to arbitrary depths and units. Because of the regional nature of the CCRP Model, the model does not reproduce physical processes that give rise to spring discharge and lacks the capacity to predict changes in spring discharge in response to stress, including the proposed groundwater development.

[42] Specifically, the impact of the proposed pumping on the discharge of the springs (alone or in combination with existing and any reasonably foreseeable future pumping) cannot be quantified without field observations described later in this section.

[43] The orifices of North and South Flag springs appear to be 9–10 feet higher than that of Middle Flag Spring.

7.1.6 *Project versus Aggregate Impacts*

The CCRP Model predicts that a minimum of half of the pumping-induced drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs would be due to the continuation of existing pumping in White River Valley within the timeframe under consideration. Rather, we conclude that, if only for a twofold underestimation of the transmissivity of carbonate rocks separating the proposed wellfield in southern Cave Valley from the springs (the southern Egan Range east of the topographic divide), 8.5 or more feet of drawdown may occur due to the proposed pumping in Cave Valley (at the full proposed rate) and a significant but less substantial additional 1.5 feet of drawdown would occur as a result of the continuation of existing pumping in White River Valley within the timeframe of this analysis. That is, the majority of pumping impacts to the discharge of Flag Springs would likely be due to project pumping in southern Cave Valley based on this analysis (if and when project pumping is performed at the full proposed rate)..

7.1.7 *Project Pumping*

The action is defined only in terms of an annual volume of pumping from each of the project basins. The number, locations, depths, and units of completion of future project production wells are unknown at this time (per the Biological Assessment, BLM 2012a). Consequently, some assumption concerning the distribution of the project production wells is necessary to estimate the potential effects of the proposed pumping (including aggregate effects) using the CCRP Model; such assumption is also a necessary starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions. The assumption made in the model simulations which have been provided to the Service in support of this consultation is that project pumping, including the proposed pumping in southern Cave Valley, will be distributed in an effort to “minimize pumping effects” (SNWA 2009d, 2010c, 2012b). Specifically, the simulated project production wells in southern Cave Valley are distributed across the valley floor and completed entirely in upper valley fill (sands, gravels, and other largely unconsolidated deposits). These analyses are predicated upon this assumption.

7.1.8 *Uncertainties Related to Potential Long-term Climate Change*

Additional uncertainties exist concerning the degree to which the effects of project pumping, in combination with existing pumping, would be compounded by climate-related increases in air temperature (consequently increases in groundwater evapotranspiration) and potential decreases in precipitation and changes in the timing of precipitation (possible decreases in groundwater recharge) over the timeframe of this analysis. Specifically, the CCRP Model simulations suggest that maximum drawdown in the regional carbonate-rock aquifer at the location of the source of Flag Springs due to project pumping in Cave Valley at the full proposed rate would occur approximately 50 years after any cessation of pumping, roughly year 2175 (assuming project pumping were to cease at 75 years after FBO), with the effects of that pumping persisting for a significant period beyond the time of maximum impacts (e.g., a 2% recovery is anticipated in a subsequent 50 years, based on the regional model simulations) (SNWA 2012b). We note that changes in air temperature and precipitation (both spatial and temporal) in connection with potential long-term climate change are not only possible, but perhaps likely in this area over the next 160 or more years (Redmond 2010) and could have an effect on the water budgets of Cave and White River valleys (inputs and outputs to the hydrologic system in the form of groundwater recharge and evapotranspiration) and the aggregate effects of project pumping. However, at this time it is not possible to quantify what those changes might be, thus potential long-term climate change remains an uncertainty associated with the groundwater model predictions.

7.2 PAHRANAGAT VALLEY SPRINGS, PONDS, AND RIPARIAN HABITAT

Based on our analysis of the available CCRP Model predictions of pumping-induced drawdown within the regional carbonate-rock aquifer at the locations of Hiko, Crystal, and Ash springs, predicted drawdown of the water table in the vicinities of Key Pittman Wildlife Management Area and Pahranagat Wash, our current understanding of uncertainties associated with the model predictions, and a range of other hydrogeologic considerations, measurable impacts to the discharge of the Pahranagat warm springs, surficial water levels in the area of the Key Pittman Wildlife Management Area, and the riparian habitat in the Pahranagat Wash are possible due to the proposed pumping in Dry Lake and Delamar valleys and cumulative pumping. However, the available information is not sufficient to assess either the likelihood or magnitude of the impacts should they occur.

7.2.1 *Description of the Resource*

7.2.1.1 Pahranagat Valley Warm Springs

Hiko, Crystal, and Ash springs are located along the White River channel in northern Pahranagat Valley, 1.5–2 miles west of the Hiko Range. (outcrop of Devonian limestone and dolomite). These springs discharge in the vicinity of identified faults and heavily brecciated zones in the outcrop of Devonian limestone and dolomite (SNWA 2009e), and appear to originate from the regional carbonate-rock aquifer. (In the case of Hiko and Ash springs, east-striking, as well as north-striking faults have been mapped in the vicinity of the spring orifices [SNWA, 2009e]). The magnitude of their combined discharge (well in excess of estimates of groundwater recharge to Pahranagat Valley; Eakin 1963) and their isotopic composition (Thomas and Mihevc 2011) indicate that water discharged from the warm springs (Hiko, Crystal, and Ash springs) is largely derived from other basins (upgradient of Pahranagat Valley within the White River Groundwater Flow System). That is, discharge from Hiko, Crystal, and Ash springs is from the regional groundwater flow system (Eakin 1963) (i.e., the regional carbonate-rock aquifer). Available water temperature data (SNWA 2008a, 2012c; USGS 2012a) suggest that the maximum depth of circulation of discharge from Hiko, Crystal, and Ash springs is approximately 2,000–2,500, 2,300–2,400, and 3,300 feet bgs, respectively44. The differences in water temperature suggest that each spring discharges from a different depth in the regional carbonate-rock aquifer. In view of the differences in water temperature and separation of the warm springs over a distance of 9 miles (SNWA 2009e), the springs are likely to respond somewhat differently to the proposed groundwater development and cumulative pumping, although their overall vulnerability are apt to be similar.

Based on intermittent measurements collected by USGS over the last one to two decades, the mean annual discharge of Hiko, Crystal, and Ash springs is approximately 5.5 (1982–1998), 12.2

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[44] Maximum depth of circulation estimated using a geothermal gradient of 1.5 ˚F per 100 feet (Mifflin 1968; as cited by SNWA 2009b).

(2004–2012), and 18.2 (2004–2012) cfs, respectively. Over the period of the available record, discharge measurements ranged from 4.0 to 7.2 cfs at Hiko Spring, 10.2 to 13.6 cfs at Crystal Springs, and 14.5 to 21.8 cfs at Ash Springs (USGS 2012a). We note that the last 30 years have been among the wettest since 1895 (NOAA 2012).

The winter flows of Crystal and Ash springs are released to Pahranagat National Wildlife Refuge—in an amount not to exceed 1,514.38 afy under the Pahranagat Lake and its Tributaries Decree, Proof No. 01793—where they are stored in Pahranagat Lake from October 1 to March 14, with a period of use of January 1 to December 31 (NSE 2010).

The pond at Key Pittman Wildlife Management Area (Pahranagat roundtail chub) is supplied from a well completed in basin-fill deposits.

7.2.1.2 Pahranagat Wash

The North Marsh is located along the White River channel in the southern half of Pahranagat Valley, i.e., Pahranagat Wash, on Pahranagat National Wildlife Refuge. The depth to groundwater is 250 feet or more along the White River channel at the north end of Pahroc Valley, decreasing to within a few feet, or tens of feet, of the land surface at Hiko Spring in northern Pahranagat Valley (Eakin 1963, SNWA 2012b). From Hiko Spring to Maynard Lake at the southern end of Pahranagat Valley, the depth to groundwater along the channel (Wash) remains within a few feet to tens of feet of the land surface (SNWA 2012b). We note that the preponderance of groundwater level data for Pahranagat Valley are from wells completed in upper and lower valley fill to depths of 500 feet or less along the channel. Due to the shallow completion of the available wells and their concentration along the channel, uncertainty exists concerning the nature of the water detected in the wells. That is, it is unclear whether shallow groundwater in the Wash is perched (separated from the main aquifer by an unsaturated zone) or indicative of the elevation of the water table more generally in Pahranagat Valley.

7.2.2 *Magnitude of the Proposed Pumping*

We examine the magnitude of project pumping in Dry Lake and Delamar valleys compared to the rate of natural discharge from the project basins as a first step in evaluating the potential impacts of the groundwater withdrawals on the warm springs and riparian habitat of Pahranagat Valley.

The project proposes to pump 11,584 afy or 10.3 MGD for municipal water supply from Dry Lake Valley over a minimum of 105 years (the period for which the Service has been asked to consult, which includes pumping to 75 years after FBO). This amount represents approximately 83% of the current rate of natural discharge from the basin[45]. Since no groundwater evapotranspiration is believed to occur in Dry Lake Valley, the proposed pumping also represents about 83% of current interbasin outflow from the basin.

Specifically, some amount of interbasin inflow is believed to occur from Cave to Pahroc valley and from Pahroc to northwestern Dry Lake valley (Thomas and Mihevc 2011; Rowley et al. 2011; SNWA 2011e). However, the volume of underflow from Pahroc Valley to Dry Lake

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[45] Due to the difficulty of directly estimating interbasin outflow from Dry Lake Valley, which represents the bulk of natural discharge from the basin (NSE 2012b), we estimate current natural discharge (approximately 13,934 afy) using the NSE-recognized estimate of groundwater recharge (15,000 afy, NSE 2012b), less current groundwater pumping in Dry Lake Valley (1,066 afy, NDWR 2011b).

Valley is highly uncertain (NSE 2012b) and may be measurably reduced by the proposed pumping in Cave Valley. Using the NSE’s estimate of recharge to Dry Lake Valley (15,000 afy), less the NSE’s estimate of groundwater evapotranspiration (0 afy, NSE 2012b) and committed groundwater rights in the basin (1,066 afy, NDWR 2011b), 13,934 afy is a reasonable estimate of the total interbasin outflow from Dry Lake Valley under current (preproject) conditions. This outflow is believed to occur largely, if not exclusively, to Delamar Valley (Thomas and Mihevc 2011; NSE 2012b). As such, the proposed pumping in Dry Lake Valley (11,584 afy) represents a substantial portion of current interbasin outflow from the basin (approximately 83%) and is likely to have an measurableeffect on interbasin inflow to Delamar Valley (a reduction of roughly 83%) over some period of time.

Likewise, the project proposes to pump 6,042 afy or 5.4 MGD for municipal water supply from Delamar Valley, which represents approximately 99% of the current rate of natural discharge from the basin[46]. Together, the proposed pumping in Dry Lake and Delamar valleys, 17,626 afy, represents approximately 84% of the current natural discharge of these project basins[47].

Moreover, little or no groundwater evapotranspiration is believed to occur in Delamar Valley (NSE 2012c; Heilweil and Brooks 2011). Using the NSE’s estimate of groundwater recharge to Delamar Valley (6,100 afy), plus a reasonable estimate of the interbasin inflow from Dry Lake Valley (approximately 13,934 afy), less the NSE’s estimate of groundwater evapotranspiration (0 afy, NSE 2012c) and committed groundwater rights in Delamar Valley (7 afy, NDWR 2011c), 20,000 afy is a reasonable estimate of the total interbasin outflow from Delamar Valley to other basins under current (preproject) conditions. This outflow in believed to occur in some combination to Pahranagat and Coyote Springs valleys. We note that Harrill 2007 (as cited by Tetra Tech 2012) estimates that roughly 250 afy of interbasin outflow currently occurs from Delamar to northern Coyote Springs valley. Although the distribution of Delamar Valley outflow is uncertain (SNWA 2011e and NSE 2012c), we conclude that the bulk of outflow may occur to southern Pahranagat Valley. Consequently, the proposed pumping in Dry Lake and Delamar valleys (17,626 afy) may represent a substantial portion of current interbasin outflow from Delamar to Pahranagat valley (a minimum of 88%)[48] and is likely to have a measurable effect on interbasin inflow to southern Pahranagat Valley (a reduction of 88% or more) over some period of time.

The Service has been asked to consult on the effects of project pumping to 75 years after FBO, a finite period of time (105 years in Cave, Dry Lake, and Delamar valleys), which depend among other things on the rate of propagation of drawdown and potential recovery from the proposed

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[46] Due to the difficulty of directly estimating interbasin outflow from Delamar Valley, which represents the bulk of natural discharge from the basin (NSE 2012c), we estimate current natural discharge (approximately 6,093 afy) using the NSE-recognized estimate of groundwater recharge (6,100 afy, NSE 2012c), less current groundwater pumping in Delamar Valley (7 afy, NDWR 2011c).

[47] Calculated as the sum of the proposed pumping in Dry Lake and Delamar valleys, 17,626 afy, divided by an estimate of the total natural discharge from the two basins under current conditions (13,934 plus 6,093 afy, respectively—approximately 21,000 afy),where the current natural discharge of Delamar Valley (6,093 afy) is calculated using the NSE’s estimate of groundwater recharge to the basin valley (6,100 afy), less the NSE-recognized estimate of groundwater evapotranspiration (0 afy, NSE 2012c), existing (preproject) groundwater rights (7 afy, NDWR 2011c and 2012b), and estimate of spring discharge from the saturated flow system of the basin (0 afy, NSE 2012c).

[48] Calculated as the sum of the proposed pumping in Dry Lake and Delamar valleys, 17,626 afy, divided by an estimate of the maximum interbasin outflow from Delamar to southern Pahranagat Valley; the latter equal to the total estimated outflow from Delamar Valley under current conditions (20,000 afy).

wellfields to the resources of concern, in this case from Dry Lake and Delamar valleys to Pahranagat Valley. Given the complexity of the groundwater flow system and the added challenge of accounting for the rate of propagation of drawdown (and recovery), we begin our analysis with an evaluation of the available regional CCRP model predictions, as a starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions.

7.2.3 *Regional Central Carbonate-Rock Province Model Predictions of Drawdown*

We note that the CCRP Model was developed by the project proponent for BLM for the purpose of evaluating the effects of the proposed project pumping and cumulative pumping at a regional scale, as is appropriate per BLM for their EIS analyses (BLM 2012b). Under the ESA the Service is tasked with assessing the potential effects of the project on federally listed species, many of which depend on site-specific groundwater-dependent habitat (springs and flowing artesian wells that discharge from discrete locations, and wetlands and riparian habitat of limited areal extent). Therefore, we use the predictions of the regional model as a starting point for our analyses (an approach necessitated by the complexity of the hydrogeologic system and the challenge of accounting for the rate of propagation of project-induced drawdown and recovery), followed by an examination of the ways and extent to which impacts to site-specific resources (those providing or creating habitat for federally listed species) have potentially been over- or under-estimated by the regional model.

The CCRP Model predictions provided to the Service by BLM in support of this analysis suggest that drawdown in the regional carbonate-rock aquifer at the locations of the Pahranagat warm springs and at the water table in the vicinities of Key Pittman Wildlife Management Area and Pahranagat Wash (the refuge) would be minimal to negligible within the timeframe of this analysis (SNWA 2012b). However, this alone is not sufficient to conclude that significant impacts to these Pahranagat Valley resources will not occur within the timeframe under consideration, since the magnitude of the predicted drawdown at these sites is uncertain (subject to error at this and other magnitudes) and the predicted rate of propagation of drawdown from the project basins into northern and/or southern Pahranagat Valley is particularly uncertain. Specifically, due to a number of factors, the model may over or underestimate project-induced drawdown in the regional carbonate-rock aquifer at the locations of the Pahranagat warm springs and at the water table in the vicinities of the Wildlife Management Area and riparian habitat in Pahranagat Wash. Therefore, we consider the model predictions a reasonable first-order approximation of the drawdown that is likely to occur in the vicinity of these resources, i.e., a reasonable starting point for additional analysis that also considers a range of hydrogeologic information and uncertainties associated with the regional model and regional model predictions.

7.2.3.1 Potential Underestimation of Drawdown by the Central Carbonate-Rock Province Model

The CCRP Model likely underestimates project-induced drawdown in the regional carbonate-rock aquifer at the locations of Hiko, Crystal, and Ash springs and drawdown of the water table in the vicinities of Key Pittman Wildlife Management Area and Pahranagat Wash within the timeframe of this analysis due to a number of factors related to the construction and calibration of the regional model, including but not limited to the following:

- The effects of simulating "net inputs" in excess of those recognized by the NSE to Dry Lake and Delamar valleys, as well as Garden, Coal, and Pahroc valleys (groundwater recharge and interbasin inflows, minus groundwater evapotranspiration and preexisting groundwater rights), on the "bulk" calibration of aquifer parameters for Dry Lake, Delamar, and Pahranagat valleys
- An assignment of runoff recharge (recharge to upper valley fill) in Dry Lake, Delamar, and Pahranagat valleys that greatly exceeds prior estimates[49], with implications for the bulk calibration of the transmissivities of upper valley fill in all 3 basins
- Under-assignment of in-place groundwater recharge compared to Basin Characterization Model (BCM) estimates (compared to runoff recharge) throughout the White River Groundwater Flow System portion of the model, including Dry Lake, Delamar, and Pahranagat valleys, which may have contributed to an assignment of low transmissivity to the regional carbonate-rock aquifer and the underestimation of project-induced drawdown at Hiko, Crystal, and Ash springs in Pahranagat Valley in the regional model simulations
- An assignment of, and uncertainties associated with, low hydraulic conductivity, consequently low transmissivity, to the upper 3,000 feet of the regional carbonate-rock aquifer in the area between the proposed wellfields in Dry Lake and Delamar valleys and Hiko, Crystal, and Ash springs in Pahranagat Valley (i.e., a conductivity of 0.7 feet/day and corresponding transmissivity of 2,300 square feet/day, SNWA 2012b)
- Unaccounted for, and unknowable, potential for the propagation of project-induced drawdown from the proposed wellfields in Dry Lake and/or Delamar valleys to Hiko, Crystal, and/or Ash springs in Pahranagat Valley through preferential pathways in the regional carbonate-rock aquifer that may or may not exist, notwithstanding the southerly direction of groundwater flow in Dry Lake and Delamar valleys under natural gradient conditions and irrespective of the reasonableness of the effective large-scale transmissivity assigned to this portion of the regional carbonate-rock aquifer in the CCRP Model. These unaccounted for and unknowable conditions may also limit the propagation of drawdowns.
- The simulation of hypothesized "perched" conditions in Pahranagat Wash (SNWA 2009b) through the assignment of hydraulic conductivities to the regional carbonate-rock aquifer that are two to three orders of magnitude (70- to 400-fold) greater than those attributed to overlying volcanic materials[50], concentrating CCRP Model-simulated drawdown in the regional carbonate-rock aquifer
- Unaccounted for, and unknowable, potential for the upward propagation of project-induced drawdown from the regional carbonate-rock aquifer into overlying fill materials of Pahranagat Wash due to the presence of preferential pathways in poorly to densely welded tuffs. These unaccounted for and unknowable conditions may also limit the propagation of drawdowns.
- Uncertainties concerning the value of specific yield assigned to upper valley fill in Dry Lake and Delamar valleys (the simulated production units), hydraulic diffusivity assigned to the

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[49] Heilweil and Brooks (2011) report estimates of runoff recharge to Dry Lake, Delamar, and Pahranagat valleys of 190, 230, and 44 afy, respectively, prepared using a BCM prediction by Flint and Flint (2007) and adjusted to reproduce discharge estimates. In contrast, runoff recharge prescribed to Dry Lake, Delamar, and Pahranagat valleys in the CCRP Model is 7,412 afy, 3,681 afy, and 1,496 afy, respectively.

[50] Hydraulic conductivities of 0.7–4 ft/day have been assigned to this portion of the regional carbonate-rock aquifer in the CCRP Model; a hydraulic conductivity of 0.001 ft/day has been assigned to overlying volcanic rocks in this same area (SNWA 2012b).

regional carbonate-rock aquifer, and hydraulic diffusivity assigned to volcanic rocks in Dry Lake, Delamar, and Pahranagat valleys, with consequences for model predictions of the rate of propagation to and magnitude of project-induced drawdown in Pahranagat Valley (i.e., at Hiko, Crystal, and Ash Springs, Key Pittman Wildlife Management Area, and the location of riparian habitat in Pahranagat Wash)

- A complex assignment of ‘stream’ parameters (in a range of model layers) and MODFLOW ‘conductances’ within the regional carbonate-rock aquifer along the White River channel, from north to south through Pahranagat Valley, the interaction and effects of which are neither explained (SNWA 2009c) nor easily anticipated, but which may have produced the following anomalies in the regional model predictionsinclude:
    - a zone of anomalously low (negligible) simulated drawdown along the White River channel from the north end of Lower Pahranagat Lake to Brownie Spring (north of Ash Springs), including the area from the North Marsh to Cottonwood Spring on Pahranagat National Wildlife Refuge;
    - complex variations in simulated drawdown within the regional carbonate-rock aquifer in the vicinities of Hiko, Crystal, and Ash springs, which may or may not be physically tenable; and
    - the simulation of alternating mounds and depressions in the piezometric surface of the regional carbonate-rock aquifer west of the White River channel from the area of Hiko, Crystal, and Ash springs to the North Marsh.

We examine the effects of simulating “net inputs” in excess of those recognized by the NSE to Dry Lake and Delamar valleys on the bulk calibration of aquifer parameters and the simulation of ‘perched’ conditions in Pahranagat Wash, and uncertainties associated with model assignments of specific yield and hydraulic diffusivity in more detail.

Calibration of Aquifer Parameters

As discussed in detail in a subsequent section, transient calibration data[51] for the regional carbonate-rock aquifer in the vicinity of Dry Lake, Delamar, and Pahranagat valleys were limited to one well at the extreme north end of Pahranagat Valley[52], the period of record of which does not appear to coincide with a period of pumping in nearby well(s) (SNWA 2012b). Water level calibration data for upper valley fill in Dry Lake and Delamar valleys were limited to steady conditions. Consequently, local calibration of aquifer parameters in Dry Lake, Delamar, and Pahranagat valleys was limited to the transmissivity of upper valley fill (at select locations) and the specific yield of upper valley fill in northern Pahranagat Valley (where transient water level calibration data were available and utilized during the model calibration). All other aquifer parameters in the vicinity of Dry Lake, Delamar, and Pahranagat valleys (e.g., the specific yield[53] of upper valley fill in Dry Lake and Delamar valleys and transmissivity and storage coefficients for this portion of the regional carbonate-rock aquifer) were either assigned to the model or the result of bulk calibration at the scale of Dry Lake, Delamar, and Pahranagat valleys or the latter in combination with adjacent basins (such as Garden, Coal, and Pahroc valleys). Any bulk model

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[51] Required to model-calibrate aquifer storage coefficients.

[52] Carbonate well 209 S03 E60 13DACD 1 in north-central Pahranagat Valley.

[53] Specific yield is defined as the volume of water released from storage per unit surface area per unit decline of the water table in an unconfined aquifer (Freeze and Cherry 1979), i.e., drainable porosity.

calibration of aquifer parameters for Dry Lake and Delamar valleys, in turn, has been affected by the simulation of "net inputs" in excess of those recognized by the NSE to the project basins (described below).

The CCRP Model simulates groundwater recharge and interbasin inflows minus groundwater evapotranspiration and preexisting groundwater rights (net inputs) in Dry Lake Valley (SNWA 2009c) that exceed values recognized by the NSE (NSE 2012b) and other investigators by a total of approximately 7,100 afy. In particular, groundwater recharge prescribed to Dry Lake Valley, 17,271 afy (SNWA 2012b), exceeds the NSE-recognized value of 15,000 afy by 2,270 afy, and exceeds by 1,070 afy the 16,200 afy estimate provided by SNWA in testimony during the 2011 rehearing (NSE 2012b). Moreover, the calibrated model simulates 1,300 afy of interbasin inflow from Cave Valley (which we believe the data do not support, SNWA 2011b), 2,900 afy of interbasin inflow from Lake Valley, and 1,600 afy of interbasin inflow from Patterson Valley to Dry Lake Valley under current (preproject) conditions (SNWA 2009c)—3,800 afy in excess of the estimates recognized by previous investigators (SNWA 2009b)[54]. Additionally, no preexisting (committed) groundwater rights are simulated by the model in Dry Lake Valley, approximately 1,066 afy less than the estimate recognized by the NSE (NDWR 2011b). In total, groundwater recharge, interbasin inflow, and unaccounted for existing groundwater rights (net inputs) simulated by the model in Dry Lake Valley exceed values recognized by the NSE (NSE 2012b) and some previous investigators by approximately 7,100 afy[55]. Of the roughly 7,100 afy of excess "net inputs" simulated by the model, approximately 974 afy represent excess inputs to basin-fill sediments of Dry Lake Valley (excess runoff recharge)—500% more runoff recharge than recognized in the GBCAAS Study[56]. The previous discussion utilized comparisons of modeled recharge and several recent studies by the USGS, SNWA, and a decision by the Nevada State Engineer where the recharge volumes are less than the model simulated value. Additional information regarding the total range of uncertainty in recharge for Dry Lake Valley, which includes values greater than what was simulated in the model, can be found in SNWA (2009a).

The CCRP Model simulates groundwater recharge and interbasin inflows minus groundwater evapotranspiration and preexisting groundwater rights (net inputs) in Delamar Valley (SNWA 2009c) that exceed values recognized by the NSE (NSE 2012c) and other investigators by a total of approximately 5,700 afy. In particular, groundwater recharge prescribed to Delamar Valley, 7,464 afy (SNWA 2012b), exceeds the NSE-recognized value of 6,100 afy by 1,360 afy, and exceeds by 860 afy the 6,600 afy estimate provided by SNWA in testimony during the 2011 rehearing (NSE 2012c). Moreover, the calibrated model simulates 21,800 afy of interbasin inflow from Dry Lake Valley (significantly more than estimated by previous investigators[57] or the 13,934 afy estimated in this analysis) and 200 afy of interbasin inflow from Kane Springs Valley (where no interbasin inflow has been previously identified, SNWA 2009b), a minimum of

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[54] Previous estimates of interbasin inflow to Dry Lake Valley are limited to 2,000 afy from Pahroc Valley, based on the isotopic studies of Thomas and Mihevc (2007), as cited by SNWA (2009b).

[55] Calculated as the sum of 2,270 afy of excess groundwater recharge, 3,800 afy of excess interbasin inflow, and 1,066 afy of unaccounted for existing groundwater rights, rounded to hundreds of acre-feet per year, a total of 7,100 afy.

[56] Heilweil and Brooks (2011) report an estimate of runoff recharge to Dry Lake Valley of 190 afy, prepared using a BCM prediction by Flint and Flint (2007) and adjusted to reproduce discharge estimates.

[57] Previous estimates of interbasin inflow to Delamar Valley are reported as follows by SNWA (2009b): 5,000 afy (Eakin 1966), 5,000 afy (Harrill et al. 1988), 5,000 afy (Scott et al. 1971), 12,000 afy (LVVWD 2001), 12,000 afy (Thomas et al. 2001), and 17,700 afy (Thomas and Mihevc 2007).

4,300 afy in excess of previously recognized amounts. Additionally, no preexisting (committed) groundwater rights are simulated by the model in Delamar Valley, 7 afy less than the amount recognized by the NSE (NDWR 2011c). In total, groundwater recharge, interbasin inflow, and unaccounted for existing groundwater rights (net inputs) simulated by the model in Delamar Valley exceed values recognized by the NSE (NSE 2012c) and previous investigators by at least 5,700 afy[58]. Of the roughly 5,700 afy of excess "net inputs" simulated by the model in Delamar Valley, approximately 670 afy represent excess inputs to basin-fill sediments (excess runoff recharge)[59]—290% more than recognized in the GBCAAS Study[60]. The previous discussion utilized comparisons of modeled recharge and several recent studies by the USGS, SNWA, and a decision by the Nevada State Engineer where the recharge volumes are less than the model simulated value. Additional information regarding the total range of uncertainty in recharge for Delamar Valley, which includes values greater than what was simulated in the model, can be found in SNWA (2009a).

We believe that the simulation of runoff recharge in excess of those recognized by the NSE to Dry Lake and Delamar valleys during the calibration of the CCRP Model may have contributed to the assignment of a what we believe to be a high value of specific yield (0.18) to upper valley fill of the project basins (the simulated production units) and the underestimation of drawdown of the water table in Dry Lake and Delamar valleys in response to project pumping in the model simulations, as well as the underestimation of drawdown in the portion of the regional carbonate-rock aquifer that underlies the project basins. Moreover, the underestimation of drawdown in upper valley fill of Dry Lake and Delamar valleys may have contributed to the underestimation of drawdown in carbonate rocks of the northern and southern Pahroc Range that separate the simulated wellfields from (Pahroc) and Pahranagat Valley, possible underestimation of the propagation of drawdown into Pahranagat Valley through the Pahranagat Shear Zone, and ultimately possible underestimation of drawdown in the regional carbonate-rock aquifer at the locations of the Pahranagat warm springs and at the water table in the vicinities of Key Pittman Wildlife Management Area and riparian habitat in Pahranagat Wash..

Simulated Perched Conditions in Pahranagat Wash

The CCRP Model construction reflects the assumption (articulated in SNWA 2009b) that wetlands and riparian habitat in Pahranagat Wash (Pahranagat National Wildlife Refuge) are maintained by discharge from Crystal and Ash springs, located north of the refuge. Specifically, the model construction reflects the assumption that wetland phreatophyte communities within the Wash are "supported by a shallow alluvial aquifer which is recharged by the regional springs" (SNWA 2009c) and that the shallow alluvial aquifer underlying Pahranagat Wash from Ash Springs to the Pahranagat Shear Zone is "perched or semi-perched," with the term "perched" being used loosely. Accordingly, the 2 uppermost model layers representing lower valley fill (the surficial aquifer) have been assigned a hydraulic conductivity of 0.01 feet/day over the full

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[58] Calculated as the sum of 1,360 afy of excess groundwater recharge, a minimum of 4,300 afy of excess interbasin inflow, and 7 afy of unaccounted for existing groundwater rights, rounded to hundreds of acre-feet per year, a total of 5,700 afy.

[59] Calculated as the product of the ratio of runoff to total groundwater recharge prescribed to Delamar Valley in the CCRP Model (SNWA 2012b), approximately 0.493 (or 49.3%), and the estimated excess groundwater recharge to the basin in the amount of 1,360 afy.

[60] Heilweil and Brooks (2011) report an estimate of runoff recharge to Delamar Valley of 230 afy, prepared using a BCM prediction by Flint and Flint (2007) and adjusted to reproduce discharge estimates.

length of the Wash and width of the riparian zone (the refuge), which may be low for materials comprising the bulk of the surficial aquifer, poorly to densely welded silicic ash-flow and airflow tuffs. These relatively low-conductivity layers, in turn, are underlain by approximately 8,000 feet of higher-conductivity model layers representing the regional carbonate-rock aquifer, which have been assigned hydraulic conductivities of approximately 4 feet/day in this portion of the valley. As a result of this simulated two to three order of magnitude (400-fold) contrast in hydraulic conductivity, model-simulated drawdown propagates from Delamar Valley (the result of project pumping in Dry Lake and Delamar valleys) through the higher-conductivity carbonate rocks well below the elevation of the Wash and refuge, accompanied by minimal upward propagation of drawdown through lower valley fill to the water table (due to the assignment of low conductivity to lower valley fill). Insomuch as none of the wells that are currently installed in the Wash penetrate the full thickness of the volcanic deposits, the existence of “perched” conditions can neither be confirmed nor refuted (i.e., “perched” conditions remain a hypothesis on which this portion of the regional CCRP Model is constructed). Moreover, we note that to the extent that higher-conductivity zones (preferential pathways) exist at some locations in the overlying poorly to densely welded tuffs, some potential exists for the upward propagation of project-induced drawdown from the regional carbonate-rock aquifer to the surficial waters of the refuge (as well as Key Pittman Wildlife Management Area).

7.2.3.2 *Uncertainties Concerning Specific Yield and Hydraulic Diffusivity*

Uncertainties exist concerning the value of specific yield assigned to upper valley fill in Dry Lake and Delamar valleys (the simulated production units), with potential consequences for the magnitude of drawdown simulated by the regional model in response to the project pumping. A value of 0.18 has been assigned to the specific yield of upper valley fill in Dry Lake and Delamar valleys, as well as elsewhere in the model domain (roughly 20,000 square miles), based on transient calibration data in a subset of basins that do not include Dry Lake or Delamar valleys (SNWA 2012b)[61]. If 0.18 overestimates the specific yield of upper valley fill in Dry Lake and Delamar valleys (assigned to depths of up to 7,000 or 8,000 feet, SNWA 2009c), the calibrated model would underestimate drawdown in the simulated wellfields, as well as in the underlying regional carbonate-rock aquifer and adjacent areas, including Pahranagat Valley. Correspondingly, if the actual value of specific yield were higher than the 0.18 value, the model would overestimate drawdowns.

Similarly, no transient groundwater level data for the regional carbonate-rock aquifer were utilized during the calibration of aquifer parameters for Dry Lake or Delamar valleys, and transient calibration data for the carbonate-rock aquifer in Pahranagat Valley were limited to one well at the extreme north end of the basin[62], the period of record of which does not appear to coincide with a period of pumping in nearby well(s) (SNWA 2012b). As a consequence, storage coefficients and hydraulic diffusivities attributed to the regional carbonate-rock aquifer in this

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[61] Transient groundwater level data are required to model-calibrate values of specific yield and other aquifer storage parameters. We note that a significant number of transient groundwater level calibration data from basin-fill wells are flagged as representing a response to pumping (Flag no. 4, SNWA 2009c), notably in Snake, Spring, Steptoe, northern White River, Lake, Panaca, Dry, Rose, Eagle, southern Coyote Spring, Garnet, and Lower Moapa valleys, the Muddy River Springs Area, and portions of Lower Meadow Valley Wash. However, the information content of these transient groundwater level data sets is generally limited, and no transient groundwater level data for basin-fill wells were available or utilized during the model calibration in Cave Valley (SNWA 2012b).

[62] Carbonate well 209 S03 E60 13DACD 1 in north-central Pahranagat Valley.

portion of the model (like those in Cave and White River valleys) are assigned, rather than model-calibrated, contributing to uncertainties concerning the rate of propagation of drawdown from the simulated wellfields to Pahranagat resources through the regional carbonate-rock aquifer and magnitude of drawdown at the locations of the resources in the regional model simulations.

7.2.4 *Project versus Aggregate Impacts*

We conclude there may be measurable impacts to the discharge of the Pahranagat warm springs and/or springs, wetlands, and riparian habitat of the Pahranagat Wash that occur within the timeframe of this analysis due to the proposed pumping in Dry Lake and Delamar valleys and cumulative pumping , if only due to

1. the magnitude of the proposed pumping compared to the rate of natural discharge from the project basins and rate of interbasin outflow from the project basins (i.e., Delamar Valley) to Pahranagat Valley (80%–90%);
2. the effects of simulating “net inputs” in excess of those recognized by the NSE to Dry Lake and Delamar valleys, as well as Garden, Coal, and Pahroc valleys (groundwater recharge and interbasin inflows, less existing groundwater rights), on the “bulk” calibration of aquifer parameters in the vicinity of Dry Lake, Delamar, and Pahranagat valleys;
3. unaccounted for, and unknowable, potential for the propagation of project-induced drawdown through preferential pathways that may or may not exist in the regional carbonate-rock aquifer from the proposed wellfields to the areas of Hiko, Crystal, and/or Ash springs (notwithstanding the southerly direction of groundwater flow in the project basins under natural gradient conditions) or the lack of potential based on similar unaccounted for, and unknowable features; and
4. unaccounted for, and unknowable, potential for the upward propagation of project-induced drawdown from the regional carbonate-rock aquifer to surficial waters of Key Pittman Wildlife Management Area and Pahranagat Wash (including riparian habitat for southwestern willow flycatcher), as a result of preferential pathways that may or may not exist in overlying volcanic rocks.

To address uncertainties associated with the assignment of specific yield to upper valley fill in Dry Lake and Delamar valleys (the simulated production units), drawdown predictions produced using the “high-diffusivity” version of the regional model have been employed in this analysis, in conjunction with the predictions of the calibrated model, with the intent of bracketing differences between specific yield values for this important aquifer parameter.

Notwithstanding the above considerations, current information concerning the hydrogeology of Dry Lake, Delamar, and Pahranagat valleys (particularly items 3 and 4 above) is not sufficient to assess the likelihood or magnitude of project-related impacts within the timeframe under consideration, should they occur.

7.2.5 *Project Pumping*

The action is defined only in terms of an annual volume of pumping from each of the project basins. The number, locations, depths, and units of completion of future project production wells are unknown at this time (per the Biological Assessment, BLM 2012a). Consequently, some assumption concerning the distribution of the project production wells is necessary to estimate the potential effects of the proposed pumping (including aggregate effects) using the CCRP Model; such assumption is also a necessary starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions. The assumption made in the model simulations which have been provided to the Service in support of this consultation is that project pumping, including the proposed pumping in Dry Lake and Delamar valleys, will be distributed in an effort to “minimize pumping effects” (SNWA 2009d, 2010c, 2012b). Specifically, the simulated project production wells in Dry Lake and Delamar valleys are distributed across the floor of the valleys and completed largely, if not entirely, in upper valley fill (sands, gravels, and other largely unconsolidated deposits); an assumption which is reflected in the model simulations provided to the Service and upon which these analyses are predicated.

7.2.6 *Uncertainties Related to Potential Long-term Climate Change*

Additional uncertainties exist concerning the degree to which the effects of project pumping, in combination with existing pumping, would be compounded by climate-related increases in air temperature (consequently increases in groundwater evapotranspiration) and potential decreases in precipitation and changes in the timing of precipitation (possible decreases in groundwater recharge) over the timeframe of this analysis. Specifically, the CCRP Model simulations suggest that maximum drawdown in the regional carbonate-rock aquifer at the locations of Hiko, Crystal, and Ash springs due to the proposed pumping in Dry Lake and Delamar valleys would occur in excess of 100 years after any cessation of pumping[63] (SNWA 2012b), i.e., beyond year 2225 (assuming project pumping were to cease at 75 years after FBO), with the effects of that pumping persisting for more than 50 years beyond the time of maximum impacts. We note that changes in air temperature and precipitation (both spatial and temporal) in connection with potential long-term climate change are not only possible, but perhaps likely in this area over the next 200 or more years (Redmond 2010) and could have a significant effect on the water budgets of Dry Lake, Delamar, Pahranagat, and other valleys of the White River Groundwater Flow System (inputs and outputs to the hydrologic system in the form of groundwater recharge and evapotranspiration) and the aggregate effects of project pumping. However, at this time it is not possible to quantify what those changes might be, thus potential long-term climate change remains an uncertainty associated with the groundwater model predictions.

7.3 FLOWING ARTESIAN WELLS AT SHOSHONE PONDS AND RIPARIAN HABITAT, SPRING VALLEY

Based on our analysis of the available CCRP Model predictions of pumping-induced drawdown in upper valley fill of Spring Valley, our current understanding of uncertainties associated with the model predictions, and a range of other hydrogeologic considerations, we conclude that measurable impacts to the discharge of the Shoshone Ponds flowing artesian wells and groundwater levels supporting riparian habitat at numerous locations throughout the valley, up to and including the cessation of flow and reductions in water levels well below the root zone of

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[63] Recovery simulations were run by the project proponent to several hundred years. However, the results provided to the Service were truncated at 100 years of recovery.

Ute ladies'-tresses, are highly likely due to the proposed pumping in Spring Valley and cumulative pumping within the timeframe of this analysis.

7.3.1 *Description of the Resource*

Riparian (potential Ute ladies'-tresses) habitat occurs throughout Spring Valley, in many instances supported by spring discharge. Based on available water temperature data (BIO-WEST 2007) suggest that the maximum depth of circulation of Spring Valley springs, as well as the artesian well flows at Shoshone Ponds, range from a few hundred to roughly 2,000 feet, all well within upper valley fill at their respective locations. In general, springs and the flowing artesian wells originating from groundwater that flows from the mountains to the valley floor through carbonate rocks and unconsolidated deposits (including alluvial fans), or runoff from low-permeability rocks, which discharges along the margins of the valley as a result of changes in topography and/or low-permeability layers within the upper valley fill, i.e., a combination of topographic and structural controls. As such, the springs in Spring Valley are water table springs (discharge from upper valley fill). The artesian well flows at Shoshone Ponds likewise appear to discharge from the basin fill and are also vulnerable to drawdown of the water table, as is Spring Valley riparian habitat not associated with spring discharges.

7.3.2 *Magnitude of the Proposed Pumping*

We examine the magnitude of project pumping in Spring Valley compared to the rate of natural discharge from the project basin as a first step in evaluating the potential impacts of the groundwater withdrawal on the discharge of the Shoshone Ponds flowing artesian wells and riparian habitat in the basin.

The project proposes to pump 61,127 afy or 54.5 MGD for municipal water supply from Spring Valley over a minimum of 97 years (the period for which the Service has been asked to consult, which includes pumping to 75 years after FBO). This amount represents approximately 75–87% of the current rate of natural discharge from the basin[64].

The NSE recognizes 84,000–96,000 afy of groundwater recharge to Spring Valley (NSE 2012d), 84,100 afy of groundwater evapotranspiration (NSE 2012d), 14,080 afy of consumptively used preexisting (committed) groundwater rights (NDWR 2011d), and not more than 4,400 afy of interbasin inflow to the basin from Steptoe and Lake valleys (NSE 2012d). Using the NSE's range of estimates of recharge and interbasin inflow to Spring Valley, less the NSE's estimate of groundwater evapotranspiration and consumptively used existing groundwater rights in the basin, not more than 2,220 afy of interbasin outflow would be expected to occur from Spring Valley to other basins under current (preproject) conditions. The NSE nonetheless recognized at least 4,400 afy of interbasin outflow to Hamlin Valley in the recent Spring Valley Ruling (Ruling 6164, NSE 2012d). We conclude that some uncertainty still exists concerning the water budget of Spring Valley, but the proposed pumping represents a substantial proportion of the current natural discharge (61,127 afy of approximately 69,900–81,900 afy) and is likely to have a

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[64] Due to the difficulty of directly estimating interbasin outflow from Spring Valley, we estimate current natural discharge (approximately 69,900–81,900 afy) using the NSE-recognized estimate of groundwater recharge (84,000–96,000 afy, NSE 2012d), less consumptively used preexisting (committed) groundwater rights in Spring Valley (14,080 afy, NSE 2011d).

measurable effect on groundwater levels throughout Spring Valley, as well as rates of interbasin outflow to Hamlin and southern Snake valleys, over some period of time.

The above considerations notwithstanding, the Service has been asked to consult on the effects of project pumping to 75 years after FBO, a finite period of time (97 years in Spring Valley). These effects depend on many factors, including the rate of propagation of drawdown and potential recovery from the proposed wellfields to the resources of concern, in this case within the project basin itself. Given the complexity of the groundwater flow system and the added challenge of accounting for the rate of propagation of drawdown (and recovery), we begin our analysis with an evaluation of the available regional CCRP model predictions, as a starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions.

7.3.3 *Regional Central Carbonate-Rock Province Model Predictions of Drawdown*

We note that the CCRP Model was developed by the project proponent for BLM for the purpose of evaluating the effects of the proposed project pumping and cumulative pumping at a regional scale, as is appropriate per BLM for their EIS analyses (BLM 2012b). Under the ESA the Service is tasked with assessing the potential effects of the project on federally listed species, many of which depend on site-specific groundwater-dependent habitat (springs and flowing artesian wells that discharge from discrete locations, and wetlands and riparian habitat of limited areal extent). Therefore, we use the predictions of the regional model as a starting point for our analyses (an approach necessitated by the complexity of the hydrogeologic system and the challenge of accounting for the rate of propagation of project-induced drawdown and recovery), followed by an examination of the ways and extent to which impacts to site-specific resources (those providing or creating habitat for federally listed species) have potentially been over- or underestimated by the regional model.

The CCRP Model predictions provided to the Service by BLM in support of this analysis suggest that the proposed pumping in Spring Valley is likely to result in measurable drawdown of the water table at the location of the Shoshone Ponds flowing artesian wells and riparian habitat throughout the basin, even if project pumping is terminated at 75 years after FBO (after 97 years of pumping in Spring Valley) (SNWA 2012b). Specifically, the model predicts that the proposed pumping of 61,127 afy would result in measurable drawdown of the water table in upper valley fill (4–45 feet), including a 24- to 42-feet drop in the elevation of the water table at the location of the Shoshone Ponds flowing artesian wells65, within the timeframe of this analysis. The model simulations further suggest that the proposed pumping in combination with the continuation of existing and any reasonably foreseeable future pumping in Spring Valley (cumulative pumping) would result in a 4- to 49-feet decline in the elevation of the water table, including a 32- to 49-feet drop at the location of the Shoshone Ponds flowing artesian wells (SNWA 2012b), i.e., likely in excess of the driving head on the flowing artesian wells.

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[65] Range of drawdown predicted in response to pumping (project and cumulative) based on predictions prepared using the calibrated and “high-diffusivity” versions of the CCRP Model, which, in combination, account for uncertainties associated with the value of specific yield assigned to upper valley fill in the basin (the simulated production unit).

7.3.4 *Project versus Aggregate Impacts*

Project pumping in Spring Valley has been simulated entirely in upper valley fill, giving rise to a conservative result in this case since the resources in question depend on the elevation of the water table (conditions in the basin-fill aquifer). At the same time, the calibrated CCRP model likely underestimates pumping-induced drawdown of the water table, due to a number of factors related to the calibration of the model and simulation of existing pumping, including the following:

- The effects of simulating net groundwater recharge and groundwater evapotranspiration in Spring Valley in excess of values recognized by the NSE[66] on the "bulk" calibration of aquifer parameters in the basin
- An assignment of runoff recharge in Spring Valley that greatly exceeds prior estimates, with implications for the bulk calibration of aquifer parameters for upper valley fill
- Uncertainties concerning the assignment of specific storage to upper valley fill in Spring Valley (the simulated production unit)
- The simulation of less consumptively used preexisting (committed) groundwater rights in Spring Valley than values recognized by the NSE[67]

To address uncertainties associated with the assignment of specific yield to upper valley fill in Spring Valley (the simulated production unit), drawdown predictions produced using the "high-diffusivity" version of the regional model have been employed in this analysis, in conjunction with the predictions of the calibrated model, with the intent of bracketing differences between specific yield values for this important aquifer parameter.

We further note that prior estimates of runoff recharge to Spring Valley range from 9,000 afy in the GBCAAS Study (Heilweil and Brooks 2011) to 13,633 afy in the BARCAS Study (Welch et al. 2007). In contrast, 50,671 afy of runoff recharge was prescribed to Spring Valley in the CCRP Model (both the "high-diffusivity" and calibrated versions). We conclude that the regional model underestimates drawdown of the water table in Spring Valley, and that measurable impacts to the discharge of the Shoshone Ponds flowing artesian wells and Spring Valley springs, up to and including the cessation of flow, and measurable decreases in the elevation of the water table in riparian areas (well below the root zone of Ute ladies'-tresses) are highly likely due to the proposed pumping in Spring Valley (and cumulative pumping) and may occur well in advance of project pumping to 75 years after FBO.

7.3.5 *Project Pumping*

The action is defined only in terms of an annual volume of pumping from each of the project basins. The number, locations, depths, and units of completion of future project production wells are unknown at this time (per the Biological Assessment, BLM 2012a). Consequently, some assumption concerning the distribution of the project production wells is necessary to estimate the potential effects of the proposed pumping (including aggregate effects) using the CCRP

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[66] The Nevada State Engineer recognizes 84,000–96,000 afy of groundwater recharge and 84,100 afy of groundwater evapotranspiration in Spring Valley (NSE 2012d), while the CCRP Model simulates 82,553 afy of groundwater recharge and 73,700 afy of groundwater evapotranspiration (SNWA 2012b).

[67] The Nevada State Engineer recognizes 14,080 afy of consumptively used preexisting (committed) groundwater rights in Spring Valley (NDWR 2011d), while the CCRP Model simulates 5,600 afy of existing groundwater pumping (SNWA 2009c).

Model; such assumption is a necessary starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions. The assumption made in the model simulations which have been provided to the Service in support of this consultation is that project pumping, including the proposed pumping in Spring Valley, will be distributed in an effort to "minimize pumping effects" (SNWA 2009d, 2010c, 2012b). Project pumping in Spring Valley has been simulated entirely in upper valley fill in the valley floor (sands, gravels, and other largely unconsolidated deposits), producing a conservative result in this case due to the nature of the resources. However, project pumping has also been areally distributed to limit the magnitude of drawdown of the water table at any one location. This notwithstanding, drawdown at all of the locations of interest in Spring Valley, from south to north across the basin, is predicted to be measurable well in advance of project pumping to 75 years after FBO (97 years of pumping).

7.3.6 *Uncertainties Related to Potential Long-term Climate Change*

Additional uncertainties exist concerning the degree to which the effects of project pumping, in combination with existing pumping, would be compounded by climate-related increases in air temperature (consequently increases in groundwater evapotranspiration) and potential decreases in precipitation and changes in the timing of precipitation (possible decreases in groundwater recharge) over the timeframe of this analysis. Specifically, CCRP Model simulations suggest that maximum drawdown of the water table at the locations of interest in Spring Valley would occur at 75 years after FBO, the proposed cessation of project pumping, with surficial water levels recovering approximately 95% in a subsequent 60–70 years (SNWA 2012b). We note that changes in air temperature and precipitation (both spatial and temporal) in connection with potential long-term climate change are not only possible, but perhaps likely in this area over the next 170 or more years (Redmond 2010) and could have an effect on the water budget of Spring Valley (inputs and outputs to the hydrologic system in the form of groundwater recharge and evapotranspiration) and the aggregate effects of project pumping. However, at this time it is not possible to quantify what those changes might be, thus potential long-term climate change remains an uncertainty associated with the groundwater model predictions.

7.4 POTENTIAL UTE LADIES'-TRESSES HABITAT, HAMLIN AND SNAKE VALLEYS

Based on our analysis of the available CCRP Model predictions of pumping-induced drawdown at the locations of South Little Spring, Big Springs / Big Springs Pond, Unnamed 1 Spring (north of Big Springs), Unnamed 2 Spring (north of Big Springs), Big Spring / Lake Creek, and Clay Spring in southern Snake Valley, and springs and Gandy Salt Marsh in northern Snake Valley—coupled with our current understanding of uncertainties associated with the model predictions and a range of other hydrogeologic considerations—leads us to conclude that potential exists for measurable impacts to the discharge of springs supporting potential Ute ladies'-tresses habitat in Hamlin and Snake valleys due to the proposed pumping in Spring Valley and cumulative pumping within the timeframe of this analysis.

7.4.1 *Description of the Resource*

Big Springs, Unnamed 1 Spring, and Unnamed 2 Spring are located at the foot of the southern Snake Range along the western margin of southern Snake Valley, just east of the range-bounding fault, roughly 12 miles from the proposed pumping in Spring Valley. Clay Spring North is located along Big Spring Creek, which emanates from Big Springs (also known as Lake Creek, east of the Nevada-Utah border), an additional 13 miles from southern Spring Valley. South Little Spring is located 3–4 miles southeast of Big Springs. Based on available water temperature data (BIO-WEST 2007; SNWA 2008a), the maximum depth of circulation of discharge from Big Springs, Unnamed 1 Spring, Unnamed 2 Spring, and South Little Spring is approximately 600–1,200 feet, 500–900 feet, 1,800 feet, and 500–1,000 feet, respectively, all within upper valley fill at their respective locations. Clay Spring North discharges from the upper carbonate-rock aquifer, which outcrops approximately 1 mile to the east. In northern Snake Valley, available water temperature data (BIO-WEST 2007) suggest that the maximum depth of circulation of discharge from Gandy Warm Springs and Leland Harris Spring is approximately 1,600–1,900 feet and 800–900 feet, respectively[68].

7.4.2 *Magnitude of the Proposed Pumping*

We have examined the magnitude of project pumping in Spring Valley compared to the rate of natural discharge from the project basin as a first step in evaluating the potential impacts of the proposed groundwater development on Spring Valley resources, including interbasin outflow to Snake Valley (see Flowing Artesian Wells at Shoshone Ponds and Riparian Habitat, Spring Valley). Using the NSE’s range of estimates of recharge and interbasin inflow to Spring Valley, less the NSE’s estimate of groundwater evapotranspiration and consumptively used existing groundwater rights in the basin, not more than 2,220 afy of interbasin outflow would be expected to occur from Spring Valley to other basins under current (preproject) conditions. The NSE nonetheless recognized at least 4,400 afy of interbasin outflow in Ruling 6164 (all from southern Spring Valley to Hamlin Valley, NSE 2012d), with previous estimates ranging from 4,000 afy (Hood and Rush 1965, Rush and Kazmi 1965, Scott et al. 1971, Gates and Kruer 1981, Harrill et al. 1988, and Brothers et al. 1994, as cited by Heilweil and Brooks 2011) to as much as 49,000 afy (Welch et al. 2007). In the case of the highest estimate, up to 33,000 afy of outflow is estimated to occur from southern Spring Valley to Hamlin and southern Snake valleys and 16,000 afy to northern Snake Valley. We conclude that some uncertainty still exists concerning the water budget of Spring Valley, but the proposed pumping represents a substantial proportion of the current natural discharge (61,127 afy of approximately 69,900–81,900 afy) and is likely to capture a measurable portion of the interbasin outflow to Hamlin and southern Snake valleys over some period of time. Likewise some potential exists for the propagation of project-induced drawdown from northern Spring Valley to northern Snake Valley (the area of Gandy Warm Springs, Gandy Salt Marsh, and Leland Harris Spring) through the pass south of the Kern Mountains over some period of time, irrespective of the presence of interbasin outflow under current (preproject) conditions.

The Service has been asked to consult on the effects of project pumping to 75 years after FBO, a finite period of time (97 years in Spring Valley). These effects depend on many factors, including the rate of propagation of drawdown and potential recovery from the proposed wellfields to the resources of concern, in this case from southern Spring Valley to northern Hamlin and southern Snake valleys and from northern Spring Valley to northern Snake Valley.

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[68] Maximum depth of circulation estimated using a geothermal gradient of 1.5 ˚F per 100 feet (Mifflin 1968; as cited by SNWA 2009b).

Given the complexity of the groundwater flow system and the added challenge of accounting for the rate of propagation of drawdown (and recovery), we begin our analysis with an evaluation of the available regional CCRP model predictions, as a starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions.

7.4.3 *Regional Central Carbonate-Rock Province Model Predictions of Drawdown*

We note that the CCRP Model was developed by the project proponent for BLM for the purpose of evaluating the effects of the proposed project pumping and cumulative pumping at a regional scale, as is appropriate per BLM for their EIS analyses (BLM 2012b). Under the ESA the Service is tasked with assessing the potential effects of the project on federally listed species, many of which depend on site-specific groundwater-dependent habitat (springs and flowing artesian wells that discharge from discrete locations, and wetlands and riparian habitat of limited areal extent). Therefore, we use the predictions of the regional model as a starting point for our analyses (an approach necessitated by the complexity of the hydrogeologic system and the challenge of accounting for the rate of propagation of project-induced drawdown and recovery), followed by an examination of the ways and extent to which impacts to site-specific resources (those providing or creating habitat for federally listed species) have potentially been over- or under-estimated by the regional model.

The CCRP Model predictions provided to the Service by BLM in support of this analysis suggest that drawdown may propagate from project pumping in southern Spring Valley across the Limestone Hills (composed of rocks of the lower carbonate unit) into Hamlin and southern Snake valleys, producing up to 2t–3 feet of drawdown at the water table at the locations of Big Springs / Big Springs Pond, Unnamed 1 Spring, Unnamed 2 Spring, and South Little Spring[69] and measurable drawdown of the water table at the location of Clay Spring North, even if project pumping is terminated at 75 years after FBO (105 years). Additionally, the model predicts that lesser amounts of drawdown (millimeters) may propagate from the proposed pumping into northern Snake Valley (the area of Gandy Warm Springs, Leland Harris Spring, and Gandy Salt Marsh) through the pass south of the Kern Mountains within the timeframe of this analysis (SNWA 2012b).

Whereas the predicted drawdown (due to project pumping to 75 years after FBO) is less than 10 feet and therefore not reliable for quantitative purposes due to the regional nature of the model per BLM (BLM 2012a, b), we note that drawdown of the magnitude predicted at Big Springs (1–3 feet), Unnamed 1 Spring (1–2 feet), Unnamed 2 Spring (2–3 feet), South Little Spring (1–3 feet), Clay Spring North (as much as 0.5 feet), and Leland Harris Spring (as much as 0.75 feet) would likely have a measurable impact on the discharge of these springs, particularly Unnamed 1 Spring, Unnamed 2 Spring, and South Little Spring (SNWA 2012b). CCRP Model simulations suggest that the combined impacts of project pumping in Spring Valley and existing and any reasonably foreseeable future pumping in southern Snake Valley (cumulative pumping) would be more significant—as much as 6 feet of drawdown at Big Springs, 4 feet at Unnamed 1 Spring, 4 feet at Unnamed 2 Spring, 7 feet at South Little Spring, 1.5–2 feet at Clay Spring North, and as

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[69] Range of drawdown predicted in response to project pumping based on predictions prepared using the calibrated and "high-diffusivity" versions of the CCRP Model.

much as 0.6 feet at Leland Harris Spring over the same period[70]. Predicted drawdown from the CCRP Model alone is not sufficient to conclude that measurable impacts to the springs are likely, only that they are possible, since the magnitude of drawdown at the locations of the springs is uncertain (subject to error at this and other levels). However, the model likely underestimates drawdown in upper valley fill (the relevant unit), i.e., at the water table, at the locations of the springs due to a number of factors, possibly to a significant extent, making the model predictions *a reasonable first-order approximation of the drawdown that is likely to occur at springs serving as potential Ute ladies'-tresses habitat in Hamlin and Snake valleys (i*.e., a reasonable starting point for additional analysis that considers a range of hydrogeologic information and uncertainties associated with the regional model and regional model predictions).

7.4.3.1 Potential Underestimation of Drawdown by the Central Carbonate-Rock Province Model

The CCRP Model likely underestimates project-induced drawdown of the water table at the locations of Big Springs / Big Springs Pond, Unnamed 1 Spring, Unnamed 2 Spring, South Little Spring, Clay Spring, Leland Harris Spring, and Gandy Salt Marsh in Hamlin and Snake valleys within the timeframe of this analysis, due to a number of factors related to the construction and calibration of the regional model, including but not limited to the following:

- The effects of simulating net groundwater recharge and groundwater evapotranspiration in Spring Valley in excess of values recognized by the NSE[71] on the "bulk" calibration of aquifer parameters in the basin
- The simulation of measurably less consumptively used preexisting (committed) groundwater rights in Spring Valley than that recognized by the NSE[72]
- Assignments of runoff recharge to both Spring and Snake valleys that greatly exceed prior estimates[73], with implications for the bulk calibration of aquifer parameters for upper valley fill
- An under-assignment of in-place groundwater recharge compared to BCM estimates (as a percentage of total groundwater recharge) throughout the Great Salt Lake Desert Groundwater Flow System portion of the model (Spring, Tippett, and Snake valleys), which may have contributed to an assignment of what we believe to be low transmissivity to the regional carbonate-rock aquifer, including the Limestone Hills
- An assignment of low hydraulic conductivity, consequently low transmissivity, to carbonate rocks of the Limestone Hills, which separate southern Spring Valley from springs in Hamlin and southern Snake valleys (potential habitat for Ute ladies'-tresses)

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[70] Range of drawdown predicted in response to cumulative pumping based on predictions prepared using the calibrated and "high-diffusivity" versions of the CCRP Model.

[71] The Nevada State Engineer recognizes 84,000–96,000 afy of groundwater recharge and 84,100 afy of groundwater evapotranspiration in Spring Valley (NSE 2012d), while the CCRP Model simulates 82,553 afy of groundwater recharge and 73,700 afy of groundwater evapotranspiration (SNWA 2012b).

[72] The Nevada State Engineer recognizes 14,080 afy of consumptively used preexisting (committed) groundwater rights in Spring Valley (NDWR 2011d), while the CCRP Model simulates 5,600 afy of existing groundwater pumping (SNWA 2009c).

[73] Heilweil and Brooks (2011) report estimates of runoff recharge to Spring and Snake valleys of 9,000 and 6,900 afy, respectively, prepared using a BCM prediction by Flint and Flint (2007) and adjusted to reproduce discharge estimates. In contrast, runoff recharge prescribed to Spring and Snake valleys in the CCRP Model is 50,671 afy and 83,341 afy, respectively.

- An assignment of what we believe to be low transmissivity to the regional carbonate-rock aquifer in the area west of the range-bounding fault near Big Springs (area of the Big Springs SW well)
- Uncertainties concerning the incorporation of a discrete low-conductivity structure (“horizontal flow barrier”) at the location of the range-bounding fault on the east side of the southern Snake Range, immediately west of Big Springs and South Little Spring, across which simulated drawdown drops more than 4 feet (from 5 feet to <1 feet) at 75 years after FBO due to a two order of magnitude (130-fold) drop in conductivity (SNWA 2012b)
- An assignment of what we believe to be low hydraulic conductivity, consequently low transmissivity, to carbonate rocks in the pass south of the Kern Mountains between northern Spring Valley and northern Snake Valley (e.g., the area of Gandy Warm Springs, Gandy Salt Marsh, and Leland Harris Spring [potential habitat for Ute ladies’-tresses])
- Uncertainties regarding the assigned values of specific storage to upper valley fill in Spring and Snake valleys, and hydraulic diffusivity for the regional carbonate-rock aquifer that may affect the predicted rate of propagation of drawdown to and magnitude of project-induced drawdown in Snake Valley due to the proposed pumping in Spring Valley

In the next section, we examine the effects of assigning what we believe to be low values of hydraulic conductivity, thus low transmissivity, to carbonate rocks separating Spring Valley from Snake Valley at the Limestone Hills and in the pass south of the Kern Mountains. We also examine the uncertainties regarding model assignments of specific yield and hydraulic diffusivity in more detail.

7.4.3.2 Propagation of Drawdown through the Limestone Hills

Values of hydraulic conductivity (0.3 to 0.4 feet/day) attributed to carbonate rocks comprising the Limestone Hills (rocks of the lower carbonate unit) which separate the area of the proposed wellfield(s) in southern Spring Valley from springs serving as potential Ute Ladies’-Tresses habitat in Hamlin and southern Snake valleys (SNWA 2012b) represent the low end of the range of estimated values for carbonate rocks in the Great Basin (Dettinger et al. 1995; SNWA 2009a, 2010a, 2010b, 2011a, 2011b; Belcher et al. 2001; Belcher and Sweetkind 2010; USGS 2012b; Welch et al. 2007), including the lower carbonate-rock unit, and are consistent with minimal fracturing (secondary permeability). Whereas this assignment of conductivity results in a total model transmissivity of 4,500–6,500 square feet/day a reasonable transmissivity for the lower (regional) carbonate-rock aquifer, the bulk of the simulated transmissivity, is at depths that greatly exceed those at which significant groundwater flow or pumping-induced drawdown can be expected to occur (up to 15,000 feet bgs), and the transmissivity of the upper portion (roughly 2,000 feet) is limited. Moreover, groundwater level calibration data for the vicinity of southern Spring, Hamlin, and southern Snake valleys include only 2 wells in the regional carbonate-rock aquifer (SNWA 2012b): 184W101 and 184W502M, located along the western margin of the Limestone Hills in southern Spring Valley (in close proximity). As such, values of transmissivity attributed to the Limestone Hills and other carbonate rocks in the vicinity of southern Spring and southern Snake valleys are not model-calibrated, but rather assigned.

If the hydraulic conductivity of the Limestone Hills has been underestimated, the propagation of drawdown from the simulated wellfield(s) in southern Spring Valley to the locations of the springs in Hamlin and southern Snake valleys may be measurably greater than predicted by the model. For example, if the conductivity of the Limestone Hills is underestimated by two-fold over the effective depth of the flow field (a small uncertainty in an aquifer parameter that can easily vary an order of magnitude and is essentially uncalibrated), drawdown in Hamlin and southern Snake valleys due to the proposed pumping could be 7 feet greater than predicted by the model[74], resulting in significantly more drawdown than the 2–3 feet predicted at Big Springs, South Little Spring, and Unnamed 1 and 2 springs, and significantly more drawdown than the 4–7 feet predicted at these springs due to cumulative pumping over the timeframe of this analysis. Conversely, if the hydraulic conductivities have been overestimated than the propagation of effects would have been overestimated. The propagation of project-induced drawdown from northern Spring to northern Snake valley (where hydraulic conductivities of 0.02–0.2 feet/day have been assigned to rocks of the upper and lower carbonate units in the pass south of the Kern Mountains) may be underestimated also.

The Theim equation used above to estimate drawdown at the location of the springs due to project and cumulative pumping in Big Springs, South Little Spring, and Unnamed 1 and 2 springs at the full proposed rate makes the following assumptions which may or may not reflect actual conditions: 1) water-bearing materials have a uniform hydraulic conductivity; 2) the aquifer is not stratified; 3) aquifer thickness is constant; 4) the potentiometric surface (prior to pumping) has no slope (or gradient); and 5) drawdowns have reached equilibrium conditions.

7.4.4 *Uncertainties Concerning Specific Yield and Hydraulic Diffusivity*

Uncertainties exist concerning the value of specific yield assigned to upper valley fill in Spring and Snake valleys, with potential consequences for the magnitude of drawdown simulated by the model in response to the proposed pumping in Spring Valley. Specifically, a value of 0.18[75] has been assigned to the specific yield of upper valley fill in both valleys, as well as elsewhere in the model domain (roughly 20,000 square miles), based on sparse transient calibration data (SNWA 2012b). If 0.18 overestimates the specific yield of upper valley fill in Spring Valley (assigned to depths of more than 6,000 feet, SNWA 2009c), the calibrated model would underestimate

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[74] Estimated using the Thiem equation for pseudosteady conditions in an unconfined aquifer (Thiem 1906) and calibrated CCRP Model predictions of drawdown across the Limestone Hills between southern Spring and southern Snake valleys in response to the proposed pumping in Spring Valley—specifically, the proposed pumping to 75 years after FBO, roughly the maximum drawdown produced across the Limestone Hills by the action per the calibrated model simulation. The Thiem equation for pseudosteady conditions in an unconfined aquifer (i.e., conditions that can be presumed to exist in the regional carbonate-rock aquifer at the location in question after 75 years of project pumping) describes the shape of a pseudosteady drawdown cone in an unconfined aquifer (in this case the regional carbonate-rock aquifer) and states (when written in terms of drawdown) that the change in drawdown from one distance to another radial distance along the drawdown cone is inversely proportional to the hydraulic conductivity (or transmissivity) of the medium, i.e., the higher the transmissivity of the medium, the “flatter” the drawdown cone. As applied to the problem in question, the Thiem equation predicts that if the calibrated CCRP Model underestimates the transmissivity of the Limestone Hills by as little as two-fold, then the model, which predicts a change in drawdown across this portion of the regional carbonate-rock aquifer of 14 ft, underestimates drawdown on the east side of the Limestone Hills by roughly 7 feet. That is, the drawdown cone produced by project pumping would be less steep than predicted by the calibrated model, resulting in roughly 7 more feet of drawdown at the springs than predicted.

[75] Transient groundwater level data are required to model-calibrate values of specific yield and other aquifer storage parameters. We note that a significant number of transient groundwater level calibration data from basin-fill wells are flagged as representing a response to pumping (Flag no. 4, SNWA 2009c) (notably in Snake, Spring, Steptoe, northern White River, Lake, Panaca, Dry, Rose, Eagle, southern Coyote Spring, Garnet, and Lower Moapa valleys, the Muddy River Springs Area, and portions of Lower Meadow Valley Wash), but that the information content of these transient groundwater level data is generally limited, and no transient groundwater level data for basin-fill wells were available or utilized during the model calibration in Dry Lake or Delamar valleys. Transient groundwater level calibration representing a response to pumping in Pahranagat Valley were limited to the north half of the basin, i.e., north of Pahranagat Wash (SNWA 2012b).

drawdown in the simulated wellfield(s), as well as in the underlying regional carbonate-rock aquifer and adjacent areas, including Snake Valley. Additionally, if the specific yield of upper valley fill has been overestimated in southern or northern Snake Valley, the magnitude of project-induced drawdown in unconfined deposits of Snake Valley, and consequently impacts to Big Springs, South Little Spring, Unnamed 1 and 2 springs, Clay Spring, Leland Harris Spring, and/or Gandy Salt Marsh, would be further underestimated. Conversely, if the specific yields have been underestimated than the effects would have been overestimated.

No transient groundwater level data for the carbonate-rock aquifers were utilized during the calibration of aquifer parameters for Spring or Snake valleys (SNWA 2012b). As a consequence, storage coefficients and hydraulic diffusivities attributed to the carbonate-rock aquifers in this portion of the model (like those in Cave, White River, Dry Lake, Delamar, and Pahranagat valleys) are assigned, rather than model-calibrated, contributing to uncertainties concerning the rate of propagation of drawdown from the simulated wellfields in Spring Valley to Snake Valley resources through the regional carbonate-rock aquifer and uncertainties in the magnitude of drawdown at the locations of the resources in the regional model simulations.

7.4.5 *Project and Aggregate Impacts*

We conclude that potential exists for measurable impacts to the discharge of springs supporting potential Ute ladies'-tresses habitat in Hamlin and Snake valleys, due to the proposed pumping in Spring Valley and cumulative pumping within the timeframe of this analysis. The following factors contribute to this conclusion:

The magnitude of the proposed pumping in Spring Valley compared to the rate of natural discharge from the project basin (approximately 75%–87%)

Possible assignment of what we believe to be a low hydraulic conductivity, consequently low transmissivity, to carbonate rocks of the Limestone Hills (which separate southern Spring Valley from Hamlin and southern Snake valleys) and a lower conductivity to carbonate rocks in the pass south of the Kern Mountains (which separate northern Spring Valley from northern Snake Valley)

To address uncertainties associated with the assignment of specific yield to upper valley fill in Spring Valley (the simulated production unit), drawdown predictions produced using the "high-diffusivity" version of the regional model have been employed in this analysis, in conjunction with the predictions of the calibrated model, with the intent of bracketing differences between specific yield values for this important aquifer parameter.

7.4.6 *Project Pumping*

The action is defined only in terms of an annual volume of pumping from each of the project basins. The number, locations, depths, and units of completion of future project production wells are unknown at this time (per the Biological Assessment, BLM 2012a). Consequently, some assumption concerning the distribution of the project production wells is necessary to estimate the potential effects of the proposed pumping (including aggregate effects) using the CCRP Model, as a starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions. The assumption made in the model simulations which have been provided to the Service in support of this consultation is that project pumping, including the proposed pumping in Spring Valley, will be distributed in an effort to "minimize pumping effects" (SNWA 2009d, 2010c, 2012b). Specifically, project pumping in Spring Valley has been simulated entirely in upper valley fill in the valley floor (sands, gravels, and other largely unconsolidated deposits) and areally distributed to limit drawdown of the water table at any one location, producing a conservative result with respect to the simulated impacts of the proposed pumping on Spring Valley resources (which depend on the elevation of the water table), but underestimating the potential propagation of project-induced drawdown into Snake Valley across the Limestone Hills or through carbonate rocks in the pass south of the Kern Mountains. Because the storativity of upper valley fill is much greater than that of carbonate-rock aquifers (in both the model and real world), simulating pumping in the upper valley fill results in less overall drawdown than would otherwise occur if some or many of the production wells were simulated in rocks of one of the carbonate-rock aquifers.

7.4.7 *Uncertainties Related to Potential Long-term Climate Change*

Additional uncertainties exist concerning the degree to which the effects of project pumping, in combination with existing pumping, would be compounded by climate-related increases in air temperature (consequently increases in groundwater evapotranspiration) and potential decreases in precipitation and changes in the timing of precipitation (possible decreases in groundwater recharge) over the timeframe of this analysis. Specifically, CCRP Model simulations suggest that maximum drawdown of the water table at the location of Big Springs would occur 50 years after any cessation of project pumping in southern Spring Valley (assuming project pumping is terminated at 75 years after FBO), with the water table recovering approximately 10% in a subsequent 50 years (SNWA 2012b). We note that changes in air temperature and precipitation (both spatial and temporal) in connection with potential long-term climate change are not only possible, but perhaps likely in this area over the next 110 or more years (Redmond 2010) and could have an effect on the water budgets of Spring and Snake valleys (inputs and outputs to the hydrologic system in the form of groundwater recharge and evapotranspiration) and the aggregate effects of project pumping. However, at this time it is not possible to quantify what those changes might be, thus potential long-term climate change remains an uncertainty associated with the groundwater model predictions.

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Chapter 8
CLIMATE CHANGE ANALYSIS

8.1 CLIMATE CHANGE PROJECTIONS

Chapter 8 lays the framework to help determine how the species in this Biological and Conference Opinion (Opinion) may be affected by climate change. As stated in Chapter 5, all models and emissions scenarios project very similar increases in average global surface temperature, the most common measure of climate change, until about 2030. While projections of warming magnitude and rate differ after 2030, the overall trajectory is one of increased global warming through the end of this century, even for the projections that assume greenhouse gas (GHG) emissions will stabilize or decline. Projections of temperature change vary slightly between the Great Basin Desert ecoregion (northern two-thirds of the action area) and the Mojave Desert ecoregion (southern one-third of the action area); consequently, projected changes in precipitation and moisture availability vary.

8.1.1 *Downscaled Projections*

8.1.1.1 Great Basin Desert Ecoregion

Dr. Kelly Redmond (2009) reviews various General Climate Models (GCM) that project changes in mean temperature over Spring Valley, Nevada, for the 21st century in Figure 16 of his summary report, “Climate and Climate Change in Eastern Nevada: An Overview”. These GCMs are referenced in the Intergovernmental Panel on Climate Change (IPCC) Report of the Intergovernmental Panel on Climate Change (IPCC 2007a). Spring Valley is found in the south-central portion of the Great Basin Desert ecoregion and is located approximately at the center of the action area. Spring Valley is likely representative of other basins in the Great Basin Desert ecoregion (Redmond 2009).

Between 2071 and 2100, Redmond (2009) projects a 3.8 degrees Celsius (°C) (6.8 degrees Fahrenheit [°F]) increase in annual mean temperature relative to the annual mean for the time period 1971–2000 (see Figure 16 in Redmond 2009). Seasonal differences exist: summer is anticipated to warm slightly more (approximately 4.3 °C [7.7 °F]) and winter is anticipated to warm slightly less (approximately 3.5 °C [6.3 °F) than the annual mean. Annual precipitation is expected to remain similar to present values as the century progresses, although winter is expected to become somewhat wetter, spring and summer somewhat drier (Redmond 2009). These projections are based on the A1B emissions scenario described in Chapter 5.

Using Climate Wizard (Girvetz et al. 2009), we were unable to model climate change projections based on the low (B1) and moderate (A1B) carbon emissions scenarios (see Chapter 5). Under the higher carbon emission rate (A2) (albeit not the highest emissions scenario by the end of century modeled by Intergovernmental Panel on Climate Change [IPCC] in 2007a,b), Climate Wizard projects a 4.8 °C (8.6 °F) increase in the annual mean temperature in Spring Valley for 2070–2099 relative to the 1961–1990 baseline. The projected change in annual mean temperature for summer is 5.4 °C (9.7 °F); for winter, it is 4.3 °C (7.7 °F). While the Climate Wizard projects larger absolute changes in temperature under the high carbon emission rate, the relative changes between seasons are similar to those found by Redmond (2009) in that summer is anticipated to warm more (winter less), than the annual mean.

For changes in annual average precipitation, Climate Wizard projects a decrease of 19.4 millimeters (mm) (0.76 inches) in central Spring Valley, which represents a 9.4% decrease relative to the 1961–1990 baseline. Compared to temperature change projections, considerable uncertainty exists regarding precipitation changes and confidence in some model estimates is higher for temperature than for precipitation (Randall et al. 2007). This uncertainty is largely because the temporal and spatial scales of GCMs are for global/regional processes, and are not able to model precipitation when driven by local convection storms. Uncertainty may also occur because precipitation can be characterized in terms of several characteristics: amount (how much), frequency (how often), intensity (rate of arrival), and type (rain or snow) (Redmond 2009). Presenting trends in increases or decreases in precipitation over the seasons may be more relevant. Similar to projections cited in Redmond (2009), Climate Wizard projects an increase in precipitation for winter and a decrease in summer. As stated in Redmond (2009), changes in hydrologic function can be brought about by changes in temperature even when no change in annual or seasonal precipitation occurs. For example, when temperatures are cooler, precipitation more effectively transforms into soil recharge and subsequent streamflow (Redmond 2009). In the Great Basin Desert ecoregion, hydrologic function, in terms of moisture availability, is critical to aquatic or groundwater-dependent species. Seven of the 11 species in this consultation are fish and rely on surface water originating from precipitation and/or groundwater. Breeding habitat for Southwestern willow flycatcher is restricted to dense riparian vegetation, and Ute ladies’-tresses requires saturated soils for much of the growing season.

Climate Wizard produces moisture metrics based on potential evapotranspiration (PET), or the balance between precipitation and the amount of water that an ecosystem could potentially lose through evaporation and transpiration (Girvetz et al. 2009). PET is calculated using monthly temperature and monthly average number of daylight hours based on a modified version of the Thornethwaite equation (Hamon 1961). Further information can be found in Wolock and McCabe (1999). PET generally increases with warmer temperatures (Girvetz et al. 2009). The projections for the Great Basin Desert ecoregion demonstrate an approximate 38% increase over existing PET levels. This increase has implications for annual moisture deficit and annual aridity index, which are metrics that quantify moisture stress and aridity in a system. Moisture deficit occurs when precipitation is less than PET: it is the gap between the amount of precipitation and PET. In this case, Climate Wizard projects an increase in that gap by 232–250 mm (9.1–9.8 inches) in central and south Spring Valley. Consequently, as the aridity index lowers, an increase in moisture stress of approximately 12% occurs.

8.1.1.2 *Mojave Desert Ecoregion*

The climate of the Mojave Desert ecoregion differs substantially enough from the Great Basin Desert ecoregion to warrant a separate analysis. The projections for Spring Valley should not be applied to systems within the Mojave Desert, such as Muddy River Springs.

Under the carbon emission rate (A2), Climate Wizard projects a 4.7 °C (8.5 °F) increase in the annual mean temperature for the Muddy Springs area for 2070–2099. The projected change in mean temperature for summer is 5.2 °C (9.4 °F); for winter, it is 4.0 °C (7.2 °F).

For changes in annual average precipitation, Climate Wizard projects an increase of 5.7 mm (0.2 inches) for the Muddy Springs area, which represents a 5% increase relative to the 1961–1990 baseline. Compared to temperature change projections, considerable uncertainty exists regarding precipitation changes. Climate Wizard suggests increased precipitation in the summer and winter, with more precipitation in the summer (10.7 mm [0.42 inches]) than the winter (1.9 mm [0.07 inches]). However, this is difficult to verify because the models show ranges of both positive and negative precipitation changes. The projections for the Mojave Desert ecoregion demonstrate the same increase (38%) in PET as the Great Basin Desert ecoregion. This increase in PET has implications for annual moisture deficit and the annual aridity index, which are metrics that quantify moisture stress and aridity in a system. Moisture deficit occurs when precipitation is less than PET; it is the gap between the amount of precipitation and PET. In this case, Climate Wizard projects an increase in that gap by 416 mm (16 inches) in central and south Spring Valley. Consequently, as the aridity index lowers, an increase in moisture stress of approximately 2% occurs.

8.2 EFFECTS TO LISTED SPECIES' HABITAT

An intermediary step in translating climate change effects to the species in this Opinion is an understanding of how species' habitat may potentially change under climate change conditions. Accordingly, we present how climate change may affect the following habitat types:

- Springs and springbrooks in the Great Basin Desert and Mojave Desert ecoregions (representing habitat for the 7 fish species in this Opinion and partial habitat for Ute ladies'-tresses [*Spiranthes diluvialis*])
- Warm desert riparian areas (representing habitat for southwestern willow flycatcher [*Empidonax traillii extimus*])

8.2.1 *Springs and Springbrooks*

Springs provide crucial habitat to a significant percentage of Nevada's federally listed species, including the 7 species of fish that are included in this Opinion. The importance of spring and springbrook (area of flowing water linked to the spring source) habitat in Nevada cannot be overstated (NDOW 2012). Of Nevada's 173 endemic species, 165 are associated with spring-fed habitats (Abele 2011). An important aspect of these systems is that fish are able to move within the system to meet their temperature needs; during winter months they can move closer to the spring source to meet thermal maintenance requirements and move toward cooler outflow systems during warm weather periods (NDOW 2012).

The source and subterranean pathway of water to springs may be local or regional, a factor which complicates the understanding of potential effects from climate change. Great Basin hydrogeology is complex and impacts on individual spring systems will depend not only on their specific correlation to carbonate or non-carbonate regional groundwater aquifers but also the physical location and elevation of individual sites within a given basin system or watershed. Generally speaking, large (often thermal) springs and spring complexes tied to regional or intermediate carbonate aquifer flow systems are likely to show minimal effects from projected changes in seasonal precipitation patterns and increasing air temperatures over the next 20 to 30 years. Effects associated with these regional springs, will primarily be expected in the springbrook components of the systems where increased air temperatures and transpiration could have potential effects on springbrook length, total wetted area, and thermal characteristics, which may affect habitat suitability for certain species (NDOW 2012).

Spring systems in Nevada not directly associated with deep carbonate regional flow systems depend more on local recharge and short-term changes in precipitation and runoff patterns. Valley bottom springs associated with non-carbonate groundwater aquifers, as well as intermediate and higher elevation (mountain block) springs, are generally characterized by discharge of “younger” (often <60 years old) water. Accordingly, they are highly dependent on groundwater recharge from winter precipitation in local mountain systems to maintain flows, and even under existing climatic conditions can show interannual variability in discharge greater than that typically shown by carbonate-based regional springs. Because these systems depend more on relatively shallow groundwater flow and local recharge, anticipated effects from climate change will be substantially greater. Warming air temperatures will affect not only springbrook characteristics but have the potential to modify precipitation characteristics; increased snowline elevations, early spring onset, and temporal changes in precipitation timing all have the potential to alter groundwater recharge characteristics with corollary effects on individual spring total discharge and increased interannual variability in flow (NDOW 2012).

8.2.2 *Warm Desert Riparian Areas*

The largest, long-term threat to warm desert riparian areas is unrelated to climate change and is instead a consequence of anthropogenic disturbance to normal geomorphic processes that govern these systems (NDOW 2012). Native plant communities have been displaced with monocultures of non-native tamarisk (*Tamarix* spp.) because of urban and suburban development. The channel stability created by these tamarisk monocultures serves to mute the beneficial effects of high flow events to aquatic habitat diversity. Regardless of future climate change, the NDOW projects that the entirety of these systems will transition to uncharacteristic vegetation classes such as non-native tamarisk or other uncharacteristic native vegetation (NDOW 2012).

In general, climate change effects to warm desert riparian areas will likely be observed where spring and early summer base flows depend on local snowpack runoff for maintenance. In this part of the Mojave Desert ecoregion, changes in the timing of spring runoff events (earlier onset) may result in lower base flows in late spring and summer. Increasing frequency of summer monsoonal storm events, as well as a temporal shift of these events, may result in higher stochasticity of flows (NDOW 2012). Depending on how that shift occurs, changes in the frequency of channel and floodplain may occur, modifying flow events.

8.3 SPECIES SENSITIVITY FACTORS

The Climate Change Vulnerability Index (CCVI; Young et al. 2011) considers a number of factors in assessing species sensitivity to climate change. Each is associated with vulnerability to climate change in published literature and references for each factor may be found in Version 2.1 of the document (Young et al. 2011). As stated in Chapter 5, we focused on the specific sensitivity factors the Nevada Department of Wildlife (NDOW) evaluated in its draft Nevada Wildlife Action Plan (WAP) (Wildlife Action Plan Team 2012). In the following paragraphs we discuss the factors applicable to fish species and Southwestern willow flycatcher. The NDOW did not evaluate climate change vulnerability for Ute ladies’-tresses because it does not include plant species in its WAP. Consequently, we considered the life history of Ute ladies’-tresses to determine what factors may contribute to the sensitivity of the species to changes in climate and subsequent changes in its habitat.

8.3.1 *Fish Species*

The following factors were identified by the NDOW to increase sensitivity of Nevada fish species to climate change in its application of the CCVI for the draft Nevada WAP (Wildlife Action Plan Team 2012):

- Natural barriers, measured by the degree to which they limit a species' ability to shift its range in response to climate change (Pahrump poolfish [*Empetrichthys latos*], White River spinedace [*Lepidomeda albivallis*], Hiko White River springfish [*Crenichthys baileyi grandis*], Pahranagat roundtail chub [*Gila robusta jordani*], White River springfish [*Crenichthys baileyi baileyi*], and Moapa dace [*Moapa coriacea*])
- Anthropogenic barriers, measured by the degree to which they limit a species' ability to shift its range in response to climate change (Pahranagat roundtail chub)
- Physiological thermal niche, measured by a species' reliance on relatively cool or cold above-ground terrestrial or aquatic environments (Pahranagat roundtail chub)
- Historical hydrological niche, measured by large-scale variations in precipitation that a species has recently experienced (White River spinedace, Hiko White River springfish, Pahranagat roundtail chub, White River springfish, and Moapa dace)
- Physiological hydrological niche pertaining to a species' dependence on a narrowly defined precipitation/hydrologic regime (Pahrump poolfish)

8.3.2 *Southwestern Willow Flycatcher*

The following factors were identified by the NDOW to increase sensitivity of Southwestern willow flycatcher to climate change in its application of the CCVI for the draft Nevada WAP (Wildlife Action Plan Team 2012):

- Physiological thermal niche, measured by a species' reliance on relatively cool or cold above-ground terrestrial or aquatic environments
- Historical hydrological niche, measured by large-scale variations in precipitation that a species has recently experienced
- Physiological hydrological niche pertaining to a species' dependence on a narrowly defined precipitation/hydrologic regime
- The extent to which the species depends on habitat generated by other species

8.3.3 *Ute ladies'-tresses*

The following life history factors likely increase the sensitivity of Ute ladies'-tresses to climate change (see the "Life History and Population Dynamics" section in Chapter 11):

- Dependence on associated wetland vegetation to attract and maintain pollinators
- Dependence on a narrowly defined precipitation/hydrologic regime
- Dependence on perennial riparian corridors maintained by regular disturbance

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Chapter 9
WHITE RIVER SPINEDACE

9.1 ANALYSIS AREA AND PROPOSED ACTION COMPONENTS

The analysis area for White River spinedace (*Lepidomeda albivallis*) is a subset of the overall action area described in Chapter 3 (Action Area). It encompasses those Hydrographic Basins (HBs) within the action area that meet one or more of the following criteria: 1) HBs containing White River spinedace and/or designated critical habitat for the species; 2) HBs in which one or more components of the proposed action have the potential to generate adverse effects to the spinedace and/or its critical habitat ("project basins"); and 3) HBs through which impacts generated in project basins would have to propagate to reach any site having spinedace and/or critical habitat. This third criterion primarily reflects the patterns of hydrologic connectivity (groundwater movement) among HBs within the action area, as described in Chapter 7 (Hydrologic Analyses) of this Biological and Conference Opinion. As explained in that chapter, groundwater pumping occurring within a given basin may affect groundwater levels within adjacent or even more distant basins. Our White River spinedace analysis area therefore includes those basins in or through which project-related activities (i.e., groundwater development) may ultimately affect spinedace and/or critical habitat, in addition to any basin in which spinedace occurs or critical habitat can be found. We provide our rationale for each of the basins included in our White River spinedace analysis area below.

As explained later in this chapter (refer to the section *Status of the Species - Distribution and Status*), only one basin within the action area contains White River spinedace (White River Valley) and therefore meets the first criterion of containing known occurrences of spinedace and/or its critical habitat. The project basins included in the analysis area based on criterion two are Cave Valley, Dry Lake Valley, and Spring Valley. The specific project components that we assessed for their potential to impact spinedace include the following: 1) construction, operation, and maintenance of any Tier 1 infrastructure (e.g., main/lateral pipeline, power lines, et cetera) in Cave Valley, which is the closest project basin to White River spinedace and its critical habitat; 2) construction, operation, and maintenance of future groundwater development facilities in Cave Valley (i.e., production wells, collector pipeline, et cetera); 3) pumping of 5,235 acre feet per year (afy) in Cave Valley; 4) pumping of 11,584 afy of groundwater annually in Dry Lake Valley; and 5) pumping of 61,127 afy of groundwater in Spring Valley. Lastly, basins meeting criterion three include those basins believed to be in hydrologic connection with the project basins and White River Valley, where spinedace and critical habitat occur. As described in Chapter 7 (Hydrological Analyses), groundwater drawdown could propagate from production sites in Cave, Dry Lake, and Spring valleys to White River Valley, including by way of intervening valleys such as Steptoe Valley and Pahroc Valley.

Therefore, we have defined our analysis area for White River spinedace to include the following HBs: White River Valley HB (the only basin within the action area in which White River spinedace and critical habitat for this species occurs); Cave Valley HB, Dry Lake Valley HB, and Spring Valley HB (three of the project basins); and Steptoe Valley HB and Pahroc Valley HB (two of the intervening basins through which groundwater drawdown could propagate to reach White River spinedace sites and critical habitat). We focus our effects analysis on those sites currently occupied by White River spinedace and/or designated as critical habitat, and other sites that the White River Spinedace Recovery Implementation Team (RIT) is considering for establishment of additional populations in White River Valley.

The White River spinedace analysis area and the above-mentioned sites are depicted in Figure 9-1**.**

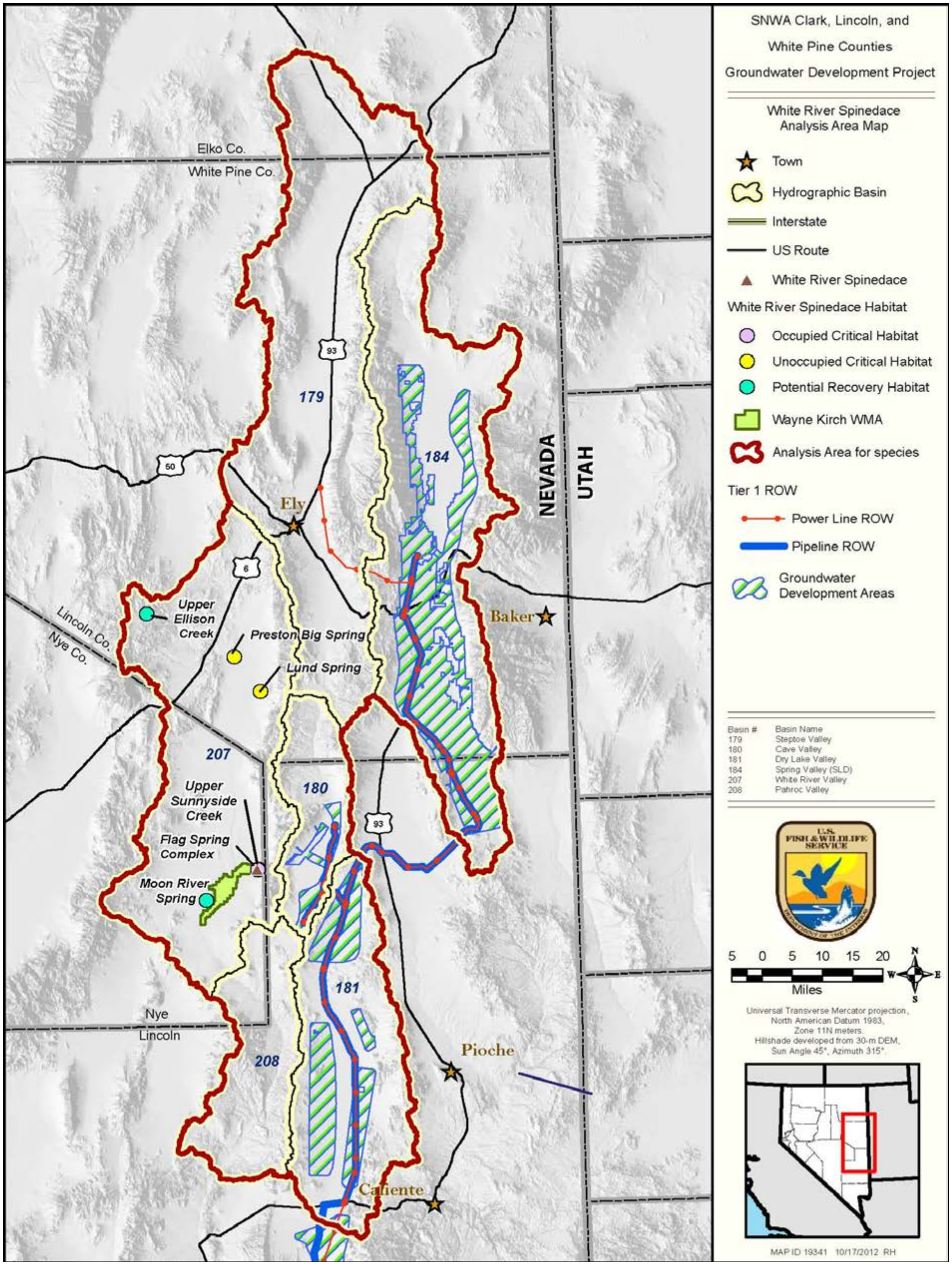


Figure 9-1. Analysis area for White River spinedace

9.2 STATUS OF THE SPECIES

9.2.1 *Regulatory Status*

The Service listed the White River spinedace as endangered with critical habitat on September 12, 1985 (USFWS 1985) and approved a Recovery Plan for the species on March 28, 1994 (USFWS 1994). White River spinedace was listed by the State of Nevada as endangered on December 11, 1982.

9.2.2 *Species Description and Taxonomy*

The White River spinedace is a member of the Plagopterini tribe of the minnow family (Cyprinidae) (Miller and Hubbs 1960), which are noted for their adaptations to small, swift-water desert streams (USFWS 1985). The Plagopterini tribe includes the monotypic genera *Meda* (spikedace) and *Plagopterus* (woundfin), and the polytypic genus *Lepidomeda* (spinedace and leatherside chub). Most members of this tribe are distinguished from other cyprinids by: 1) the spine-like character of the pelvic and pectoral fin rays, and the two anterior dorsal fin rays; 2) a membranous connection between the innermost ray of the pelvic fins and the belly; 3) bright silver body coloration; and 4) the absence or diminutive development of body scales (Miller and Hubbs 1960). However, the leatherside chub, which was recently classified with *Lepidomeda*, lacks the prominent dorsal spine characteristic of this tribe (Johnson et al. 2004). The genus *Lepidomeda* is the most generalized and diverse of the Plagopterine fishes (Miller and Hubbs 1960).

White River spinedace is a relatively large species of *Lepidomeda*, often growing to 100–130 millimeters (mm) (4–5 inches) (Miller and Hubbs 1960) or larger (up to 165 mm [6.5 inches], which is the largest reported specimen) (Scoppettone et al. 2004a). Miller and Hubbs (1960) first described White River spinedace based on specimens from the 1930s and 1940s. The following characteristics can be used to distinguish the species from other *Lepidomeda*: a pharyngeal tooth formula of 5-4 in the main row; typically fewer than 90 lateral-line scales; a moderately oblique mouth; a dorsal fin of moderate height; and its distinctive body coloration. Post-nuptial males are bright brassy green to olive dorsally, brassy over bright silver laterally, silvery-white ventrally, with coppery-red to red on the side of its head and gilt reflections on the cheeks and opercles (Miller and Hubbs 1960; La Rivers 1994).

As defined by Miller and Hubbs (1960), the Plagopterini tribe consisted of seven species (six extant and one extinct) in three genera, all endemic to the middle and lower Colorado River drainage. Included in the genus *Lepidomeda* were White River spinedace and the extinct Pahranagat spinedace (*L. altivelis*), both endemic to the pluvial White River system in southeastern Nevada; Big Spring spinedace (*L. mollispinis pratensis*) endemic to the upper pluvial Carpenter River (Meadow Valley Wash), a tributary to the pluvial White River, in southeastern Nevada; Virgin spinedace (*L. m. mollispinis*), endemic to the Virgin River and its tributaries in Nevada, Arizona, and Utah; and the Little Colorado spinedace (*L. vittata*), endemic to the upper portions of the Little Colorado River system and its tributaries in eastern Arizona (Miller and Hubbs 1960). Recent research indicates that two other species belong to the genus *Lepidomeda*: northern leatherside chub (*L. copei*) and southern leatherside chub (*L. aliciae*), previously assigned to the genus *Gila* or *Snyderichthys* (Dowling et al. 2002). The reclassification of leatherside chub as *Lepidomeda* brings the number of extant species in this genus to six, and expands the distribution of the genus to include the Bonneville basin and upper Snake River drainage in northern Utah and Nevada, southern and eastern Idaho, and western Wyoming.

Molecular tests performed to elucidate evolutionary relationships of the Plagopterine fishes indicate that White River spinedace is most closely related to Big Spring spinedace, Virgin spinedace, and the now-extinct Pahranagat spinedace (Dowling et al. 2002; Johnson et al. 2004), with a maximum divergence time of 1.3 million years ago (Dowling et al. 2002). This divergence may have occurred when pluvial Pleistocene waters became disconnected with the onset of arid conditions in recent geologic time, resulting in isolation of aquatic organisms (vicariance hypothesis) (Miller and Hubbs 1960; Dowling et al. 2002). The spinedace of the pluvial White River-Virgin River systems (as a group) are most closely related to the northern leatherside chub, with a divergence time of 1.3 to 7.4 million years ago. White River spinedace diverged from Little Colorado spinedace, southern leatherside chub, spikedace, and woundfin even further back in geologic time (Dowling et al. 2002). While the evolutionary events associated with the current distributions of *Lepidomeda* species are still unclear, the molecular similarities of these species indicate inter-connection of currently occupied drainages in the geologic (presumably pluvial) past (Miller and Hubbs 1960; Dowling et al. 2002; UDWR 2009).

9.2.3 *Distribution and Status*

9.2.3.1 Historical Distribution and Abundance

The White River spinedace is one of six native fish species endemic to springs and spring-fed creeks of the White River Valley in southern White Pine County and northeastern Nye County, Nevada (Miller and Hubbs 1960; La Rivers 1994; Scoppettone et al. 2004b). This species exhibits a relict distribution: like other native fishes of the pluvial White River, it was presumably more widespread when the pluvial White River flowed continuously over 300 kilometers (km) (186 miles) southward to join the Colorado River (Williams and Wilde 1981; Courtenay et al. 1985). With the drying of the pluvial White River in recent geologic time, White River spinedace populations likely became isolated where suitable spring habitat remained (Miller and Hubbs 1960), similar to other native fishes (e.g., White River springfish [*Crenichthys baileyi*]) of the White River system (Hubbs et al. 1974, cited in Williams and Wilde 1981; Courtenay et al. 1985).

The recent historical distribution of White River spinedace is not completely known because aquatic systems in the White River Valley were not thoroughly inventoried prior to human modification (USFWS 1994). Historical accounts from the mid-1900s indicate that the species was considered common to abundant and occurred at the following sites: the White River below the mouth of Ellison Creek (type specimen, 1934), Preston Big Spring, Nicholas Spring (and the confluence of Nicholas and Preston Big Springs), Lund Spring, Arnoldson Spring, Cold Spring, Indian Spring, Flag Springs (comprised of North, Middle and South Flag springs, which interconnect and flow into Sunnyside Creek), and the White River 15 km (9.3 miles) downstream from Flag Springs below the Adams-McGill Reservoir (Miller and Hubbs 1960; La Rivers 1994; Williams and Wilde 1981; USFWS 1994). In 1957, the Nevada Department of Wildlife (NDOW) transplanted White River spinedace to Railroad Valley in eastern Nevada, where it did not survive (La Rivers 1994) and does not currently occur. White River spinedace was also reportedly used as bait fish in the lower Colorado River in 1951, but a population did not establish there (Miller 1952, cited in USFWS 1994).

The latter part of the 20th century marks a period of rapid loss of White River spinedace populations and reduction in overall abundance. It is difficult to determine exactly when White River spinedace populations began to decline or were eliminated, but dramatic population declines and losses of many native fish populations in the White River Valley began in the 1960s (Courtenay et al. 1985; Sada and Vinyard 2002) and continued at least into the 1990s (Scoppettone et al. 2004b). Spinedace population declines and losses have been attributed to modifications and fragmentation of habitat caused by channelization and flow diversions to support agriculture, and the introduction of non-native, predaceous fishes (Deacon 1979; Courtenay et al. 1985; USFWS 1985; Scoppettone 2007). The first disappearance of White River spinedace may have been from its type locality (La Rivers 1994) in the White River near the mouth of Ellison Creek (USFWS 1994): only one individual was documented at this site in a 1956 stream survey (Frantz 1956, cited in USFWS 1994) and it has not been observed in this area in more recent surveys (Scoppettone et al. 2004b). By 1979, White River spinedace was considered rare in all localities surveyed (Hardy 1980, cited in USFWS 1985). At the time it was listed as endangered in 1985, the species had been extirpated from all historical localities except Lund Spring and Flag Springs, where populations were small and restricted to remnants of historic habitats (Courtenay et al. 1985; USFWS 1985). Extensive surveys of historical spinedace habitat by U.S. Geological Survey (USGS) in 1991 and 1992 confirmed the suspected extirpation of spinedace from Lund Spring and documented its occurrence in only a single 70-m (230-feet) stream reach at North Flag Spring (Scoppettone et al. 2004b), which was likely a remnant of their historic distribution in this system. All of the documented individuals were large, suggesting lack of recent recruitment and a species on the verge of extinction (Scoppettone et al. 2004a).

By 1991, it appeared that less than 50 adult spinedace remained in the upper-most reach of the North Flag Spring outflow, where habitat consisted of a shallow riffle (~10 cm [3.9 inches] deep) and two small ponds (one pond was 300 square meter [m^2] [3,229 square feet]), with a maximum depth of 1 meter [m] [3.3 feet]; and the other was 75 m^2 [807 square feet], with a maximum depth of 0.7 m [2.3 feet]) (Scoppettone et al. 2004a,b). These ponds had been created and spinedace moved there to keep them safe from the predaceous largemouth bass (*Micropterus salmoides*), which had been introduced downstream (NDOW 2011). However, it was thought that the ponds did not have suitable spawning habitat (e.g., substrate) (Stein and Sjoberg 2000; Scoppettone et al. 2004a). In 1995 and 1996, 20 adult spinedace (which constituted all of those captured, and thus potentially all that existed at the time) were moved out of the cool North Flag Spring headwater pools into warmer downstream reaches following eradication of largemouth bass and installation of a temporary fish barrier (Scoppettone et al. 2004a; USFWS 2010). This area had greater habitat diversity and characteristics similar to those used as spawning sites by other Plagopterine fishes (Scoppettone 2004a).

In September 1996, 61 spinedace were counted exclusively in the South Fork (defined as the combined outflows of the South Flag and Middle Flag springs) (Scoppettone et al. 2004a). The observed spinedace were all young (measured fish ranged from 33 to 65 mm [1.3 to 2.5 inches] Fork Length [FL]), and likely represented recent reproduction and recruitment. By October 1998, 396 spinedace were counted, ranging from 20 to 105 mm (0.7 to 4.3 inches) (or greater) FL, indicating continuing reproduction and recruitment. Most fish were again in the South Fork, but their distribution had also expanded downstream into Sunnyside Creek (Scoppettone et al. 2004a).

9.2.3.2 Current Distribution and Recent Abundance Estimates

Currently, White River spinedace are found only at the Flag Springs Complex, a series of three north-to-south trending springs (North, Middle, and South Flag springs) within 300 m (984 feet) of each other, the outflows of which drain into Sunnyside Creek. Spinedace distribution within the Flag Springs Complex has greatly expanded in recent years. They are now found in the outflow channel of all three springs and downstream into upper Sunnyside Creek, inhabiting approximately 2.5 km (1.55 miles) of habitat in the system (Hobbs 2006, cited in USFWS 2010). This population expansion is the result of efforts to keep predaceous non-native fish out of spinedace habitat and habitat improvement projects, described below (see *Conservation Measures to Improve and Expand Spinedace Habitat*). In 2004-2005, spinedace from Flag Springs were stocked into Indian Spring in northern White River Valley in an attempt to establish a refugium population (Hobbs 2004a; USFWS 2010). This effort was unsuccessful and there are no further plans to transplant the species to this site due to a lack of documented reproduction (USFWS 2010).

Beginning in 1995, USGS (1995-1997) and NDOW (1995-present) started conducting biannual snorkel surveys to estimate the total spinedace population and their distribution within the Flag Springs Complex and Sunnyside Creek. The abundance of spinedace has increased substantially since the lows of the early 1990s, with 1,000 or more individuals typically counted during surveys between 2002 and 2009 (Figure 9-2, Table 9-1). The presence of multiple age classes (or cohorts) of spinedace indicates successful recruitment over a series of years. However, the population has fluctuated both within and among seasons, which could be caused by seasonal population variations (reproduction, etc.) and other natural factors. Some variability is also due to survey protocol changes (e.g., minimum size FL of fish included in the counts, length of system surveyed, etc.) and periodic increases in aquatic vegetation, which decreases the ability to survey for and detect fish (USFWS 2010; NDOW 2011). This complicates the comparison of count data over time, making it difficult to draw conclusions about finer-scale population trends.

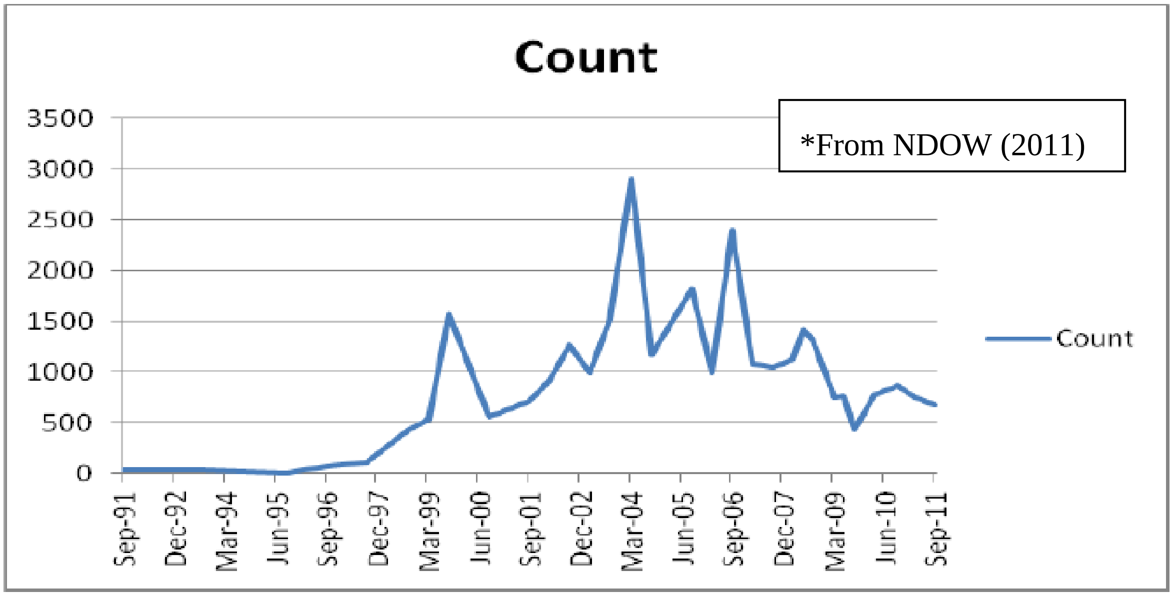


Figure 9-2. White River spinedace total counts at Flag Spring Complex and Sunnyside Creek, 1991–2011

Table 9-1. White River spinedace count by survey location, 1995–2011

Survey Month/Year	Flag Springs		Sunnyside Creek	Total WR Spinedace Count	Comments and Reference(s)
	North Spring Outflow	Middle & South Spring Outflow	Above and Below Culvert Combined		
March 1995	14			0	0 Fish counted, but aquatic vegetation too dense to see fish. In spring 2005, 14 adult fish were relocated from the North Spring headwater pools to 200m downstream (North Outflow). All relocated fish ≥ 75mm Fork Length (FL) (Scoppettone et al. 2004a)
September1995					
March 1996	6				6 adult fish relocated from North Headwater Pools to North Outflow. All relocated fish ≥ 75mm FL (Scoppettone et al. 2004a)
September 1996		61-68		61-68	Scoppettone et al. (2004a) counted 61 fish in the Middle and South Spring Outflow, and measured fish ranging from 33 to 65 mm (1.3 to 2.5 inches) FL (n=22), indicating recent reproduction. Nevada Department of Wildlife (NDOW) counted 68 spinedace in the lower reach of the Middle and South Spring Outflow, and all fish were less than 100 mm (3.9 inches) (Stein 1999)
March 1997	0				0 fish caught in headwater pools of North Fork after trapping and electrofishing, and it was concluded that no fish remained in this area (Scoppettone et al. 2004a)
September 1997		81	31	112	Measured fish ranged from 18 to 73 mm FL (0.7 to2.8 inches) (n=37), indicating recent reproduction (Scoppettone et al. 2004a)
March 1998	13	164	31	208	Stein (1999)
Sept–Oct 1998		208-305		396-429	*In September, NDOW counted 429 fish, with 305 fish in the Middle and South Outflow, 50 fish in the North Fork, and 171 fish in Sunnyside Creek (Stein 1999). In October, USGS counted 396 fish, with 208 fish in the Middle and South Spring Outflow and an additional 91 fish in North Fork <u>and</u> several hundred meters downstream into Sunnyside Creek; size ranged from 20-105 or 110mm FL (n=396) (Scoppettone et al. 2004a).
March 1999				538	Distribution in system not reported (Stein 2000). In 1999, young-of-the- year (YOY), or those fish <40mm FL, comprised ~74% of population (NDOW 2001)
September 1999				1573	Distribution in system not reported (Stein 2000). In 1999 YOY comprised ~74% of population (NDOW 2001)
March 2000	---		---	---	Complete surveys not done due to poor weather, but NDOW verified that spinedace still present and abundant (NDOW 2000)

Survey Month/Year	Flag Springs		Sunnyside Creek	Total WR Spinedace Count	Comments and Reference(s)
	North Spring Outflow	Middle & South Spring Outflow	Above and Below Culvert Combined		
September 2000				556	Aquatic vegetation limited surveys; distribution in system not reported(NDOW 2000). In 2000, YOY comprised only 34% of the population (NDOW 2001).
March 2001				<100	Cause of decline was determined to be increased avian predation from cormorants and herons. After several months of hazing, these birds fled the area (Hobbs 2004b)
September 2001				715	Aquatic vegetation may have affected visibility; distribution in system not reported (NDOW 2001)
March 2002	191	613	110	914	Only fish >40mm FL counted (Hobbs 2002b).
September 2002	109	673	482	1264	All size fish counted; majority of fish were greater than 40mm throughout the system. Cormorant problem seems to have dissipated (Hobbs 2002b).
March 2003	252	505	237	994	Only fish >40mm FL counted. Installation of a new pipeline on South Flag Spring appears to have increased the amount of water in the upper reaches of the South/Middles Flag springs outflow, potentially increasing fish habitat in the spring outflows (Hobbs 2003a)
September 2003	169	842	516	1528	All size fish counted. More spinedace counted in the outflows just below Middle and South Flag Springs, potentially due to increased flow from construction of pipeline in 2002. Watercress made visibility poor (Hobbs 2003b)
March 2004	410	1182	1318	2910	Most fish were 31-60 mm (1.2–2.3 inches)FL. 86 fish transferred to Indian Spring refuge in June (Hobbs 2004a)
September 2004	454	701	22	1177	Most fish were 31-60 mm (1.2–2.3 inches) FL. Thick watercress hampers survey (Hobbs 2004b)
March 2005	367	663	463	1493	Most fish were 31-60 mm FL (1.2–2.3 inches) (Hobbs 2005). 91 fish transplanted to Indian Spring refuge in June (USFWS 2010). Several spinedace moved into the upper pools of North Flag Spring in June 2005. Thick vegetation limiting surveys (Hobbs 2005).
September 2005	208	1165	449	1824	Most fish were 31-60 mm FL (1.2–2.3 inches) (Hobbs 2005).
March 2006	247	480	272	999	Of the 247 fish counted in North Spring Outflows, 14 were in the head of North Flag Springs where moved in 2005 (Hobbs 2006)
September 2006	442	734	1220	2396	Hobbs (2006)

Survey Month/Year	Flag Springs		Sunnyside Creek	Total WR Spinedace Count	Comments and Reference(s)
	North Spring Outflow	Middle & South Spring Outflow	Above and Below Culvert Combined		
March 2007	151	362	575	1088	Of the 151 fish counted in the North Spring Outflows, 15 were in the head of North Flag Springs where they were reportedly moved in 2005 (Hobbs 2007). Thick aquatic vegetation lowered visibility (Hobbs 2007).
September 2007	117	274	657	1048	No fish found in North Flag headwater pools, but fish may have been difficult to see due to large amount of watercress (Hobbs 2007)
March 2008	152	510	461	1123	Thick aquatic vegetation lowered visibility (Hobbs 2008)
June 2008	198	676	548	1422	Thick aquatic vegetation lowered visibility (Hobbs 2008)
September 2008	387	422	510	1319	No fish found in North Flag headwater pools, but fish may have been difficult to see due to large amount of watercress (Hobbs 2008)
March 2009	110	435	205	750	Low count may be due to thick aquatic vegetation lowering visibility (Hobbs 2009)
June 2009	101	532	137	770	Low count may be due to thick aquatic vegetation lowering visibility (Hobbs 2009)
September 2009				433	Distribution within system not reported; low count may be due to thick aquatic vegetation lowering visibility. Non-natives and piscivorous birds/fish not observed (Hobbs 2009)
March 2010	198	408	174	780	Low counts may be due to thick aquatic vegetation which lowered visibility (Beckstrand 2010)
October 2010	411	308	149	868	Low counts may be due to thick aquatic vegetation which lowered visibility (Beckstrand 2010)
March 2011	163	275	310	748	Low counts may be due to thick aquatic vegetation which lowered visibility (Beckstrand 2011)
September 2011	295	153	223	671	Low counts may be due to thick aquatic vegetation which lowered visibility (Beckstrand 2011)

Since repatriation of White River spinedace to downstream locations in the Flag Springs system, several larger population fluctuations have occurred that are noteworthy. In late 2000 and early 2001, the population experienced a rather rapid and dramatic decline (Figure 9-2, Table 9-1). Young-of-the-year (YOY) fish went from comprising 74 percent of the population in 1999 to comprising only 34 percent of the population in 2000 (NDOW 2001). It was later determined that depredation by double-crested cormorants (*Phalacrocorax auritus*) and great blue herons (*Ardea herodias*) had caused the precipitous decline and after several months of hazing, the birds left the area (Hobbs 2004b) and the spinedace population rebounded. Between 2009 and 2011, the number of fish counted during surveys has typically been less than during the previous 7 years. It is not clear if the population has actually declined during this period, or if this is the result of a system congested (in areas) with emergent aquatic vegetation [e.g., watercress (*Nasturtium officinale*), pondweed (*Potamogeton*), common reed (*Phragmites australis*), bulrush (*Schoenoplectus* spp.), and cattail (*Typh*a spp.)] that limits the ability to conduct effective snorkel surveys and obtain accurate counts. The NDOW believes that the extensive emergent vegetation has resulted in population underestimates during recent surveys and that the population remains at “healthy” numbers (NDOW 2010, 2011, and earlier NDOW field trip survey reports listed in Table 9-1).

Although spinedace have increased their numbers and distribution in historical habitat at Flag Springs and upper Sunnyside Creek, their overall limited distribution and relatively low abundance leaves the species highly susceptible to extinction (USFWS 2010).

9.2.4 *Life History*

There is little information available on the ecology, behavior, life history, population dynamics and habitat requirements of the White River spinedace. However, where information is scanty, insight can be gained from examining characteristics of closely related species, such as the Big Spring spinedace, Virgin spinedace, and other members of the Plagopterini tribe or minnow family, as appropriate. However, it is important to keep in mind that life history traits and behavior may differ between closely related species or populations of the same species due to environmental differences between sites and/or disparate responses to environmental cues (Caswell 1983; Hubbs et al. 1967).

Early estimates put White River spinedace longevity at 3 to 5 years (Sigler and Sigler 1987). However, examination of museum specimens and evidence from recent monitoring surveys indicate that this species can live well beyond 5 years, with a maximum known age of 12 years (Scoppettone et al. 2004a). Growth appears to be logarithmic with age, and there is a high correlation between body length and age (Scoppettone et al. 2004a). This is similar to the growth rate pattern observed in other fishes, where growth is rapid in early years and slows with the onset of sexual maturity (Roff 1984). Scoppettone et al. (2004a) classified White River spinedace life stages as follows: larvae (< 20 mm [0.8 inches] FL), juvenile (20–60 mm [0.8–2.3 inches] FL), and adult (> 60 mm FL).

There is some evidence that White River spinedace may be able to mature and reproduce at 1 year of age. The smallest female White River spinedace specimen (61 mm [2.4 inches] FL) inspected in a USGS study contained two size classes of eggs, the largest of which was close to maturity (Scoppettone et al. 2004a). This specimen was presumably an age-1 fish based on age and growth data generated from museum specimens (age-1 spinedace ranged from 42 to 65 mm [1.6 to 2.6 inches] FL). However, most of the fish inspected were not classified as adult (i.e., >

60 mm [2.3 inches]) until they were 2 years of age. Northern leatherside chub, which is also a relatively long-lived L*epidomeda* species (8 years), is estimated to reach maturity at 60 mm (2.3 inches) standard length (SL) or approximately 2 years of age (Johnson et al. 1995). Virgin spinedace, a presumably shorter-lived species (4 years), is sexually mature at one year of age (Rinne 1971). Annual fecundity (the total number of eggs spawned by a female during a single spawning season) of White River spinedace is unknown, but younger fish (e.g., age-1) may produce considerably fewer eggs on average than older fish, based on studies of congeners (e.g., Virgin spinedace; Rinne 1971).

White River spinedace appear to have a protracted reproductive period that extends from at least April through July based on collection dates and observation dates of larval and post-larval fish, and the presence of different sized ova in egg skeins of specimens (Scoppettone et al. 2004a). Presence of spawning tubercles (epidermal structures which facilitate contact between fish during spawning) during the early spring (March and April) and fall (August/September) on fish inhabiting Flag Springs suggests that individuals may be spawning at different times of the year over a several month period (Miller and Hubbs 1960; Hobbs 2004b). Multiple spawns over a protracted period has been suggested for other Plagopterine fishes (e.g., up to three spawns per year estimated for Little Colorado spinedace; Blinn et al. 1998).

Important proximate cues for White River spinedace spawning are unknown, but may be related to subtle interactions between water temperature, photoperiod, and hydrology (discharge), as has been suggested for Little Colorado spinedace (Blinn et al. 1998). Timing of spawning in Little Colorado spinedace appears to be temperature dependent, and fish that spawned as little as 2 weeks later than others produced YOY fish that were considerably smaller at the onset of winter (Blinn et al. 1998). Blinn et al. (1998) reported that the peak in spawning behavior (May–June) for Little Colorado spinedace coincided with periods of high discharge and food availability in many southwestern streams.

While spawning mode for White River spinedace is not specifically known, other Plagopterine fishes (Little Colorado spinedace, spikedace) are known to be broadcasters, releasing eggs and sperm into open water for external fertilization with no subsequent parental care (Johnston 1999, and references cited therein). Since most species within genera of North American minnows share the same spawning mode (Johnston and Page 1992), we presuppose that White River spinedace is also a broadcaster, as surmised by Sigler and Sigler (1987). Little Colorado spinedace has been observed “preparing the substrate” over which it spawned by forming indentations in gravel and clearing substrata of sediment (Blinn et al. 1998), but we do not known if White River spinedace engage in this type of behavior. Eggs are likely adhesive and demersal (attached to or loosely in contact with the bottom substrate) as has been reported for congeners such as the spikedace (Barber et al. 1970), woundfin (USFWS 1994), and Little Colorado spinedace (Parmeter and Platania 2004), and which is typical of most freshwater fishes.

Plagopterine fishes are among the few North American minnows that are not known to hybridize with other genera (Hubbs 1955).

White River spinedace consume a variety of food items, which indicates that the species is a dietary generalist (Scoppettone et al. 2004a). Analysis of stomach contents from White River spinedace specimens and observations of actively feeding spinedace indicate that they feed on drifting invertebrates, plant material, algae, and detritis (Scoppettone et al. 2004a). Like other spinedace species (e.g., Big Spring spinedace (Jezorek et al. 2011); Virgin spinedace

[Angrandim et al. 1991), White River spinedace are primarily insectivorous. However, gastropods and other organisms are also consumed (including the occasional fish) (Scoppettone et al. 2004a). White River spinedace are likely sight feeders, like other spinedace species (Jezorek et al. 2011). This species has been observed feeding in or near flowing water where they struck at drift items (Scoppettone et al. 2004a).

White River spinedace historically co-occurred with three other native fishes of the White River Valley (Miller and Hubbs 1960; Williams and Wilde 1981; Courtenay et al. 1985; Scoppettone et al. 2004b), and continues to co-occur with two such species at Flag Springs: White River desert sucker (*Catostomus clarki intermedius*) and White River speckled dace (*Rhinichthys osculus* spp.). Information on inter-specific interactions and habitat partitioning is not available. All of these fish species are small bodied and as such are prey for larger fish, such as the non-native largemouth bass that remains further downstream in the Flag Springs/Sunnyside Creek system, and sometimes birds.

9.2.5 *Habitat*

White River spinedace historically occupied clear, cool (16.5–22 °Celsius [°C] [62–71 °Fahrenheit (°F)]) springs and their outflows (Miller and Hubbs 1960; USFWS 1994; Scoppettone 2007). Areas occupied by spinedace were described by Miller and Hubbs (1960) as clear in the source pools, with a substrate of mostly gravel and sand, and aquatic plants that were often dense. The current in the spring outflows was described as swift to moderate. Available data on water temperature, discharge rates, and dissolved oxygen levels of springs historically occupied by White River spinedace indicate relatively similar temperatures among springs, but disparate discharge rates and dissolved oxygen levels (USFWS 1994, based on an evaluation of available information on key physical characteristics of historically occupied springs).

Many fish require a variety of habitats to complete their complex life cycle due to differences in resource utilization, predator avoidance, and physiological tolerance among the different life stages (i.e., egg, larva, juvenile, and adult) (Van Horne 1983; Billman et al. 2006). Maintaining connectivity among seasonal habitats and habitats required by successive life stages is critical to persistence of these species. There is little specific information available on White River spinedace habitat use or preference for any of its life stages. This species is capable of surviving in both pond and stream environments, which indicates that it is somewhat of a habitat generalist (Scoppettone et al. 2004a). However, the apparent lack of recruitment that occurred in the early 1990s at Flag Springs indicates that the artificial spring pools where the fish had become isolated did not have suitable habitat for spawning, development and growth of larvae and/or juveniles, or both. It appears that adult spinedace could survive for some period of time in the pools, but could not successfully reproduce. Now that the fish can move freely in the spring outflow channels and can access a variety of habitats, successful reproduction and recruitment has occurred.

Other Plagopterine fishes are known to prefer or use pool habitat during portions of the year, but move into stream habitats for spawning. For example, Little Colorado spinedace does well in pond-like conditions, but requires stream (flowing) waters with fine gravel for reproduction (Blinn et al. 1998). Gravid female spikedace have been observed moving from pools to riffle (shallow, flowing) areas to spawn over sand and gravel substrates (Barber et al. 1970). Based on a recent study of Big Spring spinedace habitat in Condor Canyon, Nevada, USGS (2011) surmised that pools provide important habitat for this species at some point during their life history. It was also noted that this species moves substantial distances within the small desert stream it inhabits in Meadow Valley Wash, presumably to seek out areas with suitable spawning habitat (Jezorek et al. 2011). Like these congeners, White River spinedace appear to use (and potentially require) both pool and stream habitats.

Based on recent NDOW survey data, the majority of spinedace are often found in the South and Middle outflow channels at Flag Springs (Table 9-1), which could be related to water volume (Hobbs 2003b, 2004b), temperature (South and Middle Flag springs emanate at warmer temperatures than North Flag Spring), or any number of other factors. Shallow, high gradient reaches with high water velocities regularly have few observations of spinedace, but it is not clear if these reaches are consistently or accurately surveyed as they are likely too shallow for snorkeling. White River spinedace may move through these higher velocity reaches, but likely feed by inhabiting slower moving water from which they strike at food that drifts by in the adjacent swifter current (Scoppettone 2007).

While specific spawning requirements for White River spinedace are not known, water temperature may be important. Scoppettone (2007) reported that White River spinedace reproduction has only been observed in relatively constant water temperatures ranging from about 19.5 to 22 ^{o}C (66 to 71 ^{o}F), which is similar to what was reported by Blinn et al. (1998) for Little Colorado spinedace. The USGS (2011) found that Big Spring spinedace spawned in stream reaches with clear water and thermally stable temperatures throughout the year, conditions provided in areas that had spring inflow (i.e., stenothermal waters). Also, it has been suggested that particular substrates and/or water velocities may be needed for successful White River spinedace spawning (Stein and Sjoberg 2000; Scoppettone et al. 2004a). Other Plagopterine fish have been reported to spawn over sand and gravel substrates in stream riffles (Barber et al. 1970; Blinn et al. 1998). The USGS (2011) found that Big Spring spinedace numbers were negatively associated with fine substrates and positively associated with substrate heterogeneity and greater amounts of gravel and coarse sediment, which are likely spawning substrates.

Based on a short-term study of habitat use at Flag Springs in the mid-1990s, larval, juvenile and adult spinedace were found occupying water of different depths and velocities (Scoppettone et al. 2004a). Adult fish occupied faster and/or deeper water than juveniles and larvae, and they tended to be benthically oriented (occupying the bottom portion of the water column). Juveniles inhabited shallower water than adults, and were found closer to the water surface. Larvae were found in much shallower and slower water than that used by adults and juveniles, and tended to be near the surface of the water column (Scoppettone et al. 2004a). Larval and juvenile stages of many fish require nursery habitat that provides specific environmental conditions suitable for growth and protection from predators (Billman et al. 2006). High water temperature is important for growth and survival of many cyprinid fishes, as juveniles tend to have higher optimal growth temperatures (Mills 1991; Billman et al. 2006). Such conditions are more likely to occur in shallower areas and/or higher in the water column due to greater exposure to ambient (air, solar) conditions.

A shift in habitat use, both seasonally and by life stage, is not uncommon in fish species. Blinn et al. (1998) found that larval Little Colorado spinedace moved into the littoral zone (close to the shore) near aquatic vegetation and did not move into deeper water habitats until they reached a certain length. Billman et al. (2006) found that least chub (*Iotichthys phlegethontis*), another cyprinid fish inhabiting spring systems in the West Desert of Utah, exhibits a seasonal shift in habitat use associated with temperature changes. Adult chub move out of pools near the spring source into shallower water at the spring margin to reproduce, and adult and age-0 fish move back to the spring pools as air and water temperatures decrease (see references in Billman et al. 2006). The warmer water in spring margins at certain times of the year presumably allows least chub to grow sufficiently to avoid overwinter mortality and reach reproductive maturity by age 1 (Billman et al. 2006).

Although specific information is not available for White River spinedace, aquatic and riparian vegetation cover, water turbidity, and dissolved oxygen concentrations are likely important habitat components in addition to water velocity, temperature, and substrate. Because White River spinedace are presumably sight feeders, high levels of turbidity would likely compromise their ability to detect and strike at drifting food items. Indeed, congeners such as the Big Spring spinedace are associated with clear waters and low turbidity (Jezorek et al. 2011). Dissolved oxygen is also an important (and potentially limiting) resource for fish, and deficiencies or excesses may cause stress and physiological and behavioral changes that lead to reduced fitness (Kramer 1987).

As mentioned above, Miller and Hubbs (1960) described historical White River spinedace habitat as often having dense aquatic vegetation. Aquatic vegetation may provide important cover, especially for larval and juvenile fish, and may also be areas with high concentrations of insects that are prey for spinedace. Jezorek et al. (2011) found that watercress patches in Big Spring spinedace habitat were occupied by many amphipods (crustaceans with no carapace) that are a food source for this species, and areas absent of Big Spring spinedace had the least amount of watercress cover. On the other hand, Big Spring spinedace numbers were low or absent from areas with dense cattail and bulrush (Jezorek et al. 2011). These plants can form dense stands that clog channels and potentially impede fish movement, and alter substrates by trapping sediment (Jezorek et al. 2011). As previously noted, recent spinedace surveys at Flag Springs have documented an increasing thickness of emergent aquatic vegetation such as watercress and the common reed (Hobbs 2007, 2008, 2009; NDOW 2010, 2011). It is not clear how or if this is affecting White River spinedace. It has been surmised that these areas of dense vegetation are only used as movement corridors and not for feeding because of total or near darkness that would affect foraging ability for a fish that relies on its eyesight to detect drifting prey (NDOW 2011).

Lastly, White River spinedace habitat at Flag Springs is influenced by the riparian vegetation that lines the outflow channels, including trees, shrubs, and herbaceous vegetation (USFWS 1985). This vegetation shades the stream, keeping water temperatures down in the summer and decreasing short-term fluctuations in water temperature. Riparian vegetation also contributes organic matter to the stream (leaves, branches), and provides habitat for macroinvertebrates (i.e., fish food), and the bank-side vegetation provides cover from predators.

9.2.6 *Population Dynamics*

There is no information available on population dynamics for White River spinedace occurring in unaltered systems; the only data available are from recent surveys at Flag Springs. At Flag Springs, fish < 60 mm (2.3 inches) in length (presumably YOY fish and juveniles) typically comprise the majority of fish counted during surveys, with subadults (61–90 mm [2.4–3.5 inches] length) comprising the next largest age class. Older, larger adults (> 90 mm [3.5 inches]) make up a relatively small percentage of the population. This demographic pattern has remained fairly consistent since regular surveys began in the 1990s, except for when the population was reduced to only a few large (presumably old) individuals and when excessive cormorant and heron depredation reduced the proportion of YOY fish in the population. As discussed above, population size at Flag Springs has fluctuated (sometimes dramatically) both within and among seasons since regular surveys began in the mid-1990s (Table 9-1, Figure 9-2). Populations of other spinedace species (e.g., Little Colorado spinedace) have also been found to fluctuate dramatically over time. Rather large seasonal or annual population fluctuations are expected given the species' life history, and likely due to environmental (e.g., climate) fluctuations and other factors affecting habitat.

It is apparent that White River spinedace has a high degree of demographic resilience: the population at Flag Springs was able to grow from as few as 20 adult fish to over 1,500 fish within a few years time. It is not surprising that this species is capable of rapid population growth given its life history characteristics. Small body size, early maturation, short generation time, multiple spawning bouts over a protracted annual period, and low investment per offspring are characteristics that suggest high intrinsic rates of increase (Winemiller and Rose 1992; Winemiller 2005). This high demographic resilience has likely allowed spinedace to persist through geologic time as their habitat dried up (as suggested by Winemiller 2005 for small desert fishes in the southwestern U.S.), and allowed the Flag Springs population to rebound in recent historical times when human intervention provided the fish access to appropriate habitat for spawning and recruitment.

9.2.7 *Threats to the Species*

The decline and endangerment of White River spinedace was precipitated primarily by habitat loss and modification from channelization, diversion, and piping of spring outflows for residential and agricultural uses, and the introduction of non-native fishes that prey upon and/or compete for resources with the spinedace (USFWS 1985). Other factors may have contributed to elimination of the spinedace at certain sites, such as the use of copper sulfate to control algae at Preston Big Spring (Courtenay et al. 1985). Most historical spinedace habitat, with the exception of Flag Springs, is not currently capable of supporting self-sustaining spinedace populations because of these ongoing threats (USFWS 2010). Repatriation of the species to unoccupied historical sites, all of which are privately owned, will not be possible without landowner cooperation and restoration of the spring systems. Even then, the outcome may not be successful, as evidenced by the failed attempt to re-establish White River spinedace at Indian Spring in 2004–2005.

Non-native fish such as mosquitofish (*Gambusia affinis*), guppies (*Poecilia reticulata*), goldfish (*Carassius auratus*), and largemouth bass have been implicated in the decline of White River spinedace and one or more have been documented at all historic spinedace sites except Preston Big Spring at some point in the past (Williams and Wilde 1981; Courtenay et al. 1985; USFWS 1985; Scoppettone et al. 2004a; USFWS 2010). Largemouth bass have invaded upper portions of Sunnyside Creek and Flag Springs from a downstream reservoir in the recent past, but are currently not present in the upper part of the Flag Springs system following eradication and the installation of several fish barriers. However, available spinedace habitat at Flag Springs is limited in part by the presence of these fish barriers and the occurrence of largemouth bass downstream of the barriers (USFWS 2010). Additionally, the threat of deliberate or inadvertent introductions of non-native fishes will always be present.

Several new threats have been identified since the species was federally listed, including groundwater withdrawal for municipal needs, fire and fire suppression activities, and climate change (USFWS 2010; for a detailed discussion of potential climate change impacts, please refer to Chapter 8 - Climate Change Analysis). All of these threats have the potential to affect water quantity and quality in spinedace habitat. Additionally, emergent aquatic vegetation, including several non-native plants (common reed, watercress), has become very thick in sections of the Flag Springs system in recent years (NDOW 2010, 2011). This vegetation is clogging and darkening substantial stretches of the system, and increasing the amount of flooded area next to Sunnyside Creek, which exacerbates the expansion of reeds. It is not known if or how this is impacting White River spinedace, but it could potentially impede movement and lower foraging efficiency.

Lastly, the current White River spinedace population at Flag Springs originated from as few as 20 individuals. Whether this population bottleneck has affected the fish in ways (e.g., low genetic variation) that could affect long-term persistence of the species has not been evaluated.

9.2.8 *Conservation Needs*

Although White River spinedace have increased their numbers and distribution in historical habitat at Flag Springs and upper Sunnyside Creek, their overall limited distribution and relatively low abundance still leave the species highly susceptible to extinction (USFWS 2010). Recovery of the species, as identified in the Service's 1994 Recovery Plan, will entail ensuring that the Flag Springs population is self-sustaining, including enhancing and providing adequate habitat to allow the spinedace population to expand at this site; establishing self-sustaining populations in the two designated, unoccupied critical habitats (Lund Spring and Preston Big Spring); and securing each critical habitat from all known threats (USFWS 1994).

Currently, spinedace habitat at Flag Springs is limited in size. The downstream distribution of spinedace in Sunnyside Creek is limited by habitat, water temperatures, and artificial fish barriers that limit upstream migration of nonnative fishes (USFWS 2010). Neither Preston Big Spring nor Lund Spring can support a self sustaining population of spinedace without substantial habitat restoration. The White River Valley Native Fishes Recovery Implementation Team has been working to identify locations for spinedace translocation that could potentially lead to other self-sustaining populations (USFWS 2010). Potential sites that have been identified include the upper portion of Ellison Creek and Lund Spring in northern White River Valley, and springs at Moon River Ranch in southern White River Valley, respectively. However, protection and enhancement of the Flag Springs population is of utmost importance to survival and recovery of the species (USFWS 1995; USFWS 2010).

9.3 STATUS OF CRITICAL HABITAT

Critical habitat was designated in 1985 concurrent with listing of the species (USFWS 1985). Critical habitat comprises approximately 3.3 hectares (ha) (8.3 acres) and includes Flag Springs, Lund Spring, and Preston Big Spring and their associated outflows, as well as the immediate surrounding riparian areas. At the time critical habitat was designated, White River spinedace were known to occur only at Flag Springs and Lund Spring. Preston Big Spring was included in the critical habitat designation as an area within the historical range of the species that was considered essential to the species' conservation. At that time, reestablishment of White River spinedace at Preston Big Spring was being considered (USFWS 1985).

The most important elements for survival of White River spinedace are the consistent quality and quantity of spring flow (USFWS 1985). The Primary Constituent Elements (PCEs) of critical habitat are: 1) consistently high quality, cool [13 to 21 ^{o}C (55 to 70 ^{o}F)] springs and outflows with a sufficient quantity of water; and 2) surrounding land areas (for a distance of 15 m [49 feet]) that provide vegetation for cover and habitat for insects and other invertebrates on which the species feeds (USFWS 1985). Critical habitat and PCEs could be adversely affected by pollution of spring water, such as through the use of chemicals to control aquatic vegetation; introduction of non-native species; excessive pumping of groundwater; and physical modification of the spring areas, such as channelization and diversion of spring flows or clearing of surrounding vegetation (USFWS 1985).

9.3.1 *Preston Big Spring and Lund Spring*

Critical habitat consists of approximately 1.6 ha (4 acres) at Preston Big Spring and approximately 0.5 ha (1.3 acres) at Lund Spring in northern White River Valley, White Pine County, Nevada. Both springs are privately owned, and the water rights are held by the Preston Irrigation Company, Lund Irrigation Company, and Carter-Griffin, Inc (NDWR 2012). Neither of these springs are currently occupied by White River spinedace, nor are these springs capable of supporting a self-sustaining population of spinedace in their present condition (USFWS 2010).

Preston Big Spring is a large, cool spring located at the headwaters of the pluvial White River. The upstream reach is wide with slow-moving water, and the downstream reach is shallow and fast; the banks are lined with big sage (*Artemesia tridentata*) (Scoppettone and Rissler 2002). The Southern Nevada Water Authority (SNWA) (2008) characterized the orifice area and channel as overgrown with aquatic plants. This spring has a relatively constant water temperature of about 21 ^{o}C (70 ^{o}F) at the source (Courtenay et al. 1985; Scoppettone and Rissler 2002; USGS 2012). The USGS has maintained and operated a gaging station at this spring from December 1982 to September 1985, and from March 2000 to present. Average daily discharge is 8.1 cubic feet per second (cfs) (minimum = 6.7 cfs and maximum = 11 cfs for entire period of record; USGS 2012), and average annual discharge is 7.9 cfs (minimum = 7.2 cfs and maximum 9.4 cfs for 1982-1985 and 2000 to 2006, as reported in SNWA [2008]).

Lund Spring is a large, cool spring (reported temperatures ranging from 18.5 to 20 ^{o}C [65 to 68 ^{o}F]) located several kilometers to the south of Preston Big Spring (Courtenay et al. 1985; Scoppettone and Rissler 2002; Scoppettone et al. 2004b; USGS 2012). The spring pool is approximately 15 m (50 feet) in diameter, and discharge from the pool forms a channel at the northwest end of the pool (SNWA 2008). This channel is lined with dense vegetation, and the bed of the channel is overgrown with aquatic plants. USGS has been conducting discharge measurements at this site since 1982 (biannually since 1990, and once a year or less before then). The average daily discharge is 8.5 cfs, with a minimum recorded daily discharge of 4.4 cfs in March 1989 and a maximum recorded daily discharge of 12.1 cfs in September 2006 (USGS 2012).

Preston Big Spring and Lund Spring outflows have been heavily modified for the irrigation of crop lands (USFWS 1985). Preston Big Spring used to be part of a larger interconnected aquatic system: flow from another spring that historically had a spinedace population used to converge with Preston Big Spring's outflow, but these systems are now disconnected (Courtenay et al. 1985). The outflow of Preston Big Spring is currently captured in a pipeline system approximately 525 m (1,722 feet) from the springhead (Scoppettone and Rissler 2002). The entire flow of Lund Spring is also captured in a pipe 35 m (115 feet) from the springhead (USFWS 2010). Irrigation districts for these springs have expressed interest in extending the pipeline from the existing intake structure on Preston Big Spring upstream to the headwaters, which would eliminate the last remaining spring outflow habitat (USFWS 2010).

As described in Chapter 4, there is considerable groundwater use in northern White River Valley associated with irrigation of crop land (Welch et al. 2008; NDWR 2012). Irrigated acreage and groundwater use for irrigation increased in this valley between 1945 and 2004 (SNWA 2009) and between 2000 and 2005 (Welborn and Moreo 2007). Groundwater pumping has occurred in the vicinity of both Preston Big Spring and Lund Spring. We infer that this pumping has affected groundwater levels and spring flows at Preston Big Spring and Lund Spring compared to historical conditions. On July 12, 2012, the Nevada State Engineer (NSE) designated White River Valley HB as a basin in need of additional administration (Order 1219, NSE 2012).

9.3.2 *Flag Springs Complex*

Critical habitat consists of approximately 1.2 ha (3 acres) at the Flag Springs Complex in southern White River Valley, Nye County, Nevada. The Flag Springs Complex consists of three springs (North, Middle, and South) within 300 m (984 feet) of each other, the outflows of which drain into Sunnyside Creek. Flag Springs and Sunnyside Creek are within the Wayne E. Kirch Wildlife Management Area (WMA), a 15,000 acre property managed by the State of Nevada in part to conserve endemic fish species such as the federally-listed White River spinedace. The State of Nevada has certificated water rights at Flag Springs of 0.022 cfs per year (not to exceed 0.592 million gallons annually) for purposes of quasi-municipal uses, which NDOW uses to manage the property and benefit wildlife, and which are existing water rights protected under Nevada water law.

North Flag Spring and a portion of its outflow (~225 meters [~738 feet]) are included within the boundary of designated critical habitat for the White River spinedace. Middle Flag Spring and a portion of its outflow (~115 meters [~377 feet]) fall within the critical habitat boundary as well. South Flag Spring and a portion of its outflow (~135 meters [~443 feet]) fall within the boundary of the designated critical habitat.

Miller and Hubbs (1960) described the current in the spring outflows and Sunnyside Creek as swift to moderate. The earliest recorded discharge for these 3 springs was 2.5 cfs from North Flag Spring in 1949. Regularly repeated measurements were not taken until the USGS started measuring discharge of all 3 springs in 1982 (SNWA 2012a), with biannual measurements (spring/fall) beginning in 1990. Currently, flow at Middle Flag Springs is monitored continuously, and the North and South Flag springs are monitored on a biannual basis. Discharge measurements over the period of record (1982-2011) are summarized below in Table 9-2 and Figure 9-3, taken from SNWA (2012b). South Flag Spring has the smallest average discharge of the three springs, and the greatest variability. Typically, flows are higher at all 3 springs during the spring than the fall sampling period, contrary to what 2011 data indicate (Table 9-2) (USGS 2011).

The three springs discharge at different temperatures with the water from North Flag Spring being the coldest and South Flag Spring being the warmest. These temperature differences indicate that the 3 springs may be “sourced” differently. Scoppettone et al. (2004b) reported temperatures of 16 ^{o}C (60.8 ^{o}F) at the northern-most spring, and 20 and 23 ^{o}C (68 to 73.4 ^{o}F) at the middle and southern springs, respectively. In 2006, water temperature within Flag Springs varied from 16 to 20.5 ^{o}C (60.8 to 68.9 ^{o}F), with the coolest water discharging from North Flag

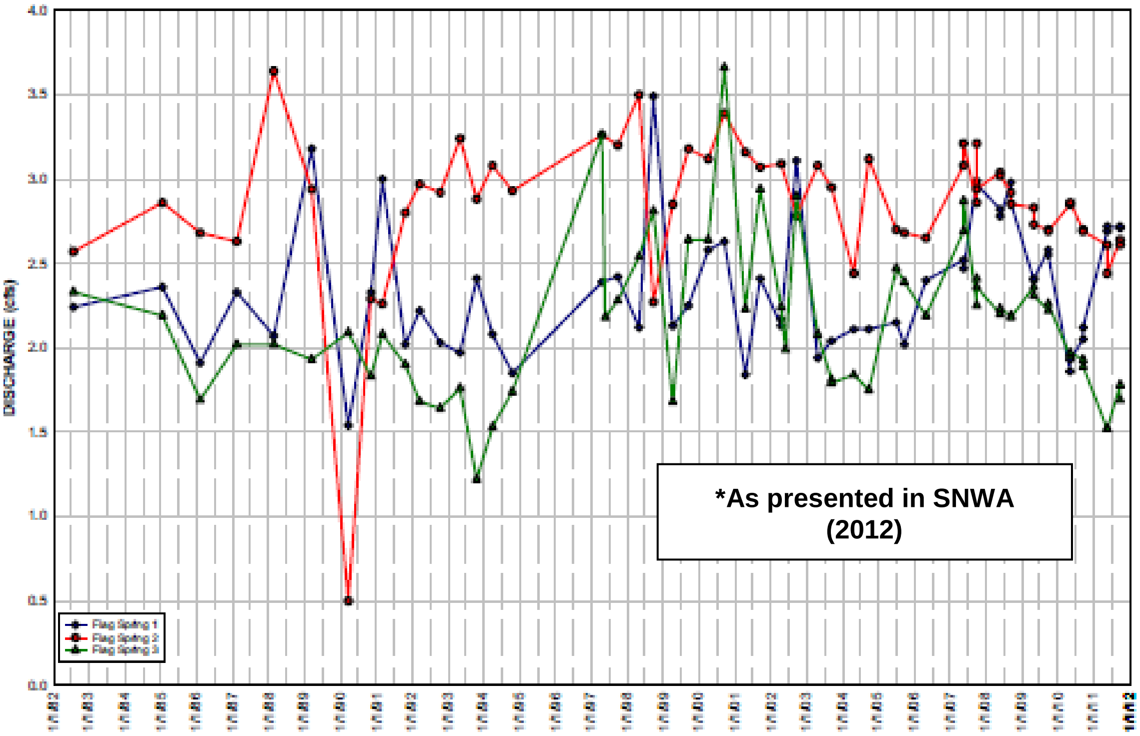
Springs and the warmest water discharging from South Flag Springs (Hobbs 2006). BIO-WEST (2007) reported temperatures at the spring source ranging from 16.3 °C (61.3 °F) at North Flag Springs, 19.7 °C (67.5 °F) at the Middle Flag Spring, and 22.6 °C (72.7 °F) at South Flag Spring. Conductivity and pH at the spring source seemed to follow a similar pattern of increasing values from north to south. As far as we know, these are all point-in-time estimates, and temperature and other water quality parameters have not been continuously monitored at any of these springs.

The riparian corridor of the North Flag Spring outflow channel is lined with willow (*Salix* sp.), currant (*Ribes* sp.), and wild rose (*Rosa* sp.), and the Middle and South Flag springs outflow channels are lined with cottonwood (*Populus* sp.) and willow (Scoppettone et al. 2004). Common emergent aquatic vegetation at the Flag Springs Complex includes rushes (*Juncus* sp.), bulrushes (*Scirpus* sp. and *Schoenoplectus* sp.), sedges (*Carex* sp.), and spikerushes (*Eleocharis* sp.) (BIO-WEST 2007). NDOW (2010, 2011) reported that parts of the Flag Springs -Sunnyside Creek system were thick with watercress and common reed.

Table 9-2. Discharge measurement summary of Flag Springs Complex

Spring Name	Average Discharge[a] (cfs)	Minimum Discharge[a] (cfs)	Maximum Discharge[a] (cfs)	Standard Deviation[a] (cfs)	May 2011 Discharge[b] (cfs)	September 2011 Discharge[b] (cfs)
Flag Spring North	2.38	1.54	3.49	0.40	2.70	2.72
Flag Spring Middle	2.84	0.50	3.64	0.43	2.52	2.62
Flag Spring South	2.15	1.22	3.66	0.45	1.52	1.74

[a] Period of record: 1982–2011.
[b] 2011 discharge measurements are the average of two reported measurements.
Source: USGS (2012), as reported in SNWA (2012b)



***As presented in SNWA (2012)**

Figure 9-3. Discharge at Flag Springs (1982–2011)

The Flag Springs Complex is the least modified of the three critical habitats; however, it has been considerably altered from its natural state. Past modifications include, but are not limited to: 1) installation of a dam in the North Spring outflow channel in 1984, which may have either modified spawning habitat above the dam or trapped spinedace in an area with unsuitable spawning habitat, likely contributing to the critically low numbers of old, non-reproducing fish observed in the early 1990s (Scoppettone et al. 2004a); 2) modifying, straightening, and diverting of spring outflow channels, reducing in-stream structural diversity and available habitat for spinedace; 3) creation of artificial pools for spinedace refugia during the 1990s; and 4) installation of fish barriers to keep non-native fish out of spinedace habitat.

North and South Flag Springs were described by BIO-WEST (2007) as being slightly or moderately disturbed by livestock, diversions, and a nearby residence on the property. Middle Flag Springs was given a ranking of highly disturbed based on its condition in 2005. In its heavily modified condition, the Middle Flag Spring outflow represented very poor habitat, lacking constituent elements for White River spinedace habitat. However, considerable work has recently occurred to restore the Flag Springs system and expand habitat for the White River spinedace. These activities are described below. A diversion structure on South Flag Spring remains because it is needed to maintain head pressure on the livestock water pipeline it supplies (Sjoberg 2009). Other recent modifications include installation of a Parshall flume in the upper Middle Flag Spring outflow channel; this structure was installed by SNWA as part of the hydrologic monitoring program for the proposed action.

Non-native vegetation and other aquatic emergent vegetation, particularly the common reed, watercress, cattails, and bulrush (*Schoenoplectus americanus*), has become prevalent and thick in the Flag Springs system in recent years (NDOW 2010, 2011). This vegetation is clogging and darkening substantial stretches of the system, and increasing the amount of flooded area next to Sunnyside Creek, which exacerbates the expansion of reeds.

9.3.2.1 Habitat Improvement Projects at Flag Springs Complex

Considerable work has occurred at the Flag Springs Complex in recent years to restore the system and hopefully expand habitat for the White River spinedace. Several fish barriers have been placed below the confluence of the Flag Springs outflow channels to prevent nonnative game fishes from invading spinedace habitat. The Service and NDOW have also created small pools within North and South Flag springs outflow to improve habitat for the species. Habitats conducive to predatory birds, primarily cormorants, have been removed from the WMA to decrease natural predation on the spinedace population (NDOW 2011; USFWS 2010). In 2002, an irrigation system on South Flag Spring was reconstructed in an effort to conserve water. A pipeline with an appropriately-sized screened intake replaced an open earthen irrigation ditch, which entrained native fishes including spinedace. The new irrigation system eliminated fish entrainment and decreased water evaporative losses, which increased flows in the South Flag Spring outflow (USFWS 2010). This action likely increased the amount of available spinedace habitat and may have helped bolster the population of spinedace at Flag Springs (Hobbs 2006).

In November 2009, NDOW completed restoration activities in all three Flag Springs outflows by: 1) returning Middle Flag outflow to its natural channel (it had been diverted to South Flag Springs for many years); (2) installing velocity dampeners (rocks) to sections of both North Flag and South Flag springs outflows to reduce average gradient and improve pool structure; and (3) adding structure below the diversion on South Flag Spring to provide passage between the upper spring and the outflow channel. Restoration has increased available habitat for White River spinedace at Flag Springs, and recent monitoring has demonstrated that spinedace are using the newly restored areas.

9.4 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed federal projects in the action area that have already undergone section 7 consultations and the impacts of state and private actions that are contemporaneous with the consultations in progress.

9.4.1 *Status of the Species and Critical Habitat within the "Analysis Area"*

The entire distribution of the White River spinedace and its designated critical habitat is within the spinedace analysis area for this Opinion, which as described above is a subset of the overall action area. Additionally, any potential sites that the White River Valley Native Fish Recovery Implementation Team may be considering for re-establishment of spinedace and/or creation of refuge populations to aid in recovery are included in the spinedace analysis area. Lastly, all three designated critical habitats are located within the spinedace analysis area. All of these sites are depicted in Figure 9-1. Therefore, the status of the species and its critical habitat within the analysis area is the same as its range-wide status, which is fully described in the preceding section (*Status of the Species* and *Status of Critical Habitat*).

9.4.2 *Factors Affecting the Species and Critical Habitat within the "Analysis Area"*

All White River spinedace occurrences and all designated critical habitat are entirely within the spinedace analysis area for this Opinion, which as described above is a subset of the overall action area. Therefore, factors affecting the species and critical habitat within the spinedace analysis area are the same as those described in preceding sections (see *Threats to the Species* and *Habitat Improvement Projects at Flag Springs Complex* under *Status of the Species* and *Status of Critical Habitat).*

9.4.3 *Recent Section 7 Consultations*

There is one recent formal consultation for the White River spinedace that is relevant to this Opinion. In October 2009, the Service provided NDOW with a biological opinion for federally-funded aquatic restoration activities in the Flag Springs area of Kirch WMA, Nye County, Nevada, as well as the installation of a Parshall Flume and associated equipment for hydrologic monitoring associated with the GWD Project (File No. 84320-2010-F-0012). Restoration efforts included restoring the Middle Flag Spring outflow to its historical channel, removing the old cross-hill ditch that connected Middle Flag to South Flag Spring, adding rock vane structures to the mid- and lower South and North Flag Spring outflows to reduce average gradient and improve pool structure, and adding structure below the diversion on South Flag Spring to provide passage between the upper spring and the outflow channel. In this opinion, the Service concluded that the proposed action could potentially have short-term adverse effects on White River spinedace, but there would likely be a very low rate of mortality or injury to a small number of spinedace from project activities. Incidental take was authorized for up to 25 spinedace (approximately 2 percent) adults and an indeterminate number of larvae. Overall, the proposed project would have long-term beneficial effects to the spinedace population at North, Middle, and South Flag Springs.

9.5 EFFECTS OF THE PROPOSED ACTION

9.5.1 *Approach to Analysis*

Regulations define effects of the action as “the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline” (50 CFR § 402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Indirect effects are defined as those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

For our effects analysis, we have examined the potential for White River spinedace and its designated critical habitat to be directly or indirectly affected by implementation of the proposed action, and if so, the likely nature of these effects. As described in Chapter 1 (Introduction), our analysis for this Opinion includes a project-level assessment of the effects of Bureau of Land Management’s (BLM’s) issuance of a right-of-way (ROW) for the main and lateral pipelines and associated facilities (Tier 1 ROW); and, a programmatic-level (conceptual) assessment of the effects associated with BLM’s issuance of ROWs for future groundwater development facilities (Subsequent Tier ROWs) and groundwater pumping. The Service is not exempting take of endangered or threatened species incidental to the programmatic portions of this Opinion. Future site-specific actions that are analyzed broadly under the programmatic portions of this Opinion and that might result in the incidental take of endangered or threatened species will undergo separate formal consultation before any take would occur.

Our assessment of project effects includes an evaluation of the ability of applicant committed measures (ACMs) and BLM monitoring and mitigation measures to avoid, minimize, or mitigate effects to the White River spinedace and its critical habitat. These measures are presented below, in some cases in summary form and we refer readers to the Final EIS for the entire text of the measure (Chapter 3.20 and Appendix E; BLM 2012b). As described in Chapter 5 (Analytical Approach), some measures are fairly specific while others are more general in nature since they are based on the programmatic portion of the National Environmental Policy Act (NEPA) analysis. Many of these programmatic measures set up a process (i.e., plan development) for monitoring, managing, and mitigating impacts from future activities, such as groundwater pumping. Any mitigation measure that is specific in terms of how and when it will be applied, and what will be required, was considered in a more specific manner in our effects analysis. We also considered those programmatic measures that are more general and process-oriented, especially if the intent behind the measure is (at least in part) to protect threatened and endangered species and their habitats. However, because development of specific mitigation measures for programmatic activities (and an analysis of the effectiveness of such measures) has been deferred to future NEPA analyses and Endangered Species Act (ESA) consultations, we do not assume (because we cannot be assured) that effects from programmatic activities will or can be completely avoided or entirely mitigated through implementation of these programmatic measures. Therefore, for our programmatic analyses, we begin by assessing potential impacts of the proposed action absent these measures, and then consider whether impacts could be minimized based on implementation of these programmatic measures (see Chapter 5 for more information on our analytical approach).

9.5.2 *Applicant Committed Measures and BLM Measures Relevant to Spinedace*

The project applicant (SNWA) has identified a suite of potential environmental protection measures that may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to water resources associated with proposed groundwater pumping (SNWA 2012a BLM 2012b). These measures are described in Section B (Programmatic Measures – Future ROWs) and Section C (Regional Water-Related Effects) of SNWA's ACMs, which are located at the end of SNWA's Conceptual Plan of Development in Appendix E of the Final EIS), and measures specific to the White River spinedace are presented or summarized below.

Commitments by SNWA under the Delamar, Dry Lake, and Cave Valleys (DDC) Stipulation are addressed in ACMs C.1.31 – C.1.42. The delineated Area of Interest for the DDC Stipulation covers the southern part of White River Valley, including Flag Springs and potential spinedace recovery sites such as Moon River Ranch, but it does not include Preston Big Spring, Lund Spring, or other potential recovery sites in northern White River Valley. Flag Springs is identified in the DDC Stipulation as a site at which spring discharge is currently being monitored (biannually) through a funding agreement between SNWA, USGS, and the Nevada Division of Water Resources (NDWR). If this funding agreement changes, terminates or expires, SNWA will continue discharge monitoring at Flag Springs if agreed upon by the Stipulation Parties. The DDC Stipulation also recognizes Flag Springs as a potential biological monitoring site. Hydrologic and biological monitoring plans have been developed by the Stipulation hydrology Technical Review Panel (TRP) and the Biological Resource Team (BRT), and these plans have been accepted by the Stipulation Executive Committee (EC) and the NSE. Initial monitoring commitments under the DDC Stipulation can be found in the 2009 DDC Hydrologic Monitoring and Mitigation Plan (SNWA 2009) and the 2011 DDC Biological Monitoring Plan (BRT 2011), which includes: 1) continuous discharge monitoring at Middle Flag Spring; 2) biannual discharge monitoring at North and South Flag springs; 3) a new monitoring well to be located northeast of Flag Springs in White River Valley, which together with existing monitoring wells in Cave Valley will provide data to evaluate the hydraulic gradient through Shingle Pass (SNWA 2012c); 4) monitoring of White River spinedace at the Flag Springs Complex through incorporation of NDOW biannual surveys; and 5) monitoring of specific spinedace habitat components (e.g., water temperature and quality; water depth, velocity, and extent; macroinvertebrates; vegetation). A minimum of 2 years of baseline data collection must be collected prior to SNWA groundwater withdrawal from DDC, and data collection must continue during groundwater withdrawal. The monitoring plans expand on this requirement; the biological monitoring plan (BRT 2011) requires that 3 years of baseline biological data be collection, and portions of the hydrologic monitoring plan (SNWA 2009) have already been implemented.

The Spring Valley Stipulation does not cover any sites in White River Valley.

The SNWA has developed programmatic measures for future ROWs for production wells, collector pipelines, and associated facilities. It is anticipated that these measures will be incorporated as part of the ACMs for future ROWs, as applicable (SNWA 2012a). Programmatic measures that are relevant to White River spinedace are summarized below and include the following:

ACM B.1.1 Groundwater production well sites will be selected considering:1) suitable hydrogeologic conditions, including well yield, groundwater drawdown, and groundwater chemistry, based upon exploratory drilling; 2) avoidance of springs, streams, and riparian/wetland areas; and 3) the presence of special status species and their habitat. [This represents a partial list of those elements of the measure that are relevant to the White River spinedace]

The SNWA has prepared a Conceptual Adaptive Management (AM) Framework for consideration at the programmatic level, which can be found in the last section of the ACMs (SNWA 2012b). This framework provides examples of measures that may be considered and implemented through the AM process to address groundwater pumping impacts. Specific criteria for implementing AM measures will be developed as part of future site-specific AM plans (SNWA 2012b). Potential AM mitigation measures that are or could be relevant to the White River spinedace include, but are not limited to the following (summarized below; for the full measures, please refer to SNWA 2012b):

ACM C.2.1 In accordance with the Stipulations and any future water right rulings, implement actions to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special status species, such as: 1) geographic redistribution of groundwater withdrawals; (2) reduction or cessation in groundwater withdrawals; (3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and (4) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range.

ACM C.2.8 Work with NDOW at the Flag Spring Complex in White River Valley to: 1) restore or enhance habitat for White River spinedace; (2) establish refugium to ensure long term conservation of the species; and (3) develop water management procedures and improvements that would optimize wetlands conditions for the species.

ACM C.2.17 Purchase property or water rights, obtain conservation easements, and or work with existing irrigation water right holder on private land in White River Valley to implement activities that would preserve and enhance habitat for the White River spinedace.

ACM C. 2.21 Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit water right holders or sensitive biological areas (e.g., routing excess surface water to subirrigate wet meadows, or creating containment ponds to store flood waters for use in recharging the aquifer).

In September 2012, in response to our concerns regarding impacts of Cave Valley pumping under the proposed action to White River spinedace, SNWA has developed a new Cave Valley ACM (Appendix C), which was submitted to BLM on September 13, 2012, and transmitted to the Service on September 17, 2012, for consideration in our effects analysis. A subsequent letter of clarification was sent by SNWA on November 7, 2012, and is included in appendix C. In this ACM, SNWA has committed to develop groundwater in Cave Valley in a staged (phased) approach, which is summarized below and included in full in Appendix C of this Opinion.

- <u>Stage 1 Development</u>: Pumping pursuant to the water rights permits will be limited to 2,600 afy, which is approximately one-half of the permitted rights. Before the increase in pumping associated with Stage 2 development can occur, SNWA will pump at 85% but not more than 100% of the Stage 1 development amount (2,210 – 2,600 afy) for a period of 5 years.
- <u>Stage 2 Development</u>: Pumping pursuant to the water rights permits will be limited to a total of 3,900 afy. Before the increase in pumping associated with Stage 3 development can occur, SNWA will pump at 85% but not more than 100% of this amount (3,315 – 3,900 afy) for a period of 5 years.
- <u>Stage 3 Development</u>: Pumping pursuant to the water rights will be limited to the full permitted amount of 5,235 afy.

Staged development will be accompanied by hydrologic monitoring and the setting of decision-making triggers, which will be approved by BLM and U.S. Fish and Wildlife Service (USFWS) and included in future consultations and NEPA analyses prior to initiation of groundwater pumping in Cave Valley. Movement from one development stage to another will depend on BLM and USFWS review of data and a determination by these agencies that the risk to White River spinedace remains at an acceptable level

9.5.2.1 <u>BLM Monitoring and Mitigation Measures</u>

The BLM has identified additional monitoring and mitigation measures through the NEPA process, which are presented in detail in Chapter 3.20 (Monitoring and Mitigation Summary) in the FEIS (BLM 2012b). Mitigation measures for future groundwater development and pumping are general in nature because they are based on the programmatic-level NEPA analysis. These general measures apply to future Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) activities, but will be replaced by more specific measures resulting from future tiered NEPA analyses (BLM 2012b). Below, we summarize those components of the BLM mitigation measures that are: 1) relevant to White River spinedace and its critical habitat; and 2) within BLM's jurisdiction.

ROW-WR-3: ***Construction Water Supply Plan.*** A construction water supply plan will be provided to the BLM for approval prior to construction. The plan will identify the specific locations of water supply wells (whether existing or new) that will be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; identify reasonable measures to reuse or conserve water; and identify any additional approvals that may be required. The BLM will review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. The SNWA will provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. The BLM, in consultation with State agencies and the grazing permittee, will review the location of any newly constructed water wells and determine if any will be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to benefit the BLM for multiple use management, the BLM will work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s). The BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. At locations of potential habitat, but where species occurrence has not yet been determined, surveys will be conducted in accordance with appropriate protocol prior to approving the plan. The construction water supply plan will be a component of the SNWA Plan of Development (POD). Prior to approval of the POD, the BLM will coordinate with the Service regarding portions of the POD relating to their regulatory role under the ESA. This process will be used to determine if there would be adverse impacts to listed species or adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary.

GW-WR-3a: ***Comprehensive Water Resources Monitoring Plan (WRMP).*** This mitigation measure requires that SNWA develop a comprehensive WRMP prior to project pumping that specifies hydrologic monitoring requirements to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variation, and other non-project related groundwater pumping activities. Monitoring would include: 1) water sources essential to federally-listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or State lands; 2) monitoring wells sited along the eastern margin of Steptoe Valley to monitor for the westward propagation of drawdown from project pumping in Spring Valley into Steptoe Valley beneath the Schell Creek Range; and 3) monitoring wells sited in Cave Valley and at the base of Shingle Pass in southern White River Valley to monitor and track the westward propagation of drawdown from project pumping in Cave Valley towards Flag Springs. The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for a period of at least 5 years prior to initiation of pumping.

GW-WR-3b: ***Numerical Groundwater Flow Modeling Requirements.*** This mitigation measure requires that SNWA update and recalibrate the regional groundwater flow model at least every 5 years after pumping is initiated, and that SNWA develop basin-specific models to be approved by BLM prior to tiered NEPA for specific groundwater development activities. BLM would use the basin-specific models to critically evaluate the effects of pumping and the effectiveness of the proposed mitigation measures, ACMs, and other measures proposed through the AM process. BLM would establish a Technical Review Team to review the model on a periodic basis.

GW-WR-7: ***Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights.*** This mitigation measure addresses BLM action in the event that monitoring or modeling information provided in accordance with GW-WR-3a indicates that impacts to federal resources from groundwater withdrawal are occurring or are likely to occur, and the GWD Project is the likely cause or a contributor to the impacts. The BLM would evaluate available information and determine if emergency action and/or a site-specific mitigation plan is required. If BLM determines that emergency action is required, BLM could serve a "Cease and Desist" order identifying actions to be taken to avoid, minimize, or offset impacts. If a site-specific mitigation plan is needed, BLM could require that specific measures be implemented per the schedule specified in the plan to avoid, minimize, or offset impacts to federal resources or federal water rights, including but not limited to: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) flow augmentation to maintain flow in specific water sources; 4) recharge projects to offset local groundwater drawdown; and 5) other on-site or off-site improvements.

Per BLM (10/04/2012), language in the ROD for this measure will be changed to state that BLM could serve a "Temporary Suspension" order pursuant to 43 CFR 2807.16-18, if needed, and not a "Cease and Desist" order.

GW-AB-3: ***Flow Change Mitigation.*** This measure specifies that BLM will identify detailed mitigation measures during subsequent NEPA for those springs and streams with special status aquatic species where flow or water level changes are identified during modeling or monitoring. Mitigation ideas are identified at the programmatic level in the ACMs, BLM's Comprehensive Monitoring, Management, and Mitigation Plan (COM Plan), and mitigation measure GW-WR-7.

GW-MN-AB-2: ***Spring and Aquatic Biological Monitoring*****.** This measure requires SNWA to monitor flows in moderate and high risk springs (as defined by BLM) with special status species where potential pumping effects could occur (as determine by BLM). (Note: BLM identified Flag Springs as a site potentially affected by SNWA's proposed pumping for Alternatives E and F in the Final EIS. These two alternatives bracket the amount of pumping anticipated under the NSE Order 6164 in CaveValley, Spring Valley, and Delamar Valley; and represent the same amount of pumping in Dry Lake Valley as that anticipated under the NSE rulilng [BLM 2012b]).

GW-MN-AB-3: ***Flow/Habitat Determination***. This measure requires SNWA to study flow or water level-habitat relationships in selected streams and springs to determine minimum flow or water levels need to support critical life stages of aquatic species in these habitats. The sites at which these studies would occur would be selected from the list being monitored as part of the Stipulations or additional waterbodies recommended for measures GWD-MN-AB-1 (relevant to game species) and GWD-MN-AB-2 (relevant to special status species).

The BLM is also developing its own COM Plan that addresses all hydrographic areas and all facilities associated with the GWD Project (BLM 2012b). The intent of the COM Plan is to prevent undue and unnecessary degradation of public lands and protect federal resources and federal water rights that may be impacted by the GWD Project, including avoiding adverse impacts that could cause jeopardy to listed species or destruction or adverse modification of designated critical habitat. The BLM will develop this plan based on SNWA's final Plan of Development and in coordination with other federal, state, local, and tribal agencies/governments, and Notices to Proceed will not be issued until the COM Plan has been completed (BLM 2012b). The COM Plan for Tier 1 will outline a process for developing additional mitigation, monitoring, and management requirements for future ROW grants, and will identify baseline and data gap information needs to better inform subsequent NEPA analysis for groundwater development. Groundwater development-specific COM Plans may be developed for subsequent tiers of the GWD Project, or the COM Plan for Tier 1 may be amended. The COM Plan(s) will also include development of triggers for management action and AM thresholds (BLM 2012b).

9.5.3 *Approach to Analysis*

Please refer to Chapter 5 (Analytical Approach) for a detailed discussion of our approach for analyzing effects related to Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping. The hydrologic analysis forms the backbone of the effects analysis for all federally-listed species that rely on groundwater-dependent ecosystems. The hydrologic analyses can be found in Chapter 7 (Hydrologic Analyses), and is referenced in this chapter as appropriate. Below, we focus primarily on describing: 1) potential effects of the proposed action to the White River spinedace and its critical habitat; and 2) potential cumulative effects. Lastly, we present our determination as to whether the proposed action is likely to jeopardize the continued existence of the White River spinedace and/or adversely modify its critical habitat.

As explained in Chapter 5 and Chapter 7, the Central Carbonate-Rock Province (CCRP) Model was developed as a tool to predict potential hydrologic change at a regional (not site-specific) scale, and there is uncertainty associated with these predictions (e.g., magnitude and timing of impacts). However, we must conduct a site-specific analysis of the potential effects of the proposed action to threatened and endangered species. Thus, we have used the CCRP Model as one of several tools for assessing potential impacts to the White River spinedace. For our hydrologic analysis, we assessed whether the CCRP Model likely over or under-predicted drawdown in the source aquifer for artesian well flows at Shoshone Ponds. We did not rely on model-predicted changes in spring discharge for our analysis as the model is a poor predictor of pumping-induced changes in spring discharge, as explained in Chapter 5.

9.5.3.1 Available Information and its Limitations

There is limited information available on the life history, food preferences, or habitat requirements of White River spinedace. A short-term study by Scoppettone et al. (2004a) described some aspects of this species' life history and quantified seasonal habitat use, but it was conducted during a period of rapid population expansion at Flag Springs and results may not represent true habitat preferences (Scoppettone et al. 2004a). While we cannot determine with any certainty what specific habitat characteristics control population dynamics and distribution of spinedace, we can conclude that water quantity, quality, and temperature have an important role. However, we do not know specifically how White River spinedace and its habitat will respond to decreases in spring flow at Flag Springs, if such changes occur due to the GWD Project. Therefore, we make general (qualitative) predictions based on the information included in this chapter (*Status of the Species* and *Environmental Baseline*), and urge that research on life history characteristics, habitat preferences, limiting environmental factors, and species' response to changes in flow and habitat change be completed prior to tiered ESA consultations to help inform these future analyses and the development of mitigation measures (see Chapter 15 – Conservation Recommendations).

9.5.4 *Potential Effects to White River Spinedace*

9.5.4.1 Tier 1 ROWs (Main Pipeline and Associated Facilities)

We do not anticipate any direct or indirect effects to White River spinedace from most of the activities associated with construction, operation, and maintenance of the main pipeline and associated facilities (but see below). Flag Springs, which is the only site where White River spinedace is found, is located approximately 17.7 km (11 miles) away from the nearest Tier 1 ROW in Cave Valley (Figure 9-1). Potential recovery sites (e.g., Preston Big Spring, Ellison Creek) are located even farther away. At this distance, the White River spinedace would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

On the other hand, we believe that groundwater pumping in Cave Valley for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) could potentially result in adverse effects to the spinedace at Flag Springs, but that this is extremely unlikely or the effects of this activity would be insignificant (*note*: we use this term as applied under the Act; i.e., that a person would not be able to meaningfully measure, detect, or evaluate insignificant effects) for the following reasons. The SNWA anticipates that at most 8.7 million gallons (or about 27 acre feet) of water will be needed for every mile of pipeline. There will be approximately 31 km (19 miles) of pipeline in Cave Valley (BLM 2012a), so we estimate that 513 acre feet of water will be needed for construction purposes in this valley. Whether or not there will be impacts to spring flow at Flag Springs could depend in part on the exact location and depth of these water supply wells, pumping rates and duration, and pumped units. However, the BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will approve prior to construction (ROW-WR-3). As indicated above, BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. The BLM will also coordinate with the Service to determine if there are adverse impacts to listed species, as well as to identify mitigation (including conditions to avoid impacts to listed species) and monitoring requirements, if necessary (Dow 2012). This has led us to conclude that adverse impacts to spring flow at the Flag Springs Complex, and thus adverse impacts to the spinedace from construction pumping are extremely unlikely.

9.5.4.2 Subsequent Tier ROWs (Groundwater Development Areas)

We do not anticipate any direct or indirect effects to White River spinedace from most of the activities associated with construction, operation, and maintenance of facilities associated with groundwater production in the Groundwater Development Areas (but see below). Flag Springs is located approximately 7 km (4.5 miles) away from the nearest Groundwater Development Area in Cave Valley (BLM 2012a) (Figure 9-1). Potential recovery sites (e.g., Lund Spring, Ellison

Creek) are located even farther away. At this distance, the White River spinedace would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

On the other hand, we believe that groundwater pumping in Cave Valley for construction purposes may adversely affect spinedace at Flag Springs, but that it is extremely unlikely or that the effects of this activity would be insignificant (*note*: we use this term as applied under the Act; i.e., that a person would not be able to meaningfully measure, detect, or evaluate insignificant effects) for the following reasons. The length of future collector pipelines is not known, but has been estimated by SNWA based on assumptions regarding number of future groundwater production wells and known geologic and hydrologic conditions. The SNWA estimates that up to 77 km (48 miles) of collector pipeline could be built in Cave Valley in order to develop and transport groundwater at quantities granted by the NSE in 2012 (BLM 2012a). Based on the assumptions discussed above regarding water needs for construction purposes, we anticipate that SNWA will need up to 1,296 acre feet of water for construction purposes for Subsequent Tier ROWs. However, based on BLM Monitoring and Mitigation Measure ROW-WR-3 and subsequent modifications to this measure (Dow 2012), as described above, it is our Opinion that this project activity is extremely unlikely to adversely affect the spinedace.

This conclusion will be re-evaluated for any tiered consultation involving ROWs in Spring Valley, based on updated information provided at that point in time.

9.5.4.3 Groundwater Pumping

We anticipate that White River spinedace will be adversely affected by declining groundwater levels and reduced spring flow from GWD Project pumping within the timeframe of our analysis, based on pumping in Cave Valley at the full proposed rate. As described in Chapter 7 (Hydrologic Analysis), we concluded that Cave Valley pumping at NSE awarded quantities (5,235 afy) would have considerable impact on the discharge of Flag Springs. However, the new Cave Valley ACM (Appendix C), with half the full proposed rate (roughly 2,617 afy) over a 5-year period of phased in pumping, followed by pumping at three quarters of the full proposed rate over a subsequent 5 year period of phased-in pumping, would result in a lesser impact to spring flow at Flag Springs and allow monitoring to identify potential impacts before levels are reached.

On the other hand, our hydrologic analyses for the full proposed pumping rate in Cave Valley (and other valleys that are part of the GWD Project) indicate low likelihood of measurable hydrologic impacts to the following sites that are potentially important to spinedace recovery: Preston Big Spring, Lund Spring, upper Ellison Creek, and Moon River Spring. Therefore, we do not anticipate impacts to these sites from the action as amended by the new Cave Valley ACM (Appendix C). As a result, our discussion below focuses entirely on potential effects to White River spinedace and its habitat at the Flag Springs Complex. This site is the only site where this species occurs, and is thus essential to the survival and recovery of this species; it is also designated as critical habitat.

As described above, Nevada has certificated water rights at Flag Springs of 0.022 cfs per year (not to exceed 0.592 million gallons annually) for purposes of quasi-municipal uses, which NDOW uses to manage the property and benefit wildlife, and which are existing water rights protected under Nevada water law. Nevada Revised Statute (NRS) 533.482 provides the NSE with the authority to seek injunctive relief to prevent any action that would violate Nevada water law's protection of existing rights or any order or regulation of the NSE. The NSE may even request an injunction before any injury to a water right occurs. Both federal district courts and Nevada state courts have consistently ruled in favor of protecting senior existing water rights from injury.

As described below, we believe that reduced spring discharge at Flag Springs due to pumping under the full proposed rate in Cave Valley is likely to cause significant impacts to the White River spinedace within the timeframe of our analysis. Detailed hydrologic modeling of the phased-in Cave Valley pumping that will happen under the new Cave Valley ACM (Appendix C), has not been conducted for this programmatic analysis, but will be conducted as part of tiered consultations prior to groundwater pumping. Thus, the specific extent that impacts to the spinedace will be lessened by this measure is unknown. Based on our biological analysis of potential impacts to spinedace and its habitat at Flag Springs (provided below), we believe that this species could be very sensitive to changes in its habitat and that at a certain level (currently unknown), changes in water volume in the system from current conditions may not be sufficient for persistence of the species (Scoppettone 2007). This, coupled with our assessment that considerable hydrologic impact is likely under the action as originally proposed, creates a seemingly precarious situation for the fish.

Following our description of potential biological impacts of reduced spring flow to White River spinedace, we provide an assessment of effects of the proposed federal action as amended by the new Cave Valley ACM (appendix C), which has additional components other than the phasing in of pumping in Cave Valley described above.

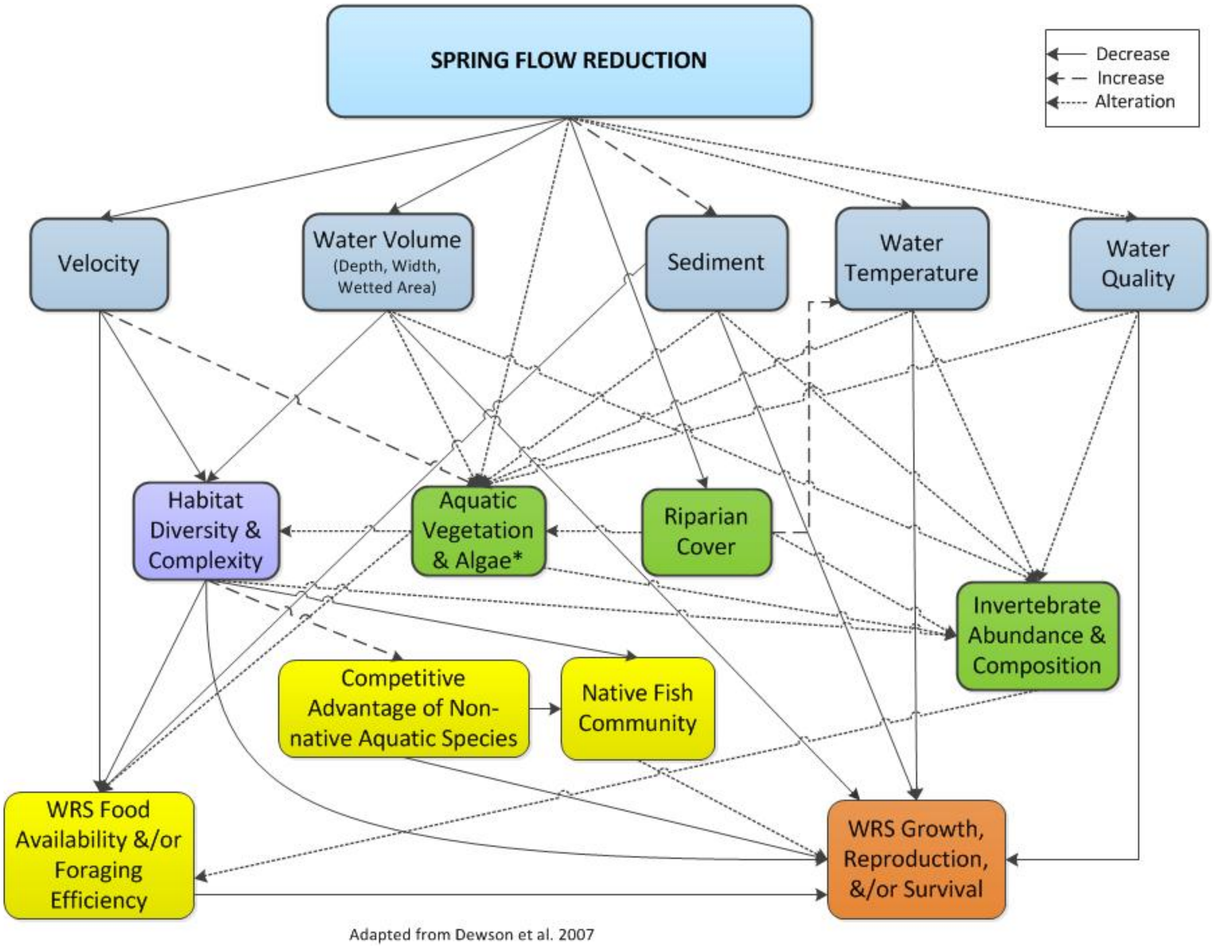
Our analysis took into consideration lag times in system responses. For example, we anticipate that there will be a lag time between pumping in Cave Valley and reduced water availability (e.g., spring flow) at Flag Springs, and between reduced spring flow and ecological response of spinedace and its habitat (Sophocleous 2007; Bredehoeft 2011). We also anticipate that the system will be relatively slow to respond if pumping were to cease at 75 years after full build out, and that effects will worsen before recovery begins (per Bredehoeft 2011). The CCRP Model simulations for the full pumping amount under the proposed action indicated that groundwater drawdown at Flag Springs will likely continue to decline if pumping ceases at 75 years after full build out, delaying the start of spring flow recovery for approximately 50 years (i.e., maximum drawdown is predicted to occur 50 years after cessation of pumping; SNWA 2012a). Recovery of groundwater levels at Flag Springs over the ensuing 50 years is predicted to be small (approximately 2 percent).

Groundwater pumping in Cave Valley could also result in changes to spring water chemistry and/or water temperature at Flag Springs. A significant supply of the water at Flag Springs appears to come from Cave Valley (NSE 2012), with some contribution from White River Valley (Burns and Drici 2011). The GWD Project could differentially affect the sources of flow at Flag Springs (i.e., cause substantial reductions in the supply of water from Cave Valley), resulting in changes to the chemical composition of the spring water (Alley et al. 1999). Additionally, because the three springs in the Flag Springs Complex appear to be "sourced" at different depths in the carbonate aquifer, and the elevation of the spring orifices vary, each spring may be impacted differently by groundwater drawdown. Disproportionate changes in discharge at one spring could affect the overall temperature and water quality in the combined outflow channel and upper Sunnyside Creek.

The complexity of ecosystem processes makes it difficult to predict *specifically* how groundwater drawdown or diminished spring flow will affect White River spinedace at Flag Springs. This is further complicated by our incomplete knowledge of spinedace life history, habitat requirements, food preferences, and individual and population-level responses to diminished water quantity and/or quality. A flow-ecological response model that describes the relationship between hydrologic variability and ecological response has not been developed for White River spinedace and its habitat. Obviously, if spring flow ceases completely at Flag Springs, spinedace will disappear. But, effects of diminished flow can also be profound (per Deacon 2007), though more difficult to predict. We also do not known whether biological responses to decreased flow will be gradual or abrupt, or gradual up to a point followed by an abrupt change (threshold response). If such an ecological threshold exists, wherein diminished flow resulting from groundwater pumping pushes the system to a new equilibrium or state, it will be disproportionately difficult to return the system to its original state (Rijnsdorp et al. 2012 and references cited therein).

Relatively small changes in flow can result in rather substantial ecological responses. This relationship has been demonstrated in both river and spring ecosystems (Hubbs 2001; Lloyd et al. 2004). For example, Hubbs (2001) found that a spring flow reduction of one-sixth coincided with an abundance reduction of nearly one-half for endemic spring-dwelling fish in Texas, and he concluded that extirpations are possible long before the final cessation of spring flow. Sensitivity to change in aquatic environments will be determined by the life history characteristics, habitat requirements, behavior, and physiology of a species. The White River spinedace appears to be very sensitive to changes in its spring-fed habitat, as indicated by its disappearance from most historical sites following channelization and diversion of spring flow and fragmentation of interconnected spring-fed habitats. It also appears to be more sensitive than some other small-bodied, native fish in northern White River Valley (e.g., White River speckled dace, Preston White River springfish) that have been able to persist at sites at which spinedace were extirpated, despite habitat alterations (Scoppettone et al. 2004b). Because repatriation of spinedace to historical sites has so far been unsuccessful (potentially due to low flow; Scoppettone 2007), and most historical sites are so severely altered that they are not currently able to support the species, maintaining suitable habitat conditions via maintaining adequate quantity and quality of spring flow at Flag Springs is imperative to survival and recovery of the species.

While we do not have a specific flow-ecological response model developed for White River spinedace, we conceptually describe how the species and its habitat may respond to reductions in spring flow in the paragraphs below. Additionally, we visually demonstrate some of these potential relationships in Figure 9-3. This is best viewed as a set of hypotheses about the responses of spinedace habitat and the fish itself to diminished flow based on the best available information.



Adapted from Dewson et al. 2007

Figure 9-4. Conceptual model of potential impacts to White River spinedace

Flow regime and discharge patterns (e.g., quantity, timing, and variability) have a major influence on spring and stream ecological processes (Poff et al. 1997; Naiman et al. 2002). Aquatic species have evolved life history strategies primarily in response to the natural flow regimes they experience (Bunn and Arthington 2002). Springs and spring-fed streams, such as inhabited by White River spinedace, are generally characterized as having lower variability in flow, temperature, and other water quality parameters than streams fed primarily by runoff (van der Kamp 1995). However, flow and water quality can vary considerably in some springs in response to climate (precipitation, snow melt), evapotranspiration, or other factors. Within a spring system, variability is typically low at the spring head with a gradient of increasing variability down the spring brook (Hubbs 2001). Some species are exclusively found in the spring head environment where more stable conditions prevail (crenobiontic species), other species predominate in downstream reaches where environmental conditions are more variable, and still others are more general in their habitat use (Hubbs 2001).

At Flag Springs, White River spinedace occurs in the springs, the spring outflow channels, and downstream into Sunnyside Creek. This species has been described as a habitat generalist in so far as it uses both pool (still water) and stream (flowing water) environments (Scoppettone et al. 2004a). Based on available information from historically occupied sites, it appears that water temperature and aquatic habitat diversity/complexity may be important habitat components influencing its persistence. It appears that spinedace at Flag Springs use or potentially need different aquatic habitats (pools, riffles, etc.) based on season and/or life-stage, and their ability to access these habitats is likely essential to successful spawning and recruitment. Therefore, we anticipate that changes in discharge that adversely affect habitat extent and diversity/complexity, and/or changes in discharge that alter water temperatures could have substantial consequences for White River spinedace.

Reductions in flow often result in diminished spring brook length, wetted width, water depth, and water velocity (Bradford and Heinonen 2008), with reduced velocity frequently being one of the largest and more apparent changes (Dewson et al. 2007). Stream habitats (pool, riffle, glide, run) will be affected differently, with shallower and/or swifter flowing waters (e.g., riffles and margins of the system) being more adversely affected and impacted sooner by decreased flows than pool habitats (Dewson et al. 2007; Bradford and Heinonen 2008; Kollaus and Bonner 2012). The result could be an overall decrease in aquatic habitat diversity and complexity. Early life stages of spinedace may be more susceptible to changes in habitat caused by decreased spring flow since larvae and juveniles appear to inhabit slower and shallower water than adults (as shown by Scoppettone et al. 2004a). Thus, decreased flows could lead to reduced survival of early life stages and reduced recruitment by disproportionately affecting young fish and/or nursery habitats.

Spring-head pools could potentially serve as refugia for adult fish during sustained low flow events (e.g., see Hubbs 2001), but eventually pool environments will also be impacted (Bond et al. 2008; Bradford and Heinonen 2008). Reductions in spring discharge that results in decreased pool size and depth would likely adversely affect spinedace (Sada and Deacon 1994). White River spinedace may be able to survive for some period of time in restricted pools, but if available habitat and habitat complexity at Flag Springs is substantially reduced over the long term, and movements among aquatic habitats is restricted by significant shallowing of riffle areas (Bradford and Heinonen 2008), survival and recovery of the species will be compromised.

Sustained reductions in spring flow of sufficient magnitude would like result in an overall reduction in water volume in the Flag Springs system, which could then affect growth and reproduction of the White River spinedace. Freshwater fish are known to scale in size to the water volume inhabited (Smith 1981). Additionally, larger fish tend to be more fecund; this relationship has been demonstrated for numerous freshwater fish species (e.g., Johnson et al. 1995; Scoppettone et al. 1992). Therefore, we infer that lower water volume, if it occurred, could result in smaller and less fecund spinedace, which would consequently reduce reproductive potential of the population.

Deacon (1979) found that during a drought year on the Virgin River that resulted in low flows, YOY fish comprised a very small (nearly inconsequential) proportion of a population of woundfin (another Plagopterine fish), indicative of low reproductive success. Additionally, young woundfin appeared later in the season in some stream reaches, which was followed by very poor survival. While we do not know the specific mechanisms behind this poor reproductive success and survival, it provides some indication of Plagopterine fish population response to low flow situations. Sustained reductions in spring flow at Flag Springs could result in multiple years of low reproductive success with substantial consequences to long-term persistence of spinedace.

While the specific habitat requirements for White River spinedace spawning and reproduction are not known, studies on this species and its congeners indicate that substrate, water velocity, and water temperature are likely important (see *Habitat* section). Lower velocities due to reduced flows could cause fine sediments to settle on spawning substrates (gravels) or fish eggs (Johnston 1999; Reiser et al. 2004; and Jezorek et al. 2011, and references cited therein), thereby limiting spawning habitat and impacting spinedace reproductive success. Additionally, reduced flows are known to result in water quality and temperature changes, which can be stressful for fish (IFC 2002, cited in Bradford and Heinonen 2008). Small changes in water temperature can have considerable consequences for freshwater fishes, affecting life history (e.g., reproduction, feeding), behavior (e.g., predator avoidance, migration, and spawning), and physiology (e.g., metabolism, growth, body condition) (Carveth et al. 2006).

The size and rate of spring flow influences the area of thermal stability downstream from the spring head (Hubbs 2001). Thus, decreased spring flow could increase variability in temperatures at downstream sites. And, as flow rates in spring systems decrease due to lowered groundwater levels, remnant flows become slower and more subject to heating or cooling from the ground surface near the spring (van der Kamp 1995). As described in the *Habitat* section, White River spinedace reproduction has only been observed in relatively constant water temperatures ranging from about 19.5 to 22 ^{o}C (66 to 71 ^{o}F), which roughly corresponds to the water temperatures at Middle and South Flag springs and the outflow channels (Hobbs 2006). Therefore, reduced spring flows that broaden fluctuations in water temperatures and decrease the area of thermal stability below the spring heads could result in a reduction in spinedace reproductive habitat (Scoppettone 2007). Cooler water temperatures in downstream spawning sites could also cause a delay in spawning, delayed egg development and hatching, and slower growth of young fish, potentially leading to lower over-winter survival, increased mortality due to predation, and/or delayed reproductive maturity (see Mills 1991; Blinn et al. 1998; Billman et al. 2006). Greater fluctuations in water temperature could also result in a shortening of the reproductive season because a lack of dynamic fluctuations in water temperature is thought to contribute to a protracted reproductive seasons in some cyprinids (Perkins et al. 2012).

Reduced water volume and loss of riparian trees at the spring heads due to groundwater drawdown could result in increased daily and annual temperature fluctuations (Carveth et al. 2006, and references therein; Whitledge et al. 2006). If shallow waters are exposed to high ambient temperatures and direct sun during summertime, water temperatures could rise to levels detrimental to spinedace. We do not know the thermal tolerance of spinedace, but an altered thermal regime could expose fish to temperature fluctuations outside of their tolerance range (Carveth et al. 2006).

The response of macrophytes (aquatic vegetation) to reduced flow in spring-dominated springs is unclear. Reduced flows could lead to decreased productivity and biomass levels of some plants, resulting in: 1) lower invertebrate populations and less food available to fish; and 2) alteration of substrate composition and spawning conditions (Rieser et al. 2004). On the other hand, a reduction in water volume and velocity could result in an increase in algae and some aquatic macrophytes that further clogs the stream channel (Suren and Riis 2010; also see Rieser et al. 2004) at Flag Springs, decreasing available aquatic habitat and impairing spinedace movement and foraging efficiency. Algae and plant material are food sources for White River spinedace (Scoppettone et al. 2004a), and macrophytes (such as watercress) provide shelter and food for aquatic invertebrates (Surin and Riis 2010), the primary food of spinedace. Emergent vegetation could also provide cover from predators, particularly for larval and juvenile fish (Perkin et al. 2012, and references therein). Therefore, while it is unclear how changes in aquatic vegetation from diminished flows would affect the spinedace population at Flag Springs, but it is possible that it would further reduce available spinedace habitat by causing cattails, reeds, and bulrushes to become overgrown and choke out the system. This excessive aquatic plant growth could reduce water velocity and increase sedimentation even further (Suren and Rus 2010).

Groundwater drawdown could also adversely affect the riparian vegetation growing adjacent to Flag Springs and the outflow channels. Depending on the magnitude of flow reductions, declines in spring flow could lower the adjacent groundwater table and could alter the composition, cover, and distribution of riparian plant communities (Reiser et al. 2004) that provide shade, cover, food (i.e., macroinvertebrates), and allocthonous (organic matter) input into the stream.

As mentioned above, aquatic invertebrates are an important food source for White River spinedace (Scoppettone et al. 2004a). Studies indicate that invertebrate response to flow reduction is variable, and responses may not be evident in some systems until substantial reductions in flow occur (e.g., > 50 percent) (Wills et al. 2006; Bradford and Heinonen 2008). Because riffles are linked to invertebrate production (Bradford and Heinonen 2008), we anticipate some impacts to invertebrate abundance from reduced flows at Flag Springs. Also, we expect that absolute abundance of aquatic invertebrates may be reduced due to a decrease in overall wetted area. But, invertebrate densities may increase as they become more concentrated in remaining aquatic habitat (Bradford and Heinonen 2008). We also expect that the composition of the invertebrate community at Flag Springs may change, with specific changes dependent on the sensitivity of each individual taxon to changes in velocity, substrate, and water quality (Dewson et al. 2007). For example, if decreased flows result in fine substrates settling on coarser substrates, this could have a deleterious effect on stream benthic macroinvertebrates, particularly on drift organisms most likely to be consumed by sight feeders such as the White River spinedace (based on Jezorek et al. 2011, and references cited therein). If occurrence and density of macroinvertebrates in the drift decreases, this can affect fish growth rate and population size (Chapman 1966, as cited in Wills et al. 2006).

A reduction in water volume at Flag Springs could reduce foraging efficiency for the White River spinedace, leading to a reduction in fitness (Scoppettone 2007). To feed efficiently, spinedace need slow water that allows them to conserve energy while sighting drift items in adjacent faster water that transports these food items. Because they rely on their eyesight to detect and capture drift items, reductions in flow that result in either increased silt loads or dense vegetation growth in the stream channel will also likely impair foraging efficiency.

Decreased flows can also alter the overall fish community. If habitat diversity and complexity is diminished by decreased flows, which seems likely, then fish species will be less able to segregate habitat and there will be greater niche overlap (Helfman 2007; Scoppettone 2007; see examples therein). This could result in increased predatory pressure and competition (Helfman 2007, cited in USFWS 2011). White River spinedace co-occur with two other native fish species in Flag Springs; how decreased flows will affect inter-specific interactions and partitioning of aquatic habitat and resources is unknown, but should be considered. And, while non-native fish are not currently an issue for White River spinedace in the upper portion of the Flag Springs system (above the fish barrier), this is not to say that this will not become an issue again in the future. Reduced flows that result in decreased habitat complexity could give a competitive advantage to non-native fishes, if any new species were to be introduced into the system. Additionally, the effectiveness of existing fish barriers in the Flag Springs system could be affected by decreased flows and velocities.

In summary, it is our Opinion that pumping at NSE-awarded quantities in Cave Valley would have a considerable impact on the discharge of Flag Springs, which if sustained would likely result in lower water volumes and changes to spinedace habitat in the Flag Springs system. Additionally, based on what we know or surmise about the White River spinedace's life history and habitat requirements, we believe that this species is sensitive to the type of changes in its habitat that could result from decreased spring flow and a reduction in water volume. Based on this and expert opinion (Scoppettone 2007), we conclude that a lower water volume in the Flag Springs system, system at a certain level (currently unknown) may not be sufficient for persistence of the White River spinedace.

9.5.5 *Potential Effects to Designated Critical Habitat*

9.5.5.1 Tier 1 ROWs (Main Pipeline and Associated Facilities)

We do not anticipate any direct or indirect effects to White River spinedace critical habitat from most of the activities associated with construction, operation, and maintenance of the main pipeline and associated facilities. Critical habitat at Flag Springs is located approximately 18 km (11 miles) away from the nearest Tier 1 ROW, and critical habitat at Lund Spring and Preston Big Spring is more than 32 km (20 miles) away from the nearest Tier 1 ROW (Figure 9-1). At this distance, the critical habitat would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

On the other hand, we believe that groundwater pumping for Tier 1 ROW construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) could potentially result in adverse effects to spinedace critical habitat, but that this is extremely unlikely or the effects of this activity would be insignificant (*note*: we use this term as applied under the Act; i.e., that a person would not be able to meaningfully measure, detect, or evaluate insignificant effects). Whether or not there will be impacts to critical habitat could depend in part on the exact location and depth of these water supply wells, pumping rates and duration, and pumped units. However, the BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will approve prior to construction (ROW-WR-3). As indicated above, BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. The BLM will also coordinate with the Service to determine if there are adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to critical habitat) and monitoring requirements, if necessary (Dow 2012). This has led us to conclude that adverse impacts to spinedace critical habitat are extremely unlikely.

9.5.5.2 Subsequent Tier ROWs (Groundwater Development Areas)

We do not anticipate any direct or indirect effects to White River spinedace critical habitat from most of the activities associated with construction, operation, and maintenance of facilities related to groundwater production in the Groundwater Development Areas. Critical habitat at Flag Springs is located approximately 7.2 km (4.5 miles) away from the nearest Groundwater Development Area, and critical habitat at Preston Big Spring and Lund Spring is located more than 32 km (20 miles) away (BLM 2012a) (Figure 9-1). At this distance, spinedace critical habitat would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

On the other hand, we believe that construction pumping for Subsequent Tier ROWs could potentially result in adverse effects to spinedace critical habitat, but that this is extremely unlikely or the effects of this activity would be insignificant (*note*: we use this term as applied under the Act; i.e., that a person would not be able to meaningfully measure, detect, or evaluate insignificant effects). Whether or not there will be impacts to critical habitat could depend in part on the exact location and depth of these water supply wells, pumping rates and duration, and pumped units. However, the BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will approve prior to construction (ROW-WR-3). As indicated above, BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. The BLM will also coordinate with the Service to determine if there are adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to critical habitat) and monitoring requirements, if necessary (Dow 2012). This has led us to conclude that adverse impacts to spinedace critical habitat are extremely unlikely.

This conclusion will be re-evaluated for any tiered consultation involving ROWs in Spring Valley, based on updated information provided at that point in time.

9.5.5.3 Groundwater Pumping

We anticipate that critical habitat at Flag Springs will be adversely modified by declining groundwater levels and reduced spring flow from GWD Project pumping within the timeframe of our analysis, based on pumping in Cave Valley at the full proposed rate. But, we do not anticipate that critical habitat at Preston Big Spring and Lund Spring will be adversely modified during the timeframe of our analysis for reasons described above (*Potential Effects to White River Spinedace - Groundwater Pumping*). As described in Chapter 7 (Hydrologic Analysis), we concluded that Cave Valley pumping at NSE awarded quantities (5,235 afy) would have measurable impact on the discharge of Flag Springs. However, the new Cave Valley ACM (Appendix C), with half the full proposed rate (roughly 2,617 afy) over a 5-year period of phased in pumping, followed by pumping at three quarters of the full proposed rate over a subsequent 5 year period of phased-in pumping, would result in a lesser impact to spring flow at Flag Springs and allow for monitoring to identify potential impacts before trigger levels are reached. Detailed model predictions of drawdown associated with the phased development under the new Cave Valley ACM (Appendix C), has not been conducted for this programmatic analysis, but will be conducted as part of tiered consultations prior to groundwater pumping. Thus, the specific extent that impacts to the spinedace will be lessened by this measure is unknown. With the phased pumping approach, additional monitoring, and Service-approved trigger setting provided for in the new Cave Valley ACM, we have the assurance necessary to ensure risk is sufficiently minimized. This reduced risk approach will ensure our ability to allow for the survival and recovery of the species and avoid adversely modifying its critical habitat.

The PCEs of critical habitat are: 1) consistently high quality, cool [13 to 21 ^{o}C (55 to 70 ^{o}F)] springs and outflows with a sufficient quantity of water, and 2) surrounding land areas (for a distance of 15 m [49 feet]) that provide vegetation for cover and habitat for insects and other invertebrates on which the species feeds. Above, we have described in detail how sustained reductions in spring flow at Flag Springs could affect water volume in the system and White

River spinedace habitat, including water quality and temperatures and the overall extent of spinedace habitat. We also discussed that, depending on the magnitude of reduced flows, adjacent groundwater levels could be affected with consequences to riparian plant communities (Reiser et al. 2004). This could then have negative consequences for macroinvertebrates (fish food) and the thermal environment of the spring-fed habitat.

Therefore, based on this biological analysis of potential impacts to spinedace habitat at Flag Springs (provided above), we believe that critical habitat at Flag Springs would be adversely modified by the full proposed pumping rate in Cave Valley. Detailed hydrologic modeling of the phased-in Cave Valley pumping that will happen under the new Cave Valley ACM (Appendix C) has not been conducted for this programmatic analysis, but will be conducted as part of tiered consultations prior to groundwater pumping. Thus, the specific extent that impacts to the spinedace habitat will be lessened by this measure is unknown.

The following section provides a description of potential effects to spinedace critical habitat based on our assessment of the proposed federal action as amended by the new Cave Valley ACM (Appendix C), which has additional components other than the phasing in of pumping in Cave Valley described above.

9.5.6 *Analysis of Effects to White River Spinedace and its Critical Habitat with Implementation of Applicant and Bureau of Land Management-committed Mitigation Measures*

Measures committed by the applicant and BLM will reduce the risk of impacts to White River spinedace and its critical habitat. Three key commitments provide assurances of an adequate reduction in the risk of impacts, 1) a commitment to phase in from smaller to larger pumping volumes, (2) a commitment for extra monitoring wells in this specific portion of the project area, and (3) a commitment to allow the Service to approve or reject triggers that would allow groundwater pumping to be modified, reduced, or ceased if necessary.

Because there are no additional, more specific hydrologic or biological data available, we are uncertain exactly what the effects of this additional mitigation will be. However, we are confident that with these measures the Service can ensure impacts will be minimized or avoided. Given the lack of data available to inform a more detailed analysis of these measures, the only way to better evaluate effects is to begin implementing the project slowly and cautiously, using extra monitoring data and the ability to detect changes and stop pumping quickly. With the phasing in of pumping starting at one-half of the proposed project volume, risk will be reduced by roughly one-half. With the additional monitoring and Service-approved trigger setting, we have the assurance necessary to ensure risk is sufficiently minimized. And by implementing this approach we will have the data necessary to inform any future levels of ground water use for the long-term. This reduced risk approach will ensure our ability to allow for the survival and recovery of the species and avoid adversely modifying its critical habitat.

9.5.7 *Cumulative Effects*

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Cumulative effects to the White River spinedace would include, but are not limited to, changes in land or water use patterns or practice (including management actions) that may adversely affect the species or its habitat. Future groundwater uses within the spinedace analysis area that we consider to be reasonably certain to occur include: 1) the continuation of current consumptive groundwater uses within the spinedace analysis area; (2) development of additional permitted irrigation rights for agriculture on private lands in Spring Valley; and (3) development of additional permitted irrigation rights, industrial water rights, and mining and milling rights in Steptoe Valley (per Table 5-1 in BLM's Biological Assessment). The BLM considered these future groundwater uses as part of their baseline assessment (BLM 2012a). As explained in Chapter 5, while we are not in complete agreement with BLM in terms of the categorization of these water uses (i.e., baseline versus cumulative), this particular point has no bearing on our overall effects conclusions (i.e. jeopardy or no jeopardy), which is based on aggregate effects (see below).

Presently, Cave Valley has very low groundwater usage, and this is for stock watering purposes. Future development and/or use of groundwater in this valley, other than what is proposed for the GWD Project, is unlikely or is anticipated to be low (NSE 2012). We agree that additional groundwater development in this valley appears unlikely.

9.6 CONCLUSION

As required under section 7, we based our overall effects conclusions on the ***aggregate*** effects of the factors analyzed under "environmental baseline," "effects of the action," and "cumulative effects." The BLM provided us with an aggregate effects analysis in support of this consultation, which included results of groundwater flow model (CCRP Model) simulations for their "baseline-plus-proposed action" scenario.

The CCRP Model simulations predicted greater groundwater drawdown and a greater decrease in spring discharge at Flag Springs, Lund Spring, and Preston Big Spring as a result of aggregate effects, over the effects of project pumping that would be added to the environmental baseline (BLM 2012a,b). Predicted decreases in spring discharge at Lund Spring and Preston Big Spring are largely, if not entirely attributable to sources other than the proposed action pumping (BLM 2012a). However, aggregate water use in White River Valley is predicted to increase groundwater drawdown and further reduce spring discharge at Flag Springs over that which would be added to the baseline by GWD Project pumping. Nevertheless, aggregate impacts at Flag Springs will be greater than effects from just GWD Project pumping, and the majority of the aggregate effects at this site are attributable to pumping under the proposed action.

Prior to receiving the Cave Valley ACM, the Service found that pumping in Cave Valley at the full proposed rate could present substantial risk to White Rive spinedace. This conclusion was based on: 1) the status of Flag Springs as the only site at which the endangered White River spinedace occurs; 2) our analysis of the potential effects of pumping groundwater from Cave Valley at the NSE-awarded amount of 5,235 afy over the analysis timeframe, which indicates that there will be considerable impact on the discharge of Flag Springs; 3) knowledge of this species' life history, habitat use, and behavior, which indicates that this species is likely very sensitive to changes in its spring-fed habitat; and 4) our conceptual analysis of the likely impacts that sustained reductions in flow of considerable magnitude could have on spinedace and its habitat. However, it is our Opinion that the action, as proposed with the Cave Valley ACM, is not likely to jeopardize the continued existence of the White River spinedace and that the proposed action is not likely to adversely modify designated critical habitat for the spinedace. This conclusion is based on the fact that the measures committed to by the applicant and BLM, especially the phased pumping and monitoring approach, will minimize the risks of project pumping and provide the necessary mechanism for the Service to ensure the survival and recovery of the White River spinedace and to avoid the adverse modification of its critical habitat

The Service anticipates substantial adverse effects to White River spinedace and its critical habitat at Flag Springs associated with groundwater drawdown and decreased spring discharge resulting from full implementation of the GWD Project pumping. We believe these effects will be partially, but not completely mitigated by ACM and BLM mitigation measures, and specifically the new Cave Valley ACM (Appendix C). Therefore, we do not concur with BLM's "may affect, not likely to adversely affect" conclusion (BLM 2012a). The most critical element to spinedace survival at Flag Springs is a consistent quantity and quality of spring flow (USFWS 1985), and both of these constituent elements could be significantly affected by full implementation of the proposed programmatic activities (i.e., groundwater pumping), which would then cause substantial (and potentially irreversible) adverse impacts to the spinedace population.

Our assessment of hydrologic impacts evaluated the potential magnitude of groundwater drawdown at occupied critical habitat (Flag Springs), unoccupied critical habitat (Preston Big and Lund springs), and other sites currently identified as having recovery potential (i.e., refuge sites) as a result of: 1) the proposed pumping in Cave Valley; and (2) the proposed pumping in combination with the continuation of existing pumping in White River Valley (cumulative pumping). All parties (USFWS, BLM, and SNWA) agree that there is considerable uncertainty associated with the CCRP Model predictions. Our hydrologic analysis has identified five factors related to the construction and calibration of the CCRP Model which may contribute to the underestimation of drawdown at Flag Springs, two of which were amenable to some degree of quantification with the available information.

As described in this chapter, there are numerous potential impacts to White River spinedace habitat that could result from reduced flows; these will interact in complex ways to affect individual fish and the spinedace population at Flag Springs. There is also considerable uncertainty associated with the predicted outcomes due to: 1) unknowns regarding project design (e.g., pumping locations, depths, completion units, rates, and schedules); (2) unknowns regarding the response of the hydrologic system to pumping stresses; (3) unknowns regarding the response of White River spinedace and its habitat to decreased flow; and (4) climate change. Therefore, the Service has taken a risk-based approach to assessing the potential implications of implementing the proposed action on White River spinedace and its critical habitat. In general, risk increases as base flows are reduced, but there is considerable uncertainty in the biological response for a given hydrological change, other than at the two extremes of the flow reduction spectrum (Bradford and Heinonen 2008). Figure 9-4 below demonstrates this relationship (taken from Bradford and Heinonen 2008, which is an adaptation from Healy 1998). Given the need to manage this risk in the face of these uncertainties, the new Cave Valley ACM (Appenidx C) is designed to directly address specific concerns to ensure White River spinedace and their critical habitat are adequately conserved.

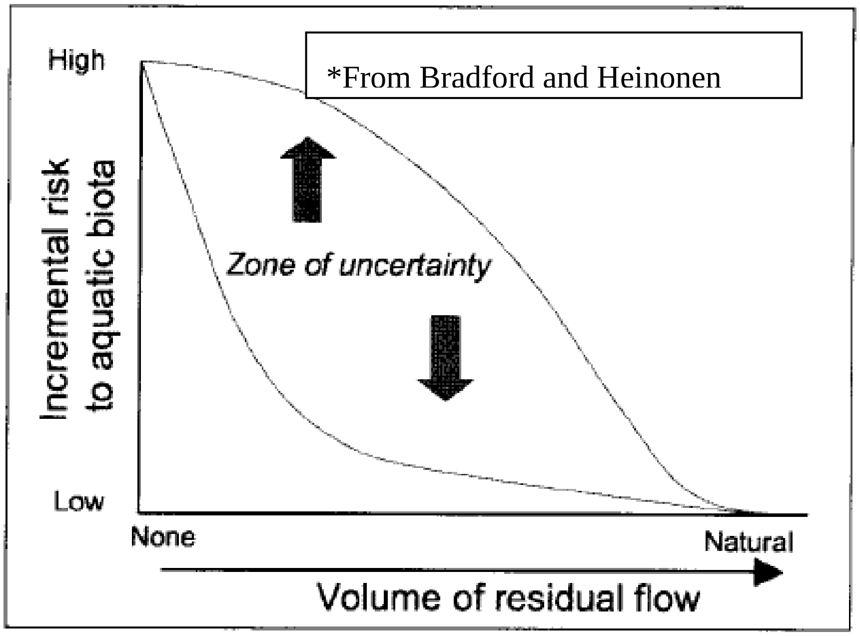


Figure 9-5. Relationship between risk to aquatic biota and residual flow

Given the potential for substantial decreases in spring discharge at Flag Springs during the timeframe of this analysis; the potential for climate change to exacerbate effects to discharge and the thermal regime at the Flag Springs Complex; the apparent sensitivity of this species to spring alterations that reduce the diversity and complexity of its habitat; and the potential for a reduction in discharge at this site to result in lower water volumes, which at a certain level (currently unknown) may be insufficient for species persistence (Scoppettone 2007), we find that there is significant risk to the White River spinedace from implementation of the action as currently proposed. We proposed additional conservation recommendations to further reduce risk for White River spinedace and its critical habitat. However, as stated above, we are confident that with the measures committed by the applicant and BLM, the Service can ensure impacts will be minimized or avoided. With phased pumping approach, additional monitoring, and Service-approved trigger setting, we have the assurance necessary to ensure risk is sufficiently minimized. This reduced risk approach will ensure our ability to allow for the survival and recovery of the species and avoid adversely modifying its critical habitat.

Lastly, the future effects of climate change may act to alter the hydrological regime upon which the White River spinedace is dependent, thus compounding the potential effects of groundwater pumping under the GWD Project. In summary, higher air temperatures, more winter precipitation in the form of rain than snow, and earlier snowmelt could result in increased evapotranspiration and shifts in the timing and/or amount of groundwater recharge and runoff (EPA 1998), potentially resulting in decreased summer flows in springs and streams. This could result in altered thermal regimes in springs, reduced springbrook length, reduced extent of the stable springhead environment, reduced heterogeneity of the aquatic environment, and reduced soil moisture (Sada and Herbst 2008). However, while climate change may affect Flag Springs, Lund Spring and/or Preston Big Spring, the attributes that will be affected and/or the timing, magnitude, and rate of change is uncertain. Future tiered analyses for groundwater development and pumping will provide us with opportunities to update the cumulative effects analysis based on current climate change information and/or local-scale model predictions for climate change. We address the potential effects of climate change within the action area, including the effects that climate change may have upon White River spinedace, in Chapter 8 of this Biological Opinion.

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Chapter 10
PAHRUMP POOLFISH

10.1 ANALYSIS AREA AND PROPOSED ACTION COMPONENTS

The analysis area for Pahrump poolfish (*Empetrichthys latos*) is a subset of the overall action area described in Chapter 3. It encompasses those Hydrographic Basins (HBs) within the action area that meet one or more of the following criteria: 1) HBs containing Pahrump poolfish; 2) HBs in which one or more components of the proposed action have the potential to generate adverse effects to the poolfish (i.e., “project basins”); and/or 3) HBs through which impacts generated in project basins would have to propagate to reach poolfish sites. This third criterion primarily reflects patterns of groundwater movement between and within HBs within the action area, as described in Chapter 7 of this Biological and Conference Opinion (Opinion).

Our analysis area for Pahrump poolfish is the Spring Valley HB, which is 1 of 4 project basins that will be developed (i.e., pumped) by the Southern Nevada Water Authority (SNWA) under the proposed action and is the location of a refuge site for the Pahrump poolfish. We do not anticipate impacts to Pahrump poolfish from groundwater development and pumping in any of the other project basins. Within Spring Valley, we focused our biological effects analysis on the Shoshone Ponds Natural Area, which is the only area in Spring Valley where Pahrump poolfish occurs. This area includes the refuge ponds, the stock pond, and an outflow stream from Shoshone Well No. 2, which flows into a marshy-wet meadow area.

The specific project components that we assessed for their potential to impact Pahrump poolfish include the following: 1) construction, operation, and maintenance of any Tier 1 right-of-way (ROW) infrastructure (e.g., main/lateral pipeline, power lines, et cetera) in Spring Valley; 2) construction, operation, and maintenance of future groundwater development facilities in Spring Valley (i.e., production wells, collector pipeline, et cetera) associated with Subsequent Tier ROWs; and 3) pumping of 61,127 acre feet per year (afy) of groundwater from Spring Valley.

The Pahrump poolfish analysis area is depicted in Figure 10-1.

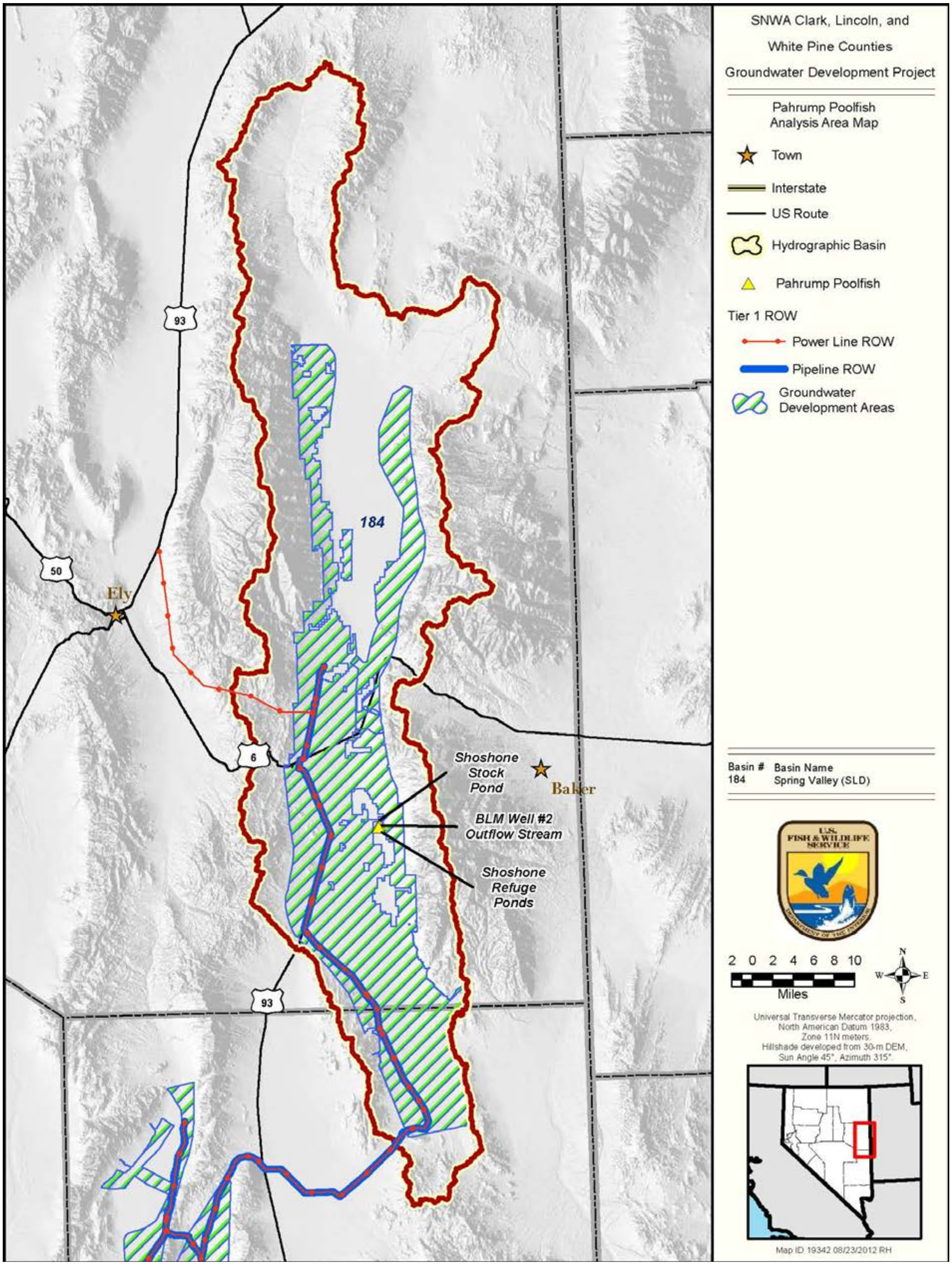

Figure 10-1. Status of existing Pahrump poolfish populations in Nevada1

10.2 STATUS OF THE SPECIES

10.2.1 *Regulatory Status*

The U.S. Fish and Wildlife Service (USFWS or Service) listed the Pahrump poolfish as endangered on March 11, 1967, under the Endangered Species Preservation Act of 1966 (USFWS 1967). Its endangered status was retained with the passage of the Endangered Species Act in 1973 (ESA or Act). The Pahrump poolfish was originally listed as a subspecies (*Empetrichthys latos latos*), but it has since been changed to full species status (*E. latos*) due to extirpation of all closely related subspecies (USFWS 2004). The Service approved a recovery plan for the species on March 17, 1980 (USFWS 1980).

No critical habitat has been designated for this species.

10.2.2 *Species Taxonomy and Description*

The Pahrump poolfish is a member of the Goodeidae family (order Cyprinodontiformes), which consists of approximately 40 freshwater fish species in 18 genera, the majority of which are known from central Mexico (Doadrio and Dominguez 2004; Webb et al. 2004). Only 2 genera of Goodeids—*Empetrichthys* (poolfish) and its closest relative *Crenichthys* (springfish)—are known from the United States, where they are or were restricted to isolated springs in southern and eastern Nevada (Miller 1948; La Rivers 1994; Grant and Riddle 1995). Over the past century, poolfish and springfish taxonomy has been controversial and these 2 genera have been aligned with several different families (reviewed by Grant and Riddle 1995). *Empetrichthys* and *Crenichthys* are now considered sister taxa within the subfamily Empetrichthyinae within the family Goodeidae, as proposed by Parenti (1981) and supported by subsequent studies (Grant and Riddle 1995; Doadrio and Dominguez 2004; also see Webb et al. 2004). In addition to their geographic separation, *Empetrichthys* and *Crenichthys* have distinct life history (e.g., egg laying) and ecological traits (e.g., endemic to spring systems) that separate them from other Goodeids (Grant and Riddle 1995; Doadrio and Dominguez 2004; Webb et al. 2004).

The Pahrump poolfish was first fully described by Miller in 1948 (Miller 1948). It is 1 of only 2 known species within the genus *Empetrichthys* (Miller 1948; La Rivers 1994), and is the only extant species in this genus following extirpation of the Ash Meadows poolfish (*E. merriami*) in the late 1940s or early 1950s (Soltz and Naiman 1978; Miller et al. 1989). Miller (1948) recognized 3 subspecies of *Empetrichthys latos* from 3 distinct springs within 7 miles of each other in Pahrump Valley, southern Nevada: Manse Ranch Pahrump poolfish (*Empetrichthys latos latos*) at Manse Spring; Pahrump Ranch Pahrump poolfish (*E. l. pahrump*) at Pahrump Spring; and Raycraft Ranch Pahrump poolfish (*E. l. concavus*) at Raycraft Spring. Both *E. l. pahrump* and *E. l. concavus* were extirpated in the 1950s when the springs they occupied either dried up or were drawn down due to excessive groundwater pumping for irrigation and subsequently filled in with soil for mosquito control (Minckley and Deacon 1968; Soltz and Naiman 1978; Miller et al. 1989; Minckley et al. 1991). Since *E. l. latos* is now the only extant representative of the species, the subspecific designation has been dropped (USFWS 2004, and references cited therein; Integrated Taxonomic Information System 2012) and the fish is now known simply as the Pahrump poolfish (*E. latos*).

The Pahrump poolfish is a small fish that obtains a maximum length of approximately 77 millimeters (mm) (3 inches), with females generally larger than males (USFWS 1980;

Baugh et al. 1988; Heckmann 1988). The poolfish has a slender, elongate body with dorsal and anal fins placed far back on the body, pectoral fins typically with 16 to 18 rays, and no pelvic fins (Sigler and Sigler 1987; La Rivers 1994). These fish have a broad upturned mouth; a dark longitudinal streak that tends to disappear in older, larger individuals; and an orange ring around the eye. The body is generally greenish-brown with black mottling, but males may be silver-blue without mottling during the spawning season (Soltz and Naiman 1978; USFWS 1980). The dorsal, anal, and caudal fins are bright orange-yellow when the fish are in an environment of optimal temperature and dissolved oxygen (Selby 1977; Soltz and Naiman 1978).

10.2.3 *Distribution and Status*

10.2.3.1 Historical Distribution and Abundance

The 3 subspecies of Pahrump poolfish—the only fish native to Pahrump Valley in southern Nye County, Nevada—historically occupied 3 distinct spring systems in this valley (Miller 1948; La Rivers 1994). By the late 1950s, the distribution of this species was restricted to Manse Spring, which was then the second largest spring in Pahrump Valley and the type locality for *E. l. latos*, now *E. latos* (Soltz and Naiman 1978; La Rivers 1994; Deacon and Williams 2010). Early estimates of abundance are not available, but Pahrump poolfish was described as being more common in its environment than its congener, the Ash Meadows poolfish, perhaps due to a lack of competition with other native fishes (Miller 1948; La Rivers 1994). The poolfish population at Manse Spring was reported to be over 1,000 individuals for several years during the 1960s and early 1970s (Deacon and Williams 2010).

By the late 1960s, Minckley and Deacon (1968) projected that Manse Spring would go dry within a decade based on declining spring discharge from groundwater pumping to support local agriculture. In the early 1970s, Manse Spring stopped flowing due to excessive groundwater pumping for agricultural development; in 1975, the spring pool dried, thus eliminating the only native habitat for Pahrump poolfish (Minckley et al. 1991). Prior to this, flow reductions from groundwater pumping, aquatic vegetation removal, introduction of the non-native goldfish (*Carassius auratus*), and other human activities had adversely affected the poolfish population at Manse Spring (Minckley et al. 1991; Deacon and Williams 2010). Human alterations to poolfish habitat at Manse Spring caused the poolfish population to experience 2 dramatic population crashes in the 1960s (to fewer than 50 adults each time), from which the species was able to rebound prior to its extirpation from the site in 1975 (Deacon and Williams 2010).

In the early 1970s, Pahrump poolfish were transplanted from Manse Spring to 3 previously fishless locations in Nevada in an attempt to prevent extinction of the only remaining member of the genus *Empetrichthys* (Minckley et al. 1991; USFWS 2004; Deacon and Williams 2010). These locations were Latos Pools on the Lake Mead National Recreation Area; Corn Creek Springs at the Desert National Wildlife Refuge, Clark County; and Shoshone Ponds on Bureau of Land Management (BLM) land southeast of Ely in White Pine County, east-central Nevada. The Latos Pools population was initially successful, but failed within a decade of establishment due to flooding (USFWS 2004). Poolfish have not been reintroduced to this location. In 1983, Pahrump poolfish were introduced into a fourth location, an irrigation reservoir known as Lake Harriett at Spring Mountain Ranch State Park in Clark County (USFWS 2004). Pahrump poolfish continue to persist at all refuge sites except Latos Pools today.

10.2.3.2 History and Status of Refuge Populations

The status of refuge populations of Pahrump poolfish varies by location (Selby 1977; USFWS 1980; Minckley et al. 1991; USFWS 2004; Deacon and Williams 2010), and is summarized below.

- **Latos Pools**: This population was initially successful but failed within a decade of establishment due to flooding. Poolfish were not reintroduced to this location.
- **Corn Creek**: Poolfish were introduced into the Corn Creek refuge site in 1971, and initially flourished until the population dwindled in the mid-1970s following invasion of the non-native mosquitofish (*Gambusia affinis*). Poolfish were reintroduced in 1976 following draining of the ponds and elimination of the mosquitofish. Again, this population flourished until red swamp crayfish (*Procambarus clarkia*) invaded Corn Creek in the early 1990s. The last free-living poolfish at Corn Creek were observed in 1998, about 27 years after poolfish were initially established and less than 10 years after crayfish invaded. In 2002, a viewing facility for poolfish was built at Corn Creek to provide an area free of crayfish and other exotic species. Poolfish were reintroduced at this site in 2003, but into an aquaria-like setting distinctly different from the original spring pools in which poolfish were originally introduced. The primary conservation value of this facility is to educate the public about poolfish. Poolfish are sometimes found downstream from the viewing facility, but most likely represent escapees from the viewing facility rather than a self-sustaining population. In 2011, the main pond fed by Corn Creek was reconstructed with smaller pools to maintain warmer water temperatures, a hardened (cement) bottom to prevent burrowing by crayfish, and a perimeter step-up to prevent and slow colonization of the pond by crayfish. Habitat restoration upstream and downstream of the pond to facilitate spring flow and reduce conditions advantageous to crayfish was largely completed in 2011. Efforts to re-establish native vegetation in the restored areas is ongoing (L. Simons, USFWS, pers. obs.).
- **Shoshone Ponds**: Poolfish were initially established in the Shoshone Ponds in 1972, and were soon extirpated due to vandalism. Poolfish were reintroduced to the ponds and reestablished in 1976. Two ponds fed by artesian well flow were constructed to hold the poolfish, which subsequently spread by unknown means to an adjacent outflow stream formed from artesian well flow and a nearby earthen stock pond (also fed by an artesian well). Although the environment at Shoshone Ponds differs and is geographically distant from the Pahrump poolfish’s ancestral home (Manse Spring), the species has survived at Shoshone Ponds for over 35 years. From 1989 to 2011, the estimated number of poolfish in 16 surveys has varied from 922 to over 8,100 fish, with a mean number of 4,217 fish. These estimates include fish in the 3 ponds but exclude fish in the outflow stream.
- **Lake Harriett at Spring Mountain Ranch State Park**: Pahrump poolfish were introduced to an irrigation reservoir known as Lake Harriett at Spring Mountain Ranch State Park in 1983. The poolfish population expanded throughout the lake, and fluctuated in response to changes in the lake’s condition. In the past, manipulation of the lake’s water level to facilitate control of aquatic vegetation negatively impacted poolfish, but is now coordinated with Nevada Department of Wildlife (NDOW) to minimize or avoid such impacts. The poolfish population rebounds well, with estimated numbers of poolfish in 14 surveys from 1998 to 2011 varying from 3,594 to 58,041 fish, with a mean estimate of 17,839 fish. Extensive areas of both shallow and deep water, combined with relatively few other aquatic species that might eat or compete with the poolfish (such as other fish or crayfish) allows this population

to exhibit robust growth and a large average population size. The reservoir is formed by an earthen dam that impounds spring flow within a floodplain, and is potentially at risk of failure due to an extreme event, such as flood or earthquake. Because Lake Harriett is close to a large urban area, there is risk to the poolfish population from introduction of invasive aquatic species; however, public access to the lake is limited to pedestrians, which lowers the risk to some extent.

10.2.3.3 Current Distribution and Abundance

Pahrump poolfish is currently found in 3 refuge sites in Clark County and distant White Pine County, Nevada, all of which are outside of the species' native Pahrump Valley. The NDOW conducts annual fish surveys using mark-recapture methods at all 3 locations to obtain population estimates and determine population structure and trends. Population estimates for the most recent surveys (August 2011) for which official field trip reports are available are below (NDOW 2011).

Corn Creek:

- North Tank: 18 poolfish with a 95% confidence interval of 10 to 34 fish.
- South Tank: 87 poolfish with a 95% confidence interval of 68 to 109 fish.
- Marsh: 11 poolfish were salvaged from the upstream portion of the marsh and released into North Tank.

Shoshone Ponds:

- Middle Pond: 826 poolfish with a 95% confidence interval of 448 to 986 fish.
- North Pond: Poolfish appeared to be extirpated in this pond (*Note*: 2012 surveys also did not find poolfish, and they are likely extirpated from this location).
- Stock Pond: 5,762 poolfish with a 95% confidence interval of 4,180 to 7,944 fish.
- Well Spring: Poolfish were confirmed to be present in this habitat.

Spring Mountain Ranch:

- Lake Harriett: 12,746 poolfish with a 95% confidence interval of 10,558 to 15,388 fish.
- The poolfish population at Lake Harriett was observed to strongly bimodal in frequency distribution with modes at 30 and 60 mm (1.2 and 2.4 inches) total length.

The Spring Mountain Ranch poolfish population is currently the largest of the 3 populations, followed by the Shoshone Ponds population. The status of the 3 refuge populations is summarized in Table 10-1 below.

Table 10-1. Status of existing Pahrump poolfish populations in Nevada[a]

Location	Population or Subpopulations	Year Established	Number of Surveys	Average Population Size[b]	Overall Population Trend[c]
Corn Creek	North Tank	1971	7	51 (± 16)	Declining
	South Tank	1971	6	63 (± 9)	None
	Marsh	Unknown	n/a	n/a	n/a
Spring Mountain Ranch	Lake Harriett	1983	13	17,839 (± 3,771)	None
Shoshone Ponds	Middle Pond	1972	14	794 (± 130)	Declining
	North Pond	1972	15	286 (± 47)	None[d]
	Stock Pond	Unknown	15	3,187 (± 433)	None
	Outflow Stream	Unknown	None	n/a	n/a
	Overall[e]	n/a	15	4,217 (± 454)	None

[a] Data are from NDOW Field Trip Reports prepared with funding under section 6 of the Act; data is from annual surveys from 1989 and 1997–2011 for North Pond and Stock Pond, and 1997–2011 for Middle Pond.

[b] Reported as mean of the time series (± 1 SE) excluding fish less than 30 mm total length.

[c] Based on slope of the regression between population size and year. “None” means slope is not statistically different from zero; “Declining” means slope is statistically negative (alpha ≤ 0.05).

[d] No poolfish were detected in North Pond in 2011, and preliminary 2012 survey data also indicate no poolfish present. The population now appears to be extirpated.

[e] Total excludes the outflow stream from Shoshone Well #2; the poolfish population in this location may be transient and has not been included in overall estimates of population size.

10.2.4 *Life History*

Information about the ecology, behavior, life history, population dynamics, and habitat requirements of the Pahrump poolfish is based largely on historical information derived from its ancestral location at Manse Spring. The species occupies entirely different habitats today. Our knowledge of the poolfish also consists of limited information on life history and habitat characteristics at refuge sites and from laboratory (aquaria) settings. Caution must be exercised in interpreting this information because habitat differences at these various sites, and even within the same site over time, can lead to divergence of life history traits. For example, certain poolfish life history traits changed following the introduction of goldfish at Manse Spring in the 1960s (Deacon and Williams 2010). Even so, available information demonstrates that the Pahrump poolfish is a hardy and fairly adaptable fish. This adaptability is established by its ability to survive and reproduce at sites that are distinctly different from its native habitat; its ability to survive and reproduce at sites that vary widely in environmental characteristics; and its ability to rebound from severe population crashes caused by habitat alterations at its native Manse Spring or from unknown causes at refuge sites (e.g., 2003 population decline at Shoshone Ponds).

Given its small size, the Pahrump poolfish is probably short lived (e.g., 2 to 4 years; Sigler and Sigler [1987]). This species is unique among Goodeids in that it (and other members of the genus *Empetrichthys*) lay eggs and do not bear live young (Grant and Riddle 1995; Doadrio and Dominguez 2004; Webb et al. 2004). Parental care (e.g., protection of eggs or fry) has not been reported for this species (Soltz and Naiman 1978) and young and adults appear to use different habitats (USFWS 1980).

Pahrump poolfish spawning peaks in spring, but may occur in any season and for much of the year if proper conditions are present (USFWS 1980; Sigler and Sigler 1987; Williams 1996). At

Manse Spring (1961–1965), Pahrump poolfish had a protracted reproductive period that extended from January through July with a peak in April based on the number of mature eggs in the ovaries of poolfish specimens collected during those years (Deacon and Williams 2010). Poolfish transplanted to new locations appear to adjust their spawning season to temperature conditions at the new sites, with delays in spawning observed at sites with cooler and more variable temperatures than the ancestral site (Selby 1977; Deacon and Williams 2010). For example, Shoshone Ponds is about 2.7 degrees latitude further north and about 914 meters (m) (3,000 feet) higher in elevation than Manse Spring. The Service's best scientific judgment is that poolfish reproduction peaks in June or July at this site (USFWS 2010).

Poolfish at Manse Spring apparently did not reach sexual maturity until they were over 30 mm (1.2 inches) Standard Length (SL) based on the absence of mature eggs in the ovaries of smaller fish (<30 mm [1.2 inches] SL) that were collected from 1961–1965 (Deacon and Williams 2010). Reproductive potential (measured as the mean number of mature eggs produced by each size class) increased substantially with size for fish ≥30 mm (1.2 inches) SL during the month of April, which was the peak period of reproduction. Deacon and Williams (2010) thus surmise that the number and proportion of larger female poolfish in the population during April was an important determinant of reproductive potential at Manse Spring. Similarly, Baugh et al. (1988) found that in a laboratory aquaria setting, larger females (>46 mm [1.8 inches]) typically produced more eggs than smaller females.

Annual fecundity (the total number of eggs spawned by a female during a single spawning season) of Pahrump poolfish is unknown. This species likely produces few eggs per spawning, but may spawn multiple times per season at sites with appropriate environmental conditions (Sigler and Sigler 1987). In the laboratory, Baugh et al. (1988) found that the number of eggs produced per female ranged from 0 to 28 over a 3-day trial period, and Deacon et al. (1964) reported that adult females produced 10–30 eggs per week for over 2 months. In the laboratory, eggs hatched in 7–10 days (average of 8 days) in water temperatures of 24 °C (75 °F) (Baugh et al. 1988), which was the approximate temperature of Manse Spring. Selby (1976) reported that poolfish eggs developed over a period of 2 to 3 weeks. Both egg and larval poolfish development will likely differ by site due to water temperature differences (e.g., slower development would be expected in cooler waters) (Baugh et al. 1988).

Young fish in transplanted populations are reportedly more active during the day and adults are more active at night (Selby 1976). Poolfish are reported to be inactive during winter at some transplant sites (e.g., Lake Harriet) when water temperature cools considerably (Baugh et al. 1988; NDOW 2009).

Pahrump poolfish are opportunistic omnivores, eating a wide variety of animal (e.g., aquatic insects, snails) and plant material, while also ingesting large amounts of debris and inorganic material (Deacon 1984; Hobbs et al. 2003; Deacon and Williams 2010). These fish appear able to adapt their diet to food item availability as determined by environmental conditions (Hobbs et al. 2003; Deacon and Williams 2010). For example, prior to the establishment of goldfish at Manse Spring, the relative volume of aquatic insects in the poolfish diet was high (Deacon and Williams 2010). Following goldfish establishment, a higher proportion of poolfish consumed plant material and the average volume of aquatic insects in the guts of samples declined. Deacon and Williams (2010) attributed this dietary shift to habitat changes caused by goldfish (e.g., higher turbidity, disturbance of aquatic macrophytes), which may have affected insect density and detectability. In a dietary study of transplanted poolfish populations in the early

1990s, Hobbs et al. (2003) found that debris and plant/algal material comprised the largest part of the poolfish's diet at Shoshone Ponds and Spring Mountain Ranch State Park, whereas insects and other animal items comprised a slightly larger part of the diet than debris and plant items at Corn Creek. Debris, such as sand or sticks, is generally coated with epiphytic bacteria or diatoms, providing nutrients to fish. Based on known diet at Manse Ranch and available food sources at Shoshone Ponds North, it has been suggested that larger zooplankton was likely an important food source for poolfish at Shoshone Ponds (Deacon et al. 1980).

10.2.5 *Habitat*

In order to understand and conceptually describe how Pahrump poolfish and its habitat may respond to changes in artesian well flow, should this occur from pumping under the proposed action, we have summarized available information on poolfish habitat and habitat use at its ancestral site and refuge locations.

Manse Spring—the ancestral location of Pahrump poolfish—was historically a large, clear limnocrene (a spring originating from a large, deep pool of water) discharging at approximately 0.17 cubic meters per second (6 cubic feet per second [cfs]) in 1875 (Deacon and Williams 2010). Water temperature was a relatively constant 24 °C (75 °F) (range 23.3–25.0 °C [74–77 °F]) (Miller 1948; Deacon and Williams 2010) and the water was alkaline (USFWS 1980). The main spring pool was 9 m (29 feet) wide and 3 m (9 feet) deep at the head, 2 m (6.5 feet) wide and 0.3 m (1 feet) deep at the outlet, and18 m (59 feet) long. A shallow ditch extended 3 to 6 m (10 to 20 feet) southward from the main spring pool (Deacon and Williams 2010). Water current ranged from slow to absent in the main spring pond and shallow ditch to swift in the outflow channel. The spring pool had a silty bottom and was dense in areas with macrophytes, including watercress (*Nasturtium* sp.), stonewort (*Chara* sp.), and pondweed (*Potamogeton* sp.) (Deacon and Williams 2010).

Miller (1948) described the genus *Empetrichthys* as being frequently found in the deeper holes of warm desert springs, and usually uncommon in shallow spring-fed ditches or marshy areas. At Manse Spring, poolfish used all 3 of the different habitats described above: the spring pool, shallow ditch, and swifter outflow stream (Deacon and Williams 2010). Larger fish utilized the more open and deeper waters, and young fish utilized the near water surface layer in shallow areas with aquatic vegetation (USFWS 1980). After hatching, fry (young fish, postlarval stage) remained near the bottom or near other substrates, presumably for protection and to feed (USFWS 1980). Given the partitioning of habitat by age class, it is likely that different life stages (larvae, fry, juveniles, adults) use or need different resources (e.g., food items, cover for predator avoidance), and/or have different physiological tolerances or requirements.

Despite the nearly constant water temperatures of 24 °C (75 °F) found in the poolfish's ancestral habitat (Manse Spring, Nye County), transplanted populations have demonstrated the ability to tolerate a much wider range of water temperatures. At Corn Creek, poolfish survived at low temperatures of 4 °C (39.2 °F) under ice in a trough; and at Latos Pools, poolfish withstood annual water temperature fluctuations from below 10.5 °C to 25 °C (51 °F to 77 °F) (Selby 1977). At the Lake Harriet, poolfish have been reported to enter torpor during winter (Baugh et al. 1988). Selby (1977), who investigated the thermal tolerance of this species in the laboratory, found that poolfish could tolerate temperatures from at least 1.5 °C (lower temperatures were not tested) to 40 °C (34.7 °F to 104 °F) for short periods of time, with specific tolerances depending on original acclimation temperatures. This same study found that poolfish are incapable of behavioral thermoregulation. Nonetheless, the wide thermal tolerance of poolfish has allowed it to be successful in transplant sites that differ substantially in temperature regime from its native Manse Spring (Selby 1977).

Pahrump poolfish also appears capable of withstanding a wide range of dissolved oxygen, including low levels. Selby (1977) found that Pahrump poolfish are able to withstand low levels of dissolved oxygen down to 1.0 parts per million, similar to its close relative *Crenichthys*. However, the poolfish has a body shape and mouth orientation that makes utilization of the surface water layer to obtain oxygen difficult; because of this, it is thought to not be able to survive extended periods of oxygen depletion (Selby 1977). Selby (1977) surmised that poolfish deaths at Corn Creek during his study were due to fish being trapped in an area with high vegetation respiration at night, which depleted the immediate environment of oxygen.

10.2.6 *Population Dynamics*

Most information available on Pahrump poolfish population dynamics is from recent surveys at transplant sites, though Deacon and Williams (2010) provide insight into population dynamics at its ancestral site (Manse Spring). The poolfish population at Manse Spring varied considerably in size during the 1960s and early 1970s, from a low of fewer than 50 adult fish to more than 1,000 individuals. Population structure during the 1960s showed multiple size classes with a preponderance of smaller size class fish (<40 mm [1.6 inches] SL). However, a greater proportion of large size class fish was present in the population prior to the establishment of goldfish, and the largest fish (≥60 mm [2.4 inches] SL) appeared to disappear from the population altogether within a couple of years of goldfish establishment. Large, presumably more fecund fish were especially scarce in April (peak spawning) following goldfish establishment, which may have affected reproductive output.

As discussed above (“Distribution and Status”), population size at transplant sites has fluctuated (often dramatically) between years since regular surveys began. Occasionally this fluctuation is from disturbances; otherwise, these fluctuations are considered natural. Rather large seasonal or annual population fluctuations are expected given the species’ life history, and are likely due in part to environmental (e.g., climate, flow) fluctuations, food availability, and other factors affecting spatial habitat relationships, natality and mortality rates, and larval recruitment (Scoppettone et al. 1992; Schlosser 1995; Durham and Wilde 2009; Rijnsdorp et al. 2009). Poolfish population structure varies by location. At Shoshone Ponds, fish in the Middle Pond are larger on average than fish (were) in the North Pond, with multiple size classes present; and the stock pond typically has more large size class fish than the other 2 ponds, again with multiple size classes present (based on NDOW survey data summarized in field trip reports; see NDOW references). Prior to extirpation, fish in the North Pond were on average smaller than fish at the other 2 ponds, with few fish >40 mm (1.6 inches). The majority of fish at the Spring Mountain Ranch locality are typically <40 mm (1.6 inches), but there is also good representation of older size class fish (50–70 mm [2–2.8 inches]).

It is apparent that the Pahrump poolfish has a high degree of demographic resilience. The population at Manse Spring was able to grow from fewer than 50 adults to over 1,000 fish within a few years time on 2 occasions during the 1960s (Deacon and Williams 2010). Additionally, refuge populations have shown the ability to grow considerably and rather rapidly from initial low stocking rates (e.g., 50 fish stocked at Shoshone Ponds in 1976 [Deacon 1984]), and to rebound following rather large population declines (e.g., 2003 population decline at Shoshone

Ponds, see below). It is not surprising that this species is capable of rapid population growth given its life history characteristics. Small body size, early maturation, short generation time, small clutch size but high reproductive effort due to multiple spawning bouts over a protracted period, and low investment per offspring are characteristics that suggest high intrinsic rates of increase (Winemiller and Rose 1992; Winemiller 2005).

10.2.7 *Threats to the Species*

The decline and endangerment of Pahrump poolfish was precipitated primarily by the destruction of its native habitat at Manse Spring from groundwater withdrawals for agricultural purposes (USFWS 1980). Additional threats to the species at its ancestral site included the introduction of non-native, invasive species (i.e., goldfish) and removal of aquatic vegetation to allow for recreational activities at the spring (Deacon and Williams 2010).

While the species no longer occurs at its ancestral site, transplanted populations face similar threats. Providing a reliable water supply of sufficient quantity and quality to maintain transplanted populations is of critical importance (USFWS 2004). Thus, any long-term declines in groundwater levels from pumping that adversely affects spring flow and/or artesian well flow at refuge sites is a significant threat to species persistence. Climate change is an emerging threat that also has the potential to affect water quantity and quality at poolfish sites (for a detailed discussion of potential climate change impacts, please refer to Chapter 8).

Non-native, invasive species have been a reoccurring problem at the Corn Creek refuge site and resulted in extirpation of poolfish in the late 1990s (NDOW 2001a; USFWS 2004), illustrating the potential severity of this threat. Currently, the poolfish populations at Spring Mountain Ranch and Shoshone Ponds Natural Area have not been substantially affected by non-native aquatic species (USFWS 2004). However, non-native species have been observed at Lake Harriet in the past (e.g., red-eared sliders [*Trachemys scripta elegans*] in 2009 [NDOW 2009]; bullfrogs [*Lithobates catesbeianus*] [Heinrich 1991]), and the potential for other non-native introductions exists due its proximity to an urban area. Shoshone Ponds is more remote, but is still susceptible to unwanted introductions of aquatic species.

All poolfish populations currently exist in artificial man-made systems, which put the fish at risk from structural failure of these systems. For example, vandalism at Shoshone Ponds Natural Area resulted in extirpation of this poolfish population in 1974 when the water supply was intentionally turned off (USFWS 2004, and references cited therein). The potential for vandalism at this site remains, although the remoteness of Shoshone Ponds diminishes the severity of this threat. As described below (“Environmental Baseline”), Shoshone Ponds is in need of maintenance (e.g., broken pipes that supply water to the ponds and other maintenance issues have likely resulted in degradation of poolfish habitat and extirpation of poolfish from one of the refuge ponds).

Lastly, the poolfish populations at the refuge sites were founded from small numbers of transplanted fish (e.g., 50 fish transplanted to Shoshone Ponds in 1976 [Deacon 1984]). Prior to this, poolfish experienced several large population bottlenecks at Manse Spring in the 1960s (reduced to <50 adult fish; Deacon and Williams 2010). Effects of such severe and repeated population bottlenecks (e.g., low genetic variation) and potential implications for long-term persistence of the species have not been evaluated previously, but are currently being studied by researchers from North Dakota State University. The genetic and demographic integrity of refuge populations is a concern of the Pahrump Poolfish Recovery Implementation Team.

10.2.8 *Conservation Needs*

Recovery of Pahrump poolfish, as identified in the recovery plan (USFWS 1980), will entail the successful establishment of at least 3 viable poolfish populations at sites that are free of immediate and potential threats (USFWS 1980). Multiple transplant populations provide assurance against extinction of the species in the event some populations are extirpated. Re-establishing a poolfish population at Manse Ranch was also identified as a high priority in the recovery plan (USFWS 1980). However, this spring is in private ownership and opportunities to re-establish poolfish in this location may be limited (USFWS 2004). Given that Manse Spring is unlikely to be available for conservation in the near term, if ever, refuge populations will remain critical for the recovery of the Pahrump poolfish (USFWS 1980).

Preserving and protecting existing transplanted poolfish populations and their habitats is one of the primary objectives of the recovery program (USFWS 1980). Currently, Shoshone Ponds and Lake Harriet are critical components of the Pahrump poolfish recovery program since they are proven sites that have held self-sustaining poolfish populations for 30 or more years and are relatively secure. Poolfish habitat at Shoshone Ponds has deteriorated, however, and this area is in need of maintenance (see Environmental Baseline). Other locations for potential poolfish transplantation are currently being considered by the Pahrump poolfish Recovery Implementation Team, but remain in the early planning stages at this time.

Other recovery objectives include, but are not limited to establishing and protecting self-sustaining poolfish populations in suitable new or restored sites and conducting ecological studies (e.g., life history characteristics, habitat use and preference) to assist with management of poolfish and its habitat in refuge environments (USFWS 1980).

10.3 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed federal projects in the action area that have already undergone section 7 consultations and the impacts of State and private actions that are contemporaneous with the consultations in progress.

10.3.1 *Status of the Species and its Habitat in the Analysis Area*

The Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) has the potential to affect Pahrump poolfish at Shoshone Ponds Natural Area in east-central Nevada, which is 1 of 3 refuge populations for this endangered fish. We do not anticipate that the other 2 refuge populations in southern Nevada—Spring Mountain Ranch and Corn Creek—will be affected by the proposed federal action. Information on baseline conditions and life history characteristics of poolfish at Shoshone Ponds is generally described above in the “Status of the Species” section. Here, we provide more detailed information about Shoshone Ponds itself, as well as Pahrump poolfish abundance and status at this particular location.

Shoshone Ponds Natural Area is located in south-central Spring Valley on land managed by the BLM as an Area of Critical Environmental Concern (ACEC). The area consists of a wet meadow-wetlands complex that is fed by 6 artesian wells, the last of which was constructed in the early 1970s to provide a water source for 3 man-made ponds (refuge ponds) to be used as a sanctuary for Nevada's native fish (BLM 2012b). The 3 refuge ponds, which are fenced to exclude livestock, are commonly referred to as the North, Middle, and South ponds. Water to these ponds is supplied by an artesian well owned by the NDOW. There is also a pipe going from a nearby BLM artesian well (Shoshone Well No. 2) to the NDOW well as a back-up water supply, but the valve on this pipe is turned off because of leaky plumbing at the NDOW well (Podborny 2010, 2012a).

Pahrump poolfish were transplanted to Shoshone Ponds after construction of the ponds was completed in 1972, but were extirpated a couple of years later due to vandalism (USFWS 2004). Fifty Pahrump poolfish were reintroduced into Shoshone Ponds in 1976 from the Corn Creek refuge location (Deacon 1984). Until recently, Pahrump poolfish resided in both the North and Middle ponds, but now appear to be extirpated from the North Pond (NDOW 2011). Poolfish are also found in a much larger earthen stock pond to the north of Shoshone Ponds and in a small outflow stream located between Shoshone Ponds and the stock pond. The stock pond is fed by an artesian well (Shoshone Well No. 4) and the stream is formed from outflow of Shoshone Well No. 2, both of which are BLM wells. The stock pond and stream outflow are not fenced to exclude livestock. Pahrump poolfish were first observed in the outflow of Shoshone Well No. 2 in 1999 (NDOW 2001a), possibly having emigrated from the nearby refuge ponds (USFWS 2010). It is not known how poolfish came to occupy the stock pond.

The outflow stream at Shoshone Well No. 2 is naturally shallow and braided—the result of water flowing overland from the artesian well. This flow has stream-like qualities for approximately 50 m (164 feet) or more before it enters a marshy/wet meadow area (NDOW 2004; BLM 2010). Pahrump poolfish are found along the entire length of the outflow stream (BLM 2010), but the population may be transient (USFWS 2010). No deep water habitat (e.g., pools) exists within the outflow stream, potentially resulting in little or no habitat for larger poolfish (USFWS 2010), which are the most fecund individuals (Deacon and Williams 2010). Thus, the outflow stream in its present condition has limited conservation value for the Pahrump poolfish (USFWS 2010).

The stock pond has the largest of the 3 poolfish populations, although population size has fluctuated considerably (Figure 10-2) (NDOW 2011). Middle Shoshone Pond, which is much smaller in size than the stock pond, has a smaller poolfish population; again, this population has experienced considerable fluctuations in size since regular surveys began (Figure 10-3). The long-term statistical trend of the Middle Pond population indicates it is declining, although numbers increased substantially in 2010 and 2011, with the 2011 population near the long-term average. This rise in numbers may be partially attributable to the addition of 508 Pahrump poolfish salvaged from Shoshone Well No. 2 in 2010 (NDOW 2010). The North Pond population, on the other hand, appears to have been extirpated as of 2011 (Figure 10-4). Prior to extirpation, fish condition was reportedly poor in this pond and the population was considerably smaller than the other 2 ponds, with no large size class fish observed (NDOW 2009). Population estimates at all sites over the past 16 years have varied from a couple 100 to a couple 1,000 fish within Shoshone Ponds, and from nearly 1,000 to more than 6,000 fish in the stock pond (NDOW 2011). The estimated population size at the stock pond has exceeded 2,000 poolfish in 11 of the 16 years surveyed (NDOW 2011). As of 2011, population size estimates were not made for the outflow stream.

Two recent population declines at the Shoshone Ponds Natural Area seem especially noteworthy: 1) an approximate 90% population decline between 2002 and 2003, from which the population later rebounded (NDOW 2003; NDOW 2004) and 2) the apparent extirpation of poolfish from the North Pond between 2010 and 2011 (NDOW 2011). The cause of these population declines is unclear. The 2003 decline may have stemmed from degradation of the pond banks and sheet flows from the ponds allowing dispersal of fish (Hobbs 2003; NDOW 2003). Also, increases in aquatic vegetation and changes in water quantity (water levels in the pond) and water quality may have contributed to these declines and the apparent extirpation of the North Pond population (see "Factors Affecting the Species in the Analysis Area") (NDOW 2003; NDOW 2011).

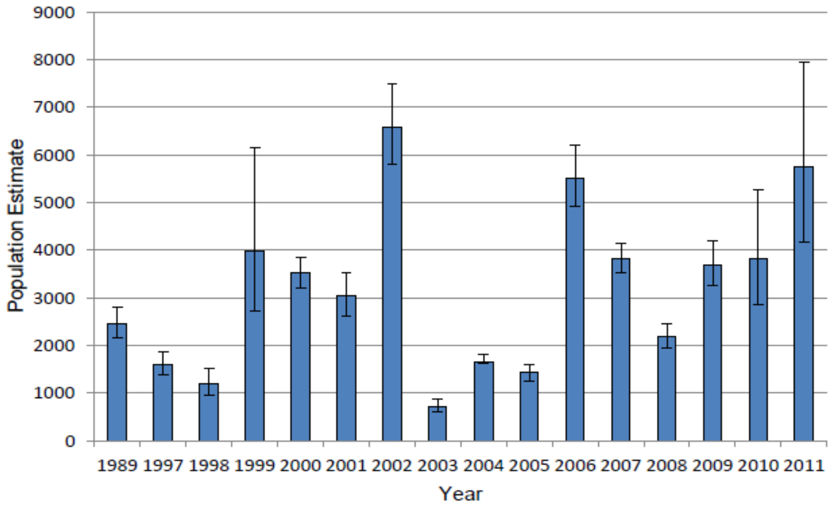

Figure 10-2. Population estimates for Pahrump poolfish at the Stock Pond at Shoshone Ponds Natural Area, from Nevada Department of Wildlife Field Trip Reports

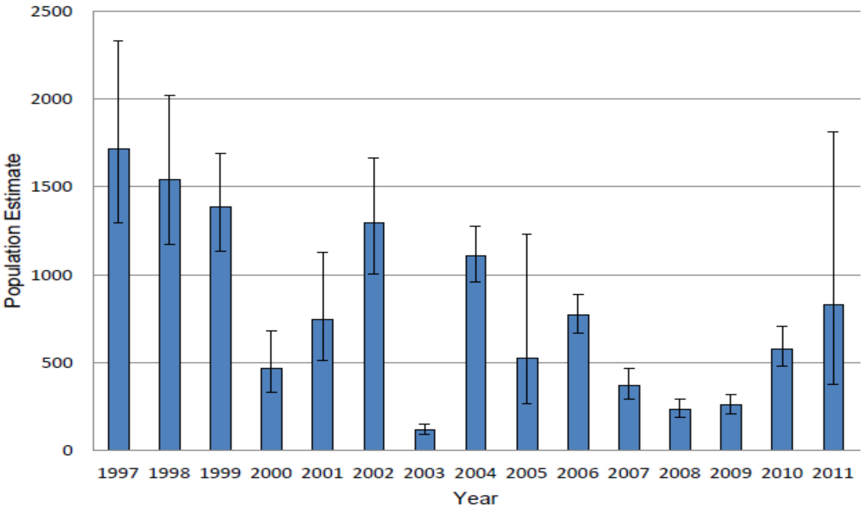

Figure 10-3. Population estimates for Pahrump poolfish at the Middle Shoshone Pond at Shoshone Ponds Natural Area, from Nevada Department of Wildlife Field Trip Reports

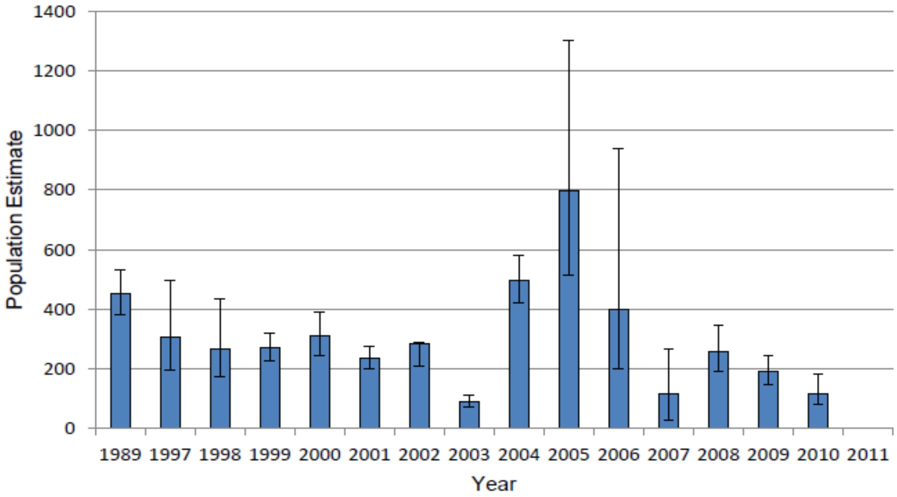

Figure 10-4. Population estimates for Pahrump poolfish at the North Shoshone Pond at Shoshone Ponds Natural Area, from Nevada Department of Wildlife Field Trip Reports

The vegetation surrounding Shoshone Ponds consists of rocky mountain juniper (*Juniperus scopulorum*), commonly referred to as “swamp cedar” in this locality. The occurrence of juniper on the valley floor at Shoshone Ponds and further north in Spring Valley is considered unique, as this species is more often found at higher elevations in the mountains (Charlet 2006). The swamp cedars are intermixed with other Great Basin shrubs (e.g., sagebrush [*Artemisia tridentata*], rabbitbrush [*Chrysothamnus* spp.], greasewood [*Sarcobatus vermiculatus*]) and grasses (e.g., salt grass [*Distichlis spicata*]). Wetland species, such as Baltic rush (*Juncus balticus*) and bulrush (*Scirpus* sp.), are found near the ponds (Charlet 2006). Predominant aquatic vegetation consisted of horsehair algae (*Chlorophyceae* sp.), pondweed, Baltic rush, Nebraska sedge (*Carex nebrascensis*), and spikerush (*Eleocharis* sp.) (BIO-WEST 2007). BIO-WEST (2007) found Shoshone Ponds to have the lowest diversity of emergent aquatic vegetation of all sites in Spring Valley that were surveyed in 2004–2006.

The 3 refuge ponds (North, Middle, and Stock) are were originally several feet deep, but are currently filled in to a great extent with silt. Additionally, there is some occupied habitat which emanates from Shoshone Well No. 2. In 1984, the North Pond was described as being rectangular in shape, about 7 m by 9 m (23 feet by 30 feet) in size, with a maximum depth of about 1.2 m (4 feet) (Deacon 1984). Over the last few years, water levels in the North Pond have dropped noticeably (NDOW 2010, 2011). The stock pond is considerably larger than the 3 refuge ponds; in 2001, it was measured at about 6 times the area of the Middle Pond (NDOW 2001b). The outflow from Shoshone Well No. 2 is shallow/braided and contains some streamlike qualities, which flow into a marsh/meadow area (NDOW 2004: BLM 2010).

Shoshone Ponds are fed by warm artesian well water (Minckley et al. 1991). The NDOW collects water quality and temperature measurements at the refuge ponds and stock pond during annual fish surveys. Based on NDOW measurements and other available information, water temperatures and dissolved oxygen levels have varied widely over the years in all 3 of the ponds where poolfish have been found (NDOW 2003, 2004, 2005, 2007, 2009, 2010, 2011), including high recorded temperatures of approximately 30 °C (84 °F) (BIO-WEST 2007). Available data are generally point-in-time measurements, which are typically taken in late summer each year.

The NDOW has water rights at the artesian well that feeds the 3 refuge ponds (Shoshone NDOW Well) for wildlife beneficial use, and BLM has water rights at the artesian wells that feed the stock pond and the outflow stream (Shoshone Wells No. 4 and No. 2, respectively), also for wildlife beneficial use. A well log for the Shoshone NDOW well indicates that it was drilled in 1971 to a total depth of 134 m (441 feet) below ground surface (bgs) (log #15172; NDWR 2012a). The well depth of Shoshone Wells No. 2 and 4 are reported in Rush and Kazmi (1965) as being 134 and 86 m (407 and 283 feet) bgs, respectively. A SNWA field investigation of these wells in 2008 found that the wells had large amounts of fill (SNWA 2008), i.e., sediments had collected in the bottom of the wells; but, the time period for this intrusion of sediments is not known and this situation may have existed for a long time (Prieur 2012).

10.3.2 *Factors Affecting the Species in the Analysis Area*

Currently, poolfish habitat at the refuge ponds appears to be deteriorating and the ponds are in need of maintenance (USFWS 2008; NDOW 2011). Low water levels and stagnant conditions have been noted at the North and Middle ponds during recent surveys (NDOW 2011; Guadalupe 2012). North Pond is overgrown with emergent, submergent, and floating aquatic vegetation, which may be creating unfavorable water quality conditions (NDOW 2011), and the Middle Pond is inundated with bulrush (Guadalupe 2012). In 2012, flow was shut off to the North Pond after a pipe was found to be leaking. The leak has been repaired, and flow has been returned to the pond. Recently, encroaching vegetation has been manually cleared from the Middle Pond, increasing the pond’s surface by approximately 100% compared to the preclearing situation. Additionally, silt is accumulating in the stock pond and it is in need of maintenance.

The BLM Ely District Office has been discussing plans to improve Pahrump poolfish habitat at Shoshone Ponds with partner agencies for several years, including enlarging the fenced enclosure at Shoshone Ponds to incorporate the flowing well area to the north and incorporating a new pond in this area using the outflow from Shoshone Well No. 2 (BLM 2008; Podborny 2012b, cited in USFWS 2010; NDOW 2011). The BLM has submitted an application to the Nevada State Engineer (NSE) to appropriate the remainder of the water from Shoshone Well No. 2 for wildlife beneficial use in order to maintain and improve Pahrump poolfish and other sensitive species habitat (BLM 2010) in accordance with the goals and objectives of the Ely Resource Management Plan (RMP) (BLM 2008). If and when such improvement projects will occur remains uncertain, pending a variety of considerations.

Livestock grazing has likely caused some habitat degradation at Shoshone Ponds, but the extent to which this has affected Pahrump poolfish populations is unknown (USFWS 2008). Shoshone Ponds is located within the Scotty Meadows livestock grazing allotment, which is grazed from June 1 to September 30 at an assigned use level of 1,227 animal unit months (AUMs). This allotment has not yet been evaluated for meeting rangeland health standards (USFWS 2008; Podborny 2012a). The SNWA is a grazing permittee on this allotment (permit issued in 2007 and expires in 2017). The 3 Shoshone refuge ponds are fenced to keep livestock out. However, the stock pond and outflow stream are not fenced; thus, these areas receive the greatest intensity of livestock grazing. As a result, poolfish in these areas may be affected by substrate disturbance, trampling, and increased sedimentation. However, grazing may help prevent vegetation encroachment at the stock pond, whereas rushes were encroaching on the refuge ponds within the livestock enclosure (USFWS 2008) prior to the recent (2012) clearing of some of this vegetation. Due to the remoteness of the site, recreational impacts are likely minimal. However, there are 2 main gravel roads that lead to the ponds and several two-track trails in the area that provide public access. Camping occurs in the area, mainly during hunting season, because the swamp cedars provide shade and the ground is flat (USFWS 2008). Public accessibility increases the risk of non-native aquatic species introductions and vandalism.

As described in Chapter 4, current groundwater uses in Spring Valley are primarily to irrigate cropland (Laczniak et al. 2007; NDWR 2012b) but also include wildlife beneficial use, especially in the Shoshone Ponds area. Central Spring Valley, which is where Shoshone Ponds Natural Area is located, had one of the higher densities of actively irrigated acreages of the many basins included in the Basin and Range Carbonate Aquifer System Study, and irrigated acreage and groundwater use increased in this valley between 1945 and 2004 (SNWA 2009) and between 2000 and 2005 (Welborn and Moreo 2007). The NSE recently found that over 14,000 afy of groundwater is consumptively used in Spring Valley, in addition to approximately 4,800 afy of committed and consumptively used spring water rights (NSE 2012). In the part of Spring Valley where Shoshone Ponds is located, groundwater is the primary source of water for irrigation during dry periods and is used to supplement water from early season runoff caused by snowmelt (Welborn and Moreo 2007). A lack of historical pumping drawdown data is available for Spring Valley to determine how consumptive uses have affected the aquifer over time (NSE 2012). While we do not know if irrigation pumping has adversely affected artesian well flow at the Shoshone Ponds Natural Area, the closest pumping wells are located within 1.6 to 3.2 kilometers (km) (1 to 2 miles) of the ponds and are completed in the basin-fill aquifer, as are the wells that supply water to the ponds. Therefore, we infer irrigation pumping has potentially affected flows at the Shoshone wells. However, seasonal drawdown observed in the irrigation wells appears to recover to pre-pumping levels each year. Additionally, the six Shoshone Ponds artesian wells may impact each other because of their close proximity and have continued to discharge for decades.

10.3.3 *Recent Section 7 Consultations*

We are aware of 3 recent formal consultations for Pahrump poolfish in the analysis area relevant to this Opinion. The first is a programmatic biological opinion (File No. 84320-2008-F-0078) issued to BLM on July 10, 2008 for implementation of the 2008 Ely District RMP. This programmatic opinion examined the potential effects of implementing various land management programs in the Ely District to the Pahrump poolfish and 4 other listed species. The action area covers 5.6 million hectares (13.9 million acres), including Pahrump poolfish habitat at Shoshone Ponds in southern White Pine County. The programmatic biological opinion has a 10-year term, ending in 2018. As part of this formal consultation, the Service assessed the potential for adverse effects to Pahrump poolfish resulting from implementation of BLM’s Livestock Grazing Management, Fire Management, and Special Status Species programs. The latter program included the following actions relevant to the poolfish at Shoshone Ponds: 1) managing the Shoshone Ponds refuge site in accordance with the recovery plan for the species; 2) expanding the fenced area at Shoshone Ponds; 3) managing the uplands around Shoshone Ponds to increase vegetation cover, reduce runoff, and prevent excessive siltation into the ponds; and 4) developing additional ponds at Shoshone Ponds for the poolfish. The RMP included numerous minimization measures relevant to the poolfish that were considered in the Service’s assessment. The Service concluded that implementing the programmatic activities could adversely affect Pahrump poolfish, but was not likely to jeopardize the continued existence of the species.

The second consultation is a project-level consultation (File No. 84320-2010-F-0272) that was appended to the programmatic biological opinion for the 2008 Ely District RMP. On April 16, 2010, the Service provided BLM with a biological opinion for the installation of a valve system on the existing well head at Shoshone Well No. 2 to restrict flow to the amount currently allocated to BLM, in accordance with NSE Permit No. 60086. The BLM is seeking additional water rights at this location, and meeting the NSE's requirements with regard to the existing permit is requisite to pursue additional water rights (Podborny 2012b, cited in USFWS 2010). Installing the valve system required BLM to temporarily divert water away from the well head, thus temporarily drying a stretch of the stream fed by this artesian flow. In this biological opinion, the Service concluded that the action could adversely affect Pahrump poolfish inhabiting the outflow stream of Shoshone Well No. 2. However, we determined that the action would result in only minor impacts due to the marginal nature of the stream habitat (i.e., no deep water), the small size of the individual fish involved (i.e., few or no reproductive individuals impacted), the small and possibly transient nature of the poolfish population present in the stream, and minimization measures associated with the project. To minimize impacts to the poolfish, 1,179 individuals were moved from the Shoshone Well No. 2 outflow to the Middle (508 individuals) and North (671 individuals) Shoshone ponds in May and June 2010 (NDOW 2010). Only 3 direct mortalities were observed as a result of this salvage operation.

The third consultation was an intra-Service consultation on the Wildlife and Sport Fish Restoration Program's issuance of a State Wildlife Grant to NDOW for a study of Pahrump poolfish genetics (File No. 84320-2010-F-0098). The NDOW will use the grant to fund research conducted by North Dakota State University. On April 13, 2012, the Service issued a biological opinion for issuance of this grant. Effects of the action described in the opinion included both purposeful (intentional) and incidental take of Pahrump poolfish; however, the purposeful take is authorized under a federal recovery permit issued under section 10(a)(1)(A) of the Act, and thus only incidental take is authorized under consultation 84320-2010-F-0098. The Service determined that purposeful take would not compromise the poolfish populations and any incidental take that could occur as a result of implementing the proposed action would be quite small. In this biological opinion, we concluded that the proposed action would not jeopardize the continued existence of Pahrump poolfish and overall, the proposed action will likely help federal agencies manage the poolfish and its refuge habitats more effectively.

10.4 EFFECTS OF THE PROPOSED ACTION

10.4.1 *Analysis Approach*

Regulations define effects of the action as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR § 402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Indirect effects are defined as those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

For our effects analysis, we have examined the potential for Pahrump poolfish to be directly or indirectly affected by implementing the proposed action, and if so, the likely nature of these effects. As described in Chapter 1, our analysis for this Opinion includes a project-level assessment of the effects of BLM's issuance of a ROW for the main and lateral pipelines and associated facilities (Tier 1 ROW); and, a programmatic-level (conceptual) assessment of the effects associated with BLM's issuance of ROWs for future groundwater development facilities (Subsequent Tier ROWs) and groundwater pumping. The Service is not exempting take of endangered or threatened species incidental to the programmatic portions of this Opinion. Future site-specific actions that are analyzed broadly under the programmatic portions of this Opinion and that might result in the incidental take of endangered or threatened species will undergo separate formal consultation before any take would occur.

Our assessment of project effects includes an evaluation of the ability of Applicant Committed Measures (ACMs) and BLM monitoring and mitigation measures to avoid, minimize, or mitigate effects to the Pahrump poolfish. These measures are presented below, in some cases in summary form and we refer readers to the Final EIS for the entire text of the measure (Chapter 3.20 and Appendix E in BLM 2012b). As described in Chapter 5, some measures are fairly specific while others are more general in nature since they are based on the programmatic portion of the National Environmental Policy Act (NEPA) analysis. Many of these programmatic measures set up a process (e.g., plan development) for monitoring, managing, and mitigating impacts from future activities, such as groundwater pumping. Any mitigation measure that is specific in terms of how and when it will be applied, and what will be required, was considered in a more specific manner in our effects analysis. We also considered those programmatic measures that are more general and process-oriented, especially if the intent behind the measure is (at least in part) to protect threatened and endangered species and their habitats. However, because development of specific mitigation measures for programmatic activities (and an analysis of the effectiveness of such measures) has been deferred to future NEPA analyses and ESA consultations, we do not assume (because we cannot be assured) that effects from programmatic activities will or can be completely avoided or entirely mitigated through implementation of these programmatic measures. Therefore, for our programmatic analyses, we begin by assessing potential impacts of the proposed action absent these measures, and then consider whether impacts could be minimized based on implementation of these programmatic measures (see Chapter 5 for more information on our analytical approach).

10.4.2 *Applicant Committed Measures and Bureau of Land Management Mitigation Relevant to Poolfish*

The project applicant (SNWA) has identified a suite of potential environmental protection measures that may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to water resources associated with proposed groundwater pumping (SNWA 2012b; BLM 2012b). These measures are described in the SNWA's ACMs which are located in Appendix E of the Final EIS (Section B [Programmatic Measures—Future ROWs] and Section C [Regional Water-Related Effects] in BLM 2012b), and measures specific to the Pahrump poolfish are presented or summarized below.

Commitments by SNWA under the Spring Valley Stipulation (Stipulation) are addressed in ACM C.1.1–C.1.30 and ACM C.2.1. One of the primary goals of the Stipulation is to manage SNWA's development of groundwater in Spring Valley without causing injury to federal water rights and/or unreasonable adverse effects to federal resources. However, if such effects were to occur, SNWA would be required to mitigate the impacts. The delineated "Area of Interest" for the Stipulation includes the Shoshone Ponds Natural Area. The Stipulation also includes a commitment by SNWA to work to evaluate and request alternative points of diversion to pumping at a location near Shoshone Ponds (ACM C.1.3), and requires that SNWA install and equip 2 monitoring wells in the vicinity of Shoshone Ponds, which are to be continuously monitored (ACM C.1.11). Hydrologic and biological monitoring plans for SNWA's groundwater withdrawal have been developed by the Stipulation hydrology Technical Review Panel (TRP) and the Biological Work Group (BWG), and these plans have been accepted by the Stipulation Executive Committee (EC) and the NSE. Initial committed measures can be found in the 2009 Spring Valley Hydrologic Monitoring and Mitigation Plan (SNWA 2009), the 2009 Biological Monitoring Plan for the Stipulation (BWG 2009), and SNWA's annual reports on the Stipulation monitoring program. These commitments include 1) continuous water level data collection at 2 monitoring wells between Shoshone Ponds and the closest anticipated SNWA production well; these wells were completed in March 2011 in the basin fill aquifer at depths of 260 and 720 feet bgs (SNWA 2012a); 2) water chemistry sampling in these wells, the first round of which has been completed (SNWA 2012a); and 3) monitoring of Pahrump poolfish at Shoshone Ponds Natural Area through incorporation of NDOW annual surveys. Habitat monitoring is not being conducted at this site under the Stipulation to limit disturbance to the system (BWG 2009), but limited water quality measurements (water temperature, dissolved oxygen, conductivity, and salinity) are collected by NDOW during annual fish surveys. The NSE required a minimum of 2 years of baseline data collection in his March 2012 ruling (Ruling #6164, NSE 2012), but SNWA has committed to 7 years of baseline biological monitoring through the Spring Valley Stipulation process (BWG 2009).

The SNWA has developed programmatic measures for future ROWs for production wells, collector pipelines, and associated facilities. It is anticipated that these measures will be incorporated as part of the ACMs for future ROWs, as applicable (SNWA 2012b). Programmatic measures that are relevant to Pahrump poolfish are summarized below and include the following:

ACM B.1.1 Groundwater production well sites will be selected considering 1) suitable hydrogeologic conditions, including well yield, groundwater drawdown, and groundwater chemistry, based upon exploratory drilling; 2) avoidance of springs, streams, and riparian/wetland areas; and 3) the presence of special status species and their habitat. (This represents a partial list of those elements of the measure that are relevant to the Pahrump poolfish.)

ACM B.1.3 Among other considerations, infrastructure associated with future tiers (i.e., collector pipelines, powerlines, and substations) will be sited as feasible to avoid springs, streams, and riparian/wetland areas and will consider the presence of special status species and their habitats.

Additionally, the Shoshone Ponds Natural Area is a BLM-designated ACEC and is a ROW exclusion area (Podborny 2012b), so we assume that no facilities associated with the GWD Project will be cited within the ACEC.

The SNWA has prepared a Conceptual Adaptive Management (AM) Framework for consideration at the programmatic level, which can be found in the last section of the ACMs

(SNWA 2012b). This framework provides examples of measures that may be considered and implemented through the AM process to address groundwater pumping impacts. Specific criteria for implementing AM measures will be developed as part of future site-specific AM plans (SNWA 2012b). Potential AM mitigation measures that are or could be relevant to Pahrump poolfish include, but are not limited to, the following (refer to SNWA 2012b for the full measures):

ACM C.2.1 In accordance with the Stipulations and any future water right rulings, implement actions to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special status species, such as: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and 4) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range.

ACM C.2.15 Modify use of SNWA’s agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This modification could be accomplished by changing crop production to a less water-intensive type or changing watering cycles, and then diverting the saved water to the wet meadow areas.

ACM C.2.19 Utilize conservation and protection nonuse on BLM grazing allotments on which SNWA holds grazing permits for the purposes of 1) protecting the land and its resources from destruction and unnecessary injury; 2) improving rangeland conditions; or 3) enhancing resource values, uses, or functions in accordance with guidelines set forth in BLM Instruction Memorandum No. 2009-057.

ACM C.2.20 Develop allotment management plans to prescribe livestock grazing practices necessary to meet specific resource objectives (in coordination with the BLM, applicable resource advisory council, a State [Nevada or Utah] having lands or managing resources in the area, and the interested public, as authorized by the Federal Land Policy and Management Act, 43 U.S.C. § 1702(k)).

ACM C.2.21 Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit water right holders or sensitive biological areas (e.g., routing excess surface water to subirrigate wet meadows or creating containment ponds to store flood waters for use in recharging the aquifer).

10.4.2.1 Bureau of Land Management Mitigation Measures

The BLM has identified additional mitigation measures through the NEPA process, which are presented in Chapter 3.20 (Monitoring and Mitigation Summary) in the Final Environmental Impact Statement (FEIS; BLM 2012b). Mitigation measures for future groundwater development and pumping are general in nature because they are based on the programmatic-level NEPA analysis. These general measures apply to future GWD Project activities, but will be replaced by more specific measures resulting from future tiered NEPA analyses (BLM 2012b). Below, we summarize those components of the BLM mitigation measures that are relevant to Pahrump poolfish and its habitat and within BLM's jurisdiction. Please reference the FEIS for the full measures.

ROW-WR-3: ***Construction Water Supply Plan.*** A construction water supply plan will be provided to the BLM for approval prior to construction. The plan will identify the specific locations of water supply wells (whether existing or new) that will be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; identify reasonable measures to reuse or conserve water; and identify any additional approvals that may be required. The BLM will review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. The SNWA will provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. The BLM, in consultation with State agencies and the grazing permittee, will review the location of any newly constructed water wells and determine if any will be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to benefit the BLM for multiple use management, the BLM will work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s). The BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. At locations of potential habitat, but where species occurrence has not yet been determined, surveys will be conducted in accordance with appropriate protocol prior to approving the plan. The construction water supply plan will be a component of the SNWA Plan of Development (POD). Prior to approval of the POD, the BLM will coordinate with the Service regarding portions of the POD relating to their regulatory role under the ESA. This process will be used to determine if there would be adverse impacts to listed species or adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary.

GW-WR-3a: ***Comprehensive Water Resources Monitoring Plan.*** This mitigation measure requires that SNWA develop a comprehensive Water Resources Monitoring Plan (WRMP) prior to project pumping that specifies hydrologic monitoring requirements to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variation, and other nonproject related groundwater pumping activities. Monitoring would include 1) water sources essential to federally listed species that are determined by BLM to be at risk from the project and that are on public or state lands and 2) wells sited in Spring Valley to monitor the magnitude and extent of groundwater drawdown over time from project pumping. The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for a period of <u>at least 5 years</u> prior to initiation of pumping.

GW-WR-3b: ***Numerical Groundwater Flow Modeling Requirements.*** This mitigation measure requires that SNWA update and recalibrate the regional groundwater flow model at least every 5 years after pumping is initiated, and that SNWA develop basin-specific models to be approved by BLM prior to tiered NEPA for specific groundwater-development activities. BLM would use the basin-specific models to critically evaluate the effects of pumping and the effectiveness of the proposed mitigation measures, ACMs, and other measures proposed through the AM process. BLM would establish a Technical Review Team to periodically review the model.

GW-WR-5: ***Shoshone Ponds.*** This mitigation measure requires that SNWA develop a surface water and groundwater monitoring plan specific to this area that would provide an early warning system for effects to flow at Shoshone Ponds. This plan would likely include monitoring of discharge and monitoring artesian pressures in the aquifer that controls discharge to the ponds. Impacts to Shoshone Ponds attributable to SNWA's groundwater pumping would be mitigated by improving the existing well or drilling a new well, and installing a pump. These mitigations will be designed to maintain the flow to the ponds for the foreseeable future regardless of groundwater drawdown. Any new well should be designed to pump groundwater from the same aquifer system to maintain the same general water quality and temperature characteristics currently used as the source of water for the ponds and sufficient to support the federally listed and special status species that inhabit the ponds.

GW-WR-7: ***Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights.*** This mitigation measure addresses BLM action in the event that monitoring or modeling information provided in accordance with GW-WR-3a indicates that impacts to federal resources from groundwater withdrawal are occurring or are likely to occur, and the GWD Project is the likely cause or a contributor to the impacts. The BLM would evaluate available information and determine if emergency action and/or a site-specific mitigation plan is required. If the BLM determines that emergency action is required, the BLM could serve a "Cease and Desist" order identifying actions to be taken to avoid, minimize, or offset impacts. If a site-specific mitigation plan is needed, the BLM could require that specific measures be implemented per the schedule specified in the plan to avoid, minimize, or offset impacts to federal resources or federal water rights, including but not limited to 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) flow augmentation to maintain flow in specific water sources; 4) recharge projects to offset local groundwater drawdown; and 5) other on-site or off-site improvements.

Per the BLM (10/04/2012), language in the ROD for this measure will be changed to state that BLM could serve a "Temporary Suspension" order pursuant to 43 CFR 2807.16-18, if needed, and not a "Cease and Desist" order.

GW-AB-1: ***Avoid Disturbance to Springs.*** This mitigation measure specifies that SNWA will avoid direct disturbance to springs and wetlands in Spring Valley with known special status aquatic species by establishing a 0.8 km (0.5-mile) buffer around these areas.

GW-AB-3: ***Flow Change Mitigation.*** This measure specifies that BLM will identify detailed mitigation measures during subsequent NEPA for those springs and streams with special status aquatic species where flow or water level changes are identified during modeling or monitoring. Mitigation ideas are identified at the programmatic level in the ACMs, BLM's comprehensive monitoring, management, and mitigation plan (COM Plan), and mitigation measure GW-WR-7.

GW-MN-AB-2: ***Spring and Aquatic Biological Monitoring.*** This measure requires the SNWA to monitor flows in moderate and high risk springs (as defined by the BLM) with special status species where potential pumping effects could occur (as determined by the BLM). (Note: The BLM identified Shoshone Ponds as a site potentially affected by SNWA's proposed pumping for Alternatives E and F in the FEIS. These 2 alternatives bracket the amount of pumping anticipated under the NSE Order 6164 for Spring Valley [BLM 2012b]).

GW-MN-AB-3: ***Flow/Habitat Determination***. This measure requires SNWA to study flow or water level–habitat relationships in selected streams and springs to determine minimum flow or water levels needed to support critical life stages of aquatic species in these habitats. The sites at which these studies would occur would be selected from the list being monitored as part of the Stipulations or additional waterbodies recommended for measures GWD-MN-AB-1 (relevant to game species) and GWD-MN-AB-2 (relevant to special status species).

The BLM is also developing its own COM Plan that addresses all hydrographic areas and all facilities associated with the GWD Project (BLM 2012b). Objectives of the COM Plan include protecting federal resources and federal water rights that may be impacted by the GWD Project, including avoiding adverse impacts that could cause jeopardy to listed species or destruction or adverse modification of designated critical habitat. The BLM will develop this plan based on SNWA's final Plan of Development and in coordination with other federal, State, local, and tribal agencies/governments, and Notices to Proceed will not be issued until the COM Plan has been completed (BLM 2012b). The COM Plan for Tier 1 ROWs will outline a process for developing additional mitigation, monitoring, and management requirements for future ROW grants, and will identify baseline and data gap information needs to better inform subsequent NEPA analyses for groundwater development. Groundwater development-specific COM Plans may be developed for subsequent tiers of the GWD Project, or the COM Plan for Tier 1 ROWs may be amended. The COM Plan(s) will also include development of triggers for management action and AM thresholds (BLM 2012b).

10.4.3 *Approach to Analysis*

Please refer to Chapter 5 for a detailed discussion of our approach for analyzing effects related to Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping. The hydrologic analysis forms the backbone of the effects analysis for all federally listed species that rely on groundwater-dependent ecosystems. The hydrologic analyses can be found in Chapter 7, and is referenced in this chapter as appropriate. Below, we focus primarily on describing potential effects of the proposed action to the Pahrump poolfish and its habitat and potential cumulative effects. Lastly, we present our determination as to whether the proposed action is likely to jeopardize the continued existence of the Pahrump poolfish.

As explained in Chapters 5 and 7, the Central Carbonate-Rock Province (CCRP) Model was developed as a tool to predict potential hydrologic change at a regional (not site-specific) scale, and uncertainty is associated with these predictions (e.g., magnitude and timing of impacts). However, we must conduct a site-specific analysis of the potential effects of the proposed action to threatened and endangered species. Thus, we have used the CCRP Model as one of several tools for assessing potential impacts to the Pahrump poolfish. For our hydrologic analysis, we additionally assessed whether the CCRP Model likely over- or underpredicted drawdown in the source aquifer for the Shoshone Ponds flowing artesian wells.

10.4.3.1 Available Information and its Limitations

Limited information is available on the life history, food preference, or habitat requirements of Pahrump poolfish. Most of the information available is from short-term studies in the 1960s at the poolfish's ancestral site (Manse Spring), and other studies conducted during the 1970s and 1980s at transplant sites or in the laboratory. The NDOW conducted a limited study of summer food habits of the poolfish at transplant sites (Hobbs et al. 2003). Other than this study, we are unaware of any recent studies specific to Shoshone Ponds other than the biannual fish surveys conducted by the NDOW and the water quality (temperature, dissolved oxygen, pH) measurements taken during these surveys. Recently, North Dakota State University initiated a habitat and genetics study at all 3 transplant sites for which information is not yet available (see "Recent Section 7 Consultations" for more details). While we cannot determine with any certainty what specific habitat characteristics control population dynamics and other life history characteristics of poolfish, we can conclude that water quantity and quality likely play an important role. However, we do not know specifically how Pahrump poolfish and its habitat will respond to decreases in flow at Shoshone Ponds, if such changes were to occur due to the GWD Project. Therefore, we make general (qualitative) predictions based on the information included in this chapter ("Status of the Species" and "Environmental Baseline"), while recognizing that Shoshone Ponds is an artificial system that can very likely be maintained through human manipulation despite large anticipated groundwater drawdown near the ponds. We also urge that research on life history characteristics, habitat preferences, limiting environmental factors, and species' response to changes in flow and habitat change is completed prior to tiered ESA consultations to help inform these future analyses and the development of mitigation measures (see Chapter 15).

10.4.3.2 Potential Effects to Pahrump Poolfish

Tier 1 ROWs (Main Pipeline and Associated Facilities)

We do not anticipate any direct or indirect effects to Pahrump poolfish from most of the activities associated with construction, operation, and maintenance of the main pipeline and associated facilities (other than as discussed below). Shoshone Ponds, which is the only site that harbors Pahrump poolfish in Spring Valley, is located approximately 4 miles away from the nearest Tier 1 ROW (BLM 2012a) (Figure 10-1). At this distance, the Pahrump poolfish would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

On the other hand, groundwater pumping in Spring Valley for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) could potentially adversely affect the poolfish at Shoshone Ponds, but effects are extremely unlikely or the effects of this activity would likely be insignificant (Note: we use this term as applied under the Act [i.e., that a person would not be able to meaningfully measure, detect, or evaluate insignificant effects]) for the following reasons. The SNWA anticipates that, at most, 27 acre-feet (or about 8.7 million gallons) of water will be needed for every mile of pipeline, and approximately 88 km (55 miles) of pipeline will be laid in Spring Valley (BLM 2012a). Therefore, we estimate that, at most, 1,485 acre-feet of water will be needed for construction purposes in this valley. Whether or not impacts to artesian well flow will occur at Shoshone Ponds will depend, in part, on the exact location and depth of these water supply wells, pumping rates and duration, and pumped units. In correspondence dated September 27, 2012, the BLM clarified that the SNWA anticipates using its existing agricultural wells for temporary construction water needs associated with main pipeline construction (Tier 1) rather than drilling a temporary construction water well near Shoshone Ponds; and that SNWA would not pump more groundwater from these wells than is currently used and authorized for agricultural production (Woods 2012). Also, season of use would likely be similar, as agricultural water is generally pumped in the summer, which is when dust control water would be needed.

The above-stated clarifications and commitments do not guarantee that there will be no impacts to the poolfish from construction pumping; we do not have any data to indicate that current pumping of agricultural rights is not causing impacts. However, this, in combination with BLM mitigation measure ROW-WR-3 and subsequent modifications to this measure (Dow 2012) as described above, led us to conclude that adverse impacts to artesian well flow at Shoshone Ponds, and thus adverse impacts to the Pahrump poolfish, from construction pumping are extremely unlikely to occur.

Subsequent Tier ROWs (Groundwater Development Areas)

We do not anticipate any direct or indirect effects to Pahrump poolfish from most of the activities associated with construction, operation, and maintenance of facilities associated with groundwater production in the Groundwater Development Areas (other than as discussed below). Shoshone Ponds is located approximately 0.5 km (0.3 mi) away from the nearest groundwater development area (BLM 2012a) (**Figure 10-1**). BLM mitigation measure GW-AB-1 requires a 0.8-km (0.5-mi) buffer around springs and wetlands in Spring Valley that harbor special status aquatic species, so we presume that BLM will not allow SNWA to disturb ground within 0.8 km (or 0.5 mi) of Shoshone Ponds, the stock pond, and the outflow stream. At this distance, Pahrump poolfish would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

On the other hand, groundwater pumping in Spring Valley for construction purposes may adversely affect poolfish at Shoshone Ponds, but adverse effects are extremely unlikely or the effects would be insignificant (Note: we use this term as applied under the Act [i.e., that a person would not be able to meaningfully measure, detect, or evaluate insignificant effects]) for the following reasons. The length of future collector pipelines is not known but has been estimated by SNWA based on assumptions regarding number of future groundwater production wells and known geologic and hydrologic conditions. The SNWA estimates that up to 164 km (102 mi) of collector pipeline could be built in Spring Valley to develop and transport groundwater at quantities granted by the NSE in 2012 (BLM 2012a). Based on the assumptions discussed above regarding water needs for construction purposes, we anticipate that the SNWA will need up to 2,754 acre-feet of water for construction purposes for Subsequent Tier ROWs. Whether or not impacts to artesian well flow will occur at Shoshone Ponds will depend, in part, on the exact location and depth of these water supply wells, pumping rates and duration, and pumped units. As described above, the SNWA anticipates using its existing agricultural wells for temporary construction water rather than drilling a temporary construction water well near Shoshone Ponds (Woods 2012). And while using existing agricultural wells does not guarantee there will be no impacts to the poolfish from construction pumping, we believe that BLM mitigation measure ROW-WR-3 and subsequent modifications to this measure (Dow 2012), as described above, makes it extremely unlikely that the poolfish will be adversely affected by this activity.

This conclusion will be re-evaluated for any tiered consultation involving ROWs in Spring Valley, based on updated information provided at that point in time.

Groundwater Pumping

We anticipate that Pahrump poolfish could be adversely affected by declining groundwater levels and decreased artesian well flow from GWD Project pumping within the timeframe of our analysis. However, we anticipate that if adverse effects materialize or are predicted to materialize, they can be minimized and/or at least partially mitigated by implementing BLM measure GW-WR-5. This measure requires SNWA to improve the existing well or drill a new well and install a pump to maintain water flows to the ponds and maintain water quality and temperature at this location by pumping from the same aquifer. However, we do not know the extent to which impacts will be minimized and we cannot assume that effects will or can be completely avoided.

There are existing BLM and NDOW water rights at their wells at Shoshone Ponds that are protected under Nevada water law (Nevada Revised Statute [NRS] 533.370 and 533.482). NRS 533.482 provides the NSE with the authority to seek injunctive relief to prevent any action that would violate Nevada water law’s protection of existing rights or any order or regulation of the NSE. The NSE may even request an injunction before any injury to a water right occurs. The fact that both federal district courts and Nevada state courts have consistently ruled in favor of protecting senior existing water rights from injury indicating that flows from artesian wells that support these existing water rights are may be insulated from adverse effects from the GWD Project.

Additionally, the NSE Ruling 6164 requires staged development of SNWA’s Spring Valley water rights, which includes SNWA submittal of hydrologic and biological monitoring data and updated modeling results and NSE approval to proceed to the next stage. While we do not have authority over NSE decisions on phased development under Ruling 6164, we anticipate receiving the hydrologic and biological data and being able to provide input to the NSE as part of the Stipulated Agreement process.

As described in Chapter 7, we have assessed whether pumping of 61,127 afy of groundwater in Spring Valley could result in adverse hydrologic impacts to the artesian well-fed aquatic habitat in the Shoshone Ponds Natural Area where poolfish occur (i.e., the North and Middle refuge ponds, the stock pond, and the outflow stream from Shoshone Well No. 2). While we cannot predict with precision the magnitude of groundwater drawdown at Shoshone Ponds, we anticipate that drawdown will be substantial. The calibrated CCRP Model simulates groundwater drawdown in the Shoshone Ponds area (drawdown of the water table) of up to approximately 25 feet from pumping under the proposed action at 75 years after full build out (BLM 2012a) given the distribution of production wells simulated by the model. In view of the likely proximity of project pumping to the Shoshone Ponds Natural Area, we anticipate that there could be a relatively short lag time between the initiation of pumping in south-central Spring Valley and groundwater drawdown in the vicinity of Shoshone Ponds, and that this drawdown will occur well within the timeframe of our analysis (collaborated by CCRP Model predictions provided to the Service [SNWA 2012c]). We also anticipate that groundwater levels may recover more quickly in the area of the Shoshone Ponds than at other sites (in other basins) due to the likely proximity of the production wells to the resource if project pumping were to cease at 75 years after full build out. Nonetheless, the CCRP Model predicts that groundwater levels may recover less than 2 feet in 10 years and less than 10 feet in 20 years were project pumping to cease at 75 years after full build out (SNWA 2012c).

The most critical threat to Pahrump poolfish has historically been the destruction of spring-fed habitat from groundwater pumping, as demonstrated by the desiccation of Manse Spring and the extirpation of the other 2 Pahrump poolfish subspecies due to drying of spring habitats (Minckley and Deacon 1968; Minckley et al. 1991; USFWS 2004). Pumping effects to poolfish habitat within the Shoshone Ponds Natural Area will depend on the interconnection between the aquifer that sustains flow in the artesian wells and the aquifer(s) developed for production under the proposed action. If they are one in the same (upper valley fill), or if there is a connection between the aquifer(s) targeted for production and the aquifer that supplies the Shoshone Ponds flowing artesian wells, then project-induced drawdown could substantially reduce the natural flow of the wells, up to and including the cessation of natural flow, within the timeframe of this consultation (see Chapter 7, “Flowing Artesian Wells at Shoshone Ponds and Riparian Habitat, Spring Valley”).

The location, depth, and targeted aquifer(s) (e.g., carbonate or alluvial) for SNWA’s production wells in the Shoshone Ponds area are not known, although assumptions have been made for purposes of the programmatic analysis (i.e., the distributed pumping scenario described in Chapters 5 and 7). Additionally, while the well log for the NDOW Shoshone Well suggests that the well penetrates multiple clay layers in this area, the continuity (or lack thereof) of these potential confining layers is not known. Therefore, we do not know if and the degree to which hydrologic impacts (i.e., reduced flows to the ponds) may be prevented or limited by confining layers.

The Shoshone refuge ponds and the stock pond are highly artificial systems that are fed by artesian well flow as opposed to natural spring flows. We agree with BLM’s assessment (BLM 2012a) that flows to Shoshone Ponds can be maintained by improving the existing well(s) or drilling a new well(s) and installing a pump(s), as will be required of SNWA if GWD Project pumping impacts the artesian well flows supplying the ponds (GW-WR-5). (Note: This BLM measure does not indicate that there are multiple wells that would need to be maintained; we added that emphasis). Even though Shoshone Ponds ACEC is a ROW exclusion area, maintenance of the wells by the BLM or NDOW will be allowed, including deepening of a well and drilling of a new well as long as it was for the same purpose as the existing well

(Podborny 2012b). The BLM would have to drill the well and it would be owned by BLM, but the SNWA would assume the cost.

Despite this provision of BLM mitigation measure GW-WR-5, we cannot be assured that no adverse impacts will occur to the Pahrump poolfish from pumping under the proposed action. While GW-WR-5 requires that any new well is designed to pump groundwater from the same aquifer system, this does not guarantee maintenance of the same general water quality and temperature in the ponds. Groundwater pumping under the proposed action could differentially affect the sources of flow at the artesian wells, resulting in changes to the chemical composition of the well water (Alley et al. 1999) as well as changes in temperature. And, while GW-WR-5 requires the SNWA to develop a site-specific surface water and groundwater monitoring plan that will provide early warning of effects to flow at Shoshone Ponds, the measure does not require the SNWA to continuously monitor discharge or artesian pressures and it does not require that data be made available in real time in order to document changes in artesian well flow and implement mitigation in a timely manner.

For this and other reasons described below, we believe that adverse effects to Pahrump poolfish could occur. Therefore, we provide our conceptual analysis of the potential impacts to the poolfish and its habitat from decreased artesian well flow and lowered groundwater levels in the vicinity of Shoshone Ponds in the following paragraphs. This analysis is best viewed as a set of hypotheses about the responses of poolfish habitat at Shoshone Ponds and the fish itself to diminished flow based on the best available information.

The Pahrump poolfish appears to be a hardy and adaptable fish. It has a high degree of demographic resilience (rebounding from large population declines), the ability to survive and reproduce in environments that are very different from its native habitat at Manse Spring, and at least some life history and behavioral plasticity in response to different environmental conditions. However, this species is susceptible to extirpation resulting from habitat changes (e.g., changes in aquatic vegetation, water quantity, and/or quality) and non-native aquatic species interactions, as evidenced by past extirpation events and its recent disappearance from the North Pond. While it is not known why poolfish disappeared from the North Pond, this event provides some insight into poolfish response to curtailed flows and subsequent stagnant water conditions at this locale. In 2011, water levels at this pool were low, water was stagnant, and there was an overgrowth of submergent, emergent, and floating vegetation, possibly resulting from plumbing issues with the pipeline supplying water to the pond (NDOW 2011). It has been conjectured that the high organic matter in this pond may have created low pH and large diel variations in dissolved oxygen (NDOW 2011), which can be harmful to the fish. Prior to poolfish extirpation from North Pond, fish were in poor condition, population size was comparatively small, and no large size class fish were observed during surveys (NDOW 2009).

A flow-ecological response model that describes the relationship between hydrologic variability and ecological response has not been developed for Pahrump poolfish and its habitat at Shoshone Ponds (or elsewhere). The complexity of ecosystem processes makes predicting *specifically* how diminished flow would affect Pahrump poolfish at Shoshone Ponds difficult, if diminished flow were to result from GWD Project pumping. Predicting effects from diminished flow is further complicated by our incomplete knowledge of poolfish life history, habitat requirements or preferences, food preferences, and individual and population-level responses to diminished water quantity and quality. However, we can generally describe the likely or possible consequences of decreased artesian well flow to Pahrump poolfish and its habitat at Shoshone Ponds.

A decrease in discharge from the artesian wells would likely result in diminished extent and/or quality of poolfish habitat at the Shoshone refuge ponds, the stock pond, and the outflow stream. The degree to which will primarily be influenced by the magnitude and duration of the flow change. Sustained decreases in flow of sufficient magnitude will likely result in reduced water volume in the ponds (i.e., reduced wetted area and water depth). Additionally, reduced flows of sufficient magnitude will likely diminish the extent of the shallow stream created by outflow of Shoshone Well No. 2, and diminished flows could affect the ability to effectively create more deep water habitat for the poolfish in this outflow area (or it could affect any newly created habitat, if this has occurred by the time pumping commences).

An overall reduction in water volume could affect growth and reproduction of the Pahrump poolfish. Freshwater fish are known to scale in size to the water volume inhabited (Smith 1981). Additionally, larger fish tend to be more fecund; this relationship has been demonstrated for numerous freshwater fish species (Johnson et al. 1995; Scoppettone et al. 1992) including Pahrump poolfish (Baugh et al. 1988; Deacon and Williams 2010). Therefore, we infer that lower water volume could result in smaller and less fecund poolfish, which would consequently reduce reproductive potential of the population. Additionally, reduced flows of sufficient magnitude could create stagnant conditions in the ponds and could result in water quality and temperature changes, which can be stressful for fish (Instream Flow Council 2002, cited in Bradford and Heinonen 2008). Small changes in water temperature can have considerable consequences for freshwater fishes, affecting life history (e.g., reproduction, feeding), behavior (e.g., predator avoidance, migration, and spawning), and physiology (e.g., metabolism, growth, body condition) (as reviewed in Carveth et al. 2006).

However, Pahrump poolfish has demonstrated the ability to thrive at sites with widely different temperature regimes and water quality (e.g., dissolved oxygen) compared to its ancestral site. Therefore, we do not anticipate that Pahrump poolfish will be adversely affected by minor changes in water quality and temperature from either temporary diminished flow during or before implementation of BLM mitigation measure GW-WR-5 or sustained flow achieved by pumping water from deeper or different depths (as could occur under GW-WR-5), as long as these changes are not extreme, rapid, or long term. Changes in water quality and temperature could, however, result in phenotypic changes (life history traits, behavior, physiology) that could have subtle effects on poolfish survival and reproduction, which could translate into effects to population persistence over the long term. And, we anticipate that if water quality was to change dramatically and persist, negative consequences would occur to the fish.

The Shoshone refuge ponds are fairly small and deep (when full). Though fed by warm well water, there may be a vertical temperature gradient in the pond created by exposure of the top surface layer to air temperatures (e.g., surface water could become warmer in the summer and colder in the winter). In fact, water quality surveys conducted by the SNWA in August 2012 showed a large vertical gradient in dissolved oxygen levels in the Middle Pond (3.11 milligrams per liter [mg/L] at a depth of 15.2 centimeters [cm] [6 inches] and 0.49 mg/L at a depth of 122 cm [48 inches]) (SNWA 2012d). Lowered water levels due to decreased well flow could alter this vertical temperature gradient, and a relatively greater proportion of water could become exposed and affected by air temperatures.

Stagnant conditions and lowered water levels caused by decreased well flow could also lead to an overall deterioration of water quality, which could stress the poolfish. Crowding of fish into a smaller volume of water could result in oxygen depletion and a concentration of metabolites. Nutrients (such as nitrogen and phosphorus) in the ponds may become more concentrated, leading to excessive growth of aquatic plants and algae. While plant and algal material appear to comprise a large part of the poolfish's diet at Shoshone Ponds (Hobbs et al. 2003) and likely provides some cover from predators, it could also create large diel variations in dissolved oxygen that could be stressful to the poolfish. Large amounts of aquatic vegetation can create high dissolved oxygen levels during the day from photosynthesis, but depleted dissolved oxygen at night due to high vegetation respiration. Additionally, dissolved oxygen can become depleted by bacteria that decompose plants. While poolfish appear capable of withstanding a wide range of dissolved oxygen levels (including low levels), its body shape and mouth orientation makes utilization of the surface water layer to obtain oxygen difficult (Selby 1977). Thus, poolfish may not be able to survive extended periods of oxygen depletion by utilizing the surface water layer (Selby 1977).

If decreased flows lead to lower water volumes and stagnant conditions, further and/or continuing encroachment of wetland and aquatic vegetation could occur. This encroachment could affect Pahrump poolfish by decreasing open aquatic habitat and impacting water quality as described above. Groundwater drawdown could also adversely affect phreatophytic vegetation growing in the vicinity of Shoshone Ponds. Impacts to vegetation on poolfish and its habitat is unclear, but a loss of ground cover could result in increased erosion and sedimentation issues.

Because much of Spring Valley is predicted to have substantial groundwater drawdown as a result of GWD Project pumping, the amount of available surface water on the valley floor will likely be diminished. While it appears that water flow can be maintained at Shoshone Ponds through implementation of GW-WR-5, the loss of other water sources in Spring Valley (and other areas within the action area) could crowd animals at remaining water holes, such as the stock pond within the Shoshone Ponds Natural Area. Water availability is a limiting factor for many animals in this arid landscape, including wild horse herds, and affects their distribution and degree of conflict with other animals, including livestock and wildlife (BLM 2007). Thus, impacts to permanent and ephemeral water sources may affect the distribution and space use of wild animals (including wild horses and pronghorn antelope), leading to indirect and cascading effects on federally listed species dependent on the remaining aquatic environments, wetlands vegetation, and surrounding upland habitats (e.g., water quality issues [nutrient loads], loss of vegetation, sedimentation).

10.4.4 *Cumulative Effects*

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Cumulative effects to the Pahrump poolfish would include, but are not limited to, changes in land or water use patterns or practice (including management actions) that may adversely affect the species or its habitat. Within the analysis area for poolfish, such actions would most likely be undertaken by the private landholders in Spring Valley, including the SNWA. The SNWA has already identified potential groundwater development on its private lands as part of the federal action. Other future groundwater uses within the poolfish analysis area that we consider to be reasonably certain to occur include the continuation of current consumptive groundwater uses associated with private lands and development of an addditional 1,426 afy of permitted irrigation rights for agriculture on private lands in Spring Valley. The BLM considered these future groundwater uses as part of their baseline assessment (BLM 2012a). As explained in Chapter 5, while we are not in complete agreement with BLM in terms of the categorization of these water uses (i.e., baseline versus cumulative), this particular point has no bearing on our overall effects conclusions (i.e., jeopardy or no jeopardy), which is based on aggregate effects (see below).

10.5 CONCLUSION

As required under section 7, we based our overall effects conclusions on the ***aggregate*** effects of the factors analyzed under “environmental baseline,” “effects of the action,” and “cumulative effects.” The BLM provided us with an aggregate effects analysis in support of this consultation, which included results of groundwater flow model (CCRP Model) simulations for their “baseline-plus-proposed action” scenario. The calibrated CCRP Model simulation results showed greater groundwater drawdown in the vicinity of Shoshone Ponds under the aggregate effects scenario >9 m (>30 feet) over that which would occur due to project pumping only (approximately 7.6 m [25 feet]) (BLM 2012a). As explained in Chapter 7 and the NSE’s Ruling #6164, these site-specific predictions are highly uncertain for a number of reasons, one being the limitations of the regional model in representing the complex geologic stratification on the valley floor in Spring Valley (NSE 2012). Nevertheless, assuming that groundwater drawdown at Shoshone Ponds under the aggregate effects scenario will be at least somewhat greater than drawdown from GWD Project pumping only but that the majority of this drawdown is attributable to pumping under the proposed action seems safe.

It is our opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Pahrump poolfish. No critical habitat has been designated for this species, therefore none will be affected.

We base this determination primarily upon the following factors, identified and discussed above:

- Poolfish habitat at Shoshone Ponds is supported by discharge from flowing artesian wells that can be maintained by equipping the existing well(s), or new (replacement) well(s), with pump(s) and pumping water from the wells to maintain water flows if GWD Project pumping causes impacts to the natural discharge of the wells, as required under GW-WR-5.
- While effects to water quality associated with the proposed action may occur, poolfish are relatively hardy and have demonstrated the ability to thrive in environments that vary considerably from each other and from the fish’s ancestral habitat (e.g., different temperature and other water quality parameters).

However, we believe that the proposed action may affect, is likely to adversely affect the Pahrump poolfish at Shoshone Ponds within the timeframe of our analysis. The CCRP Model predicts considerable groundwater drawdown in the vicinity of the Shoshone Ponds flowing artesian wells which would likely result in substantial impacts to the natural discharge of the wells, up to and including the cessation of natural flow, within the timeframe of this consultation. The degree and timing of these effects will depend, moreover, on the degree of interconnection of the aquifer(s) targeted for production and the aquifer that supplies the Shoshone wells. Even though well flow can likely be maintained to support poolfish habitat (through the installation of pump(s)), impacts to water quality could occur. Additionally, we believe that continuous monitoring of artesian well discharge and water quality in the ponds is vital to detecting change and implementing mitigation in a timely manner, and no firm commitment to do so exists. Also, groundwater drawdown in the vicinity of Shoshone Ponds and Spring Valley in general will likely affect phreatophytic vegetation and overall availability of water on the landscape, which could have cascading effects to Pahrump poolfish and its habitat.

Lastly, the future effects of climate change may act to alter the hydrological regime upon which the Pahrump poolfish depends, thus compounding the potential effects of groundwater pumping under the GWD Project. In summary, higher air temperatures could result in increased evapotranspiration, and more winter precipitation in the form of rain than snow and earlier snowmelt could result in shifts in the timing and/or amount of groundwater recharge and runoff (EPA 1998). This change in runoff could result in decreased spring flow, diminished aquatic habitat area, reduced heterogeneity of the aquatic environment, altered thermal regimes in spring systems, and reduced soil moisture (Sada and Herbst 2008). The wells that supply the ponds where poolfish occur are within the basin-fill aquifer, and as such, may be quicker to respond to climate change than large regional springs located at a distance from mountain recharge zones. However, while climate change may affect artesian well flow at Shoshone Ponds, the specific poolfish habitat attributes that will be affected and/or the timing, magnitude, and rate of change is uncertain. Future tiered analyses for groundwater development and pumping will provide us with opportunities to update the cumulative effects analysis based on current climate change information and/or local-scale model predictions for climate change. We address the potential effects of climate change within the action area, including the effects that climate change may have upon Pahrump poolfish, in Chapter 8 of this Opinion.

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Chapter 11
UTE LADIES'-TRESSES

11.1 ANALYSIS AREA AND PROPOSED ACTION COMPONENTS

As described in Chapter 3, the U.S. Fish and Wildlife Service (Service or USFWS) has defined an action area (Figure 3-1) that differs from that presented in the Biological Assessment. In particular, the Service action area encompasses two known locations of Ute ladies'-tresses (*Spiranthes diluvialis*), in Panaca and Snake Valleys. Therefore, in contrast with the Biological Assessment, we regard the species as known from the action area associated with this consultation.

The analysis area for Ute ladies'-tresses (Figure 11-1) is a subset of the action area. It encompasses those hydrologic basins within the action area that meet one or both of the following criteria: 1) containing confirmed or potential occurrences of the species, as indicated by potentially suitable habitat and 2) hydrologic basins in which one or more components of the proposed action have the potential to create effects that may extend into those basins where the species is known or has the potential to occur. This second criterion primarily reflects the patterns of hydrologic connectivity (particularly groundwater movement) between hydrologic basins within the action area, as described in Chapter 7 of this Biological and Conference Opinion (Opinion). As explained in that chapter, groundwater pumping occurring within a given basin may affect groundwater levels within adjacent or even more distant basins. Our Ute ladies'-tresses analysis area therefore contains not only those basins in which Ute ladies'-tresses is known or has the potential to occur, but also those basins in or through which project-related activities (i.e., groundwater development) may ultimately affect basins containing or potentially containing Ute ladies'-tresses. We provide our rationale for each of the basins included in our Ute ladies'-tresses analysis area below.

As explained later in this chapter (refer to the "Status of the Species Within the Analysis Area" section), four basins within the action area (Hamlin, Panaca, Snake and Spring valleys) meet the first criterion of containing known or potential occurrences of Ute ladies'-tresses, and have been included in our Ute ladies'-tresses analysis area on this basis. In addition, evidence of groundwater movement from Spring Valley to Snake Valley via Hamlin Valley (described in Chapter 7, Hydrological Analyses) suggests that the proposed groundwater development within Spring Valley may affect potential Ute ladies'-tresses habitat within Snake Valley (a basin in which the species is known to occur), by way of Hamlin Valley (a basin containing potentially suitable habitat). This potential for project-related effects to be conveyed from Spring Valley to Snake Valley via Hamlin Valley reinforces the need to include all three of these basins in the Ute ladies'-tresses analysis area. Finally, due to evidence of hydrologic connectivity between Dry Lake Valley and Panaca Valley via Patterson Valley (Chapter 7, Hydrologic Analyses), Dry Lake and Patterson valleys have also been included in our Ute ladies'-tresses analysis area—not because we expect Ute ladies'-tresses to occur in these latter two basins, but because the proposed groundwater withdrawals in Dry Lake Valley have the potential to propagate through Patterson Valley to Panaca Valley, where Ute ladies'-tresses is known to occur and where additional areas of potential habitat for the species exist.

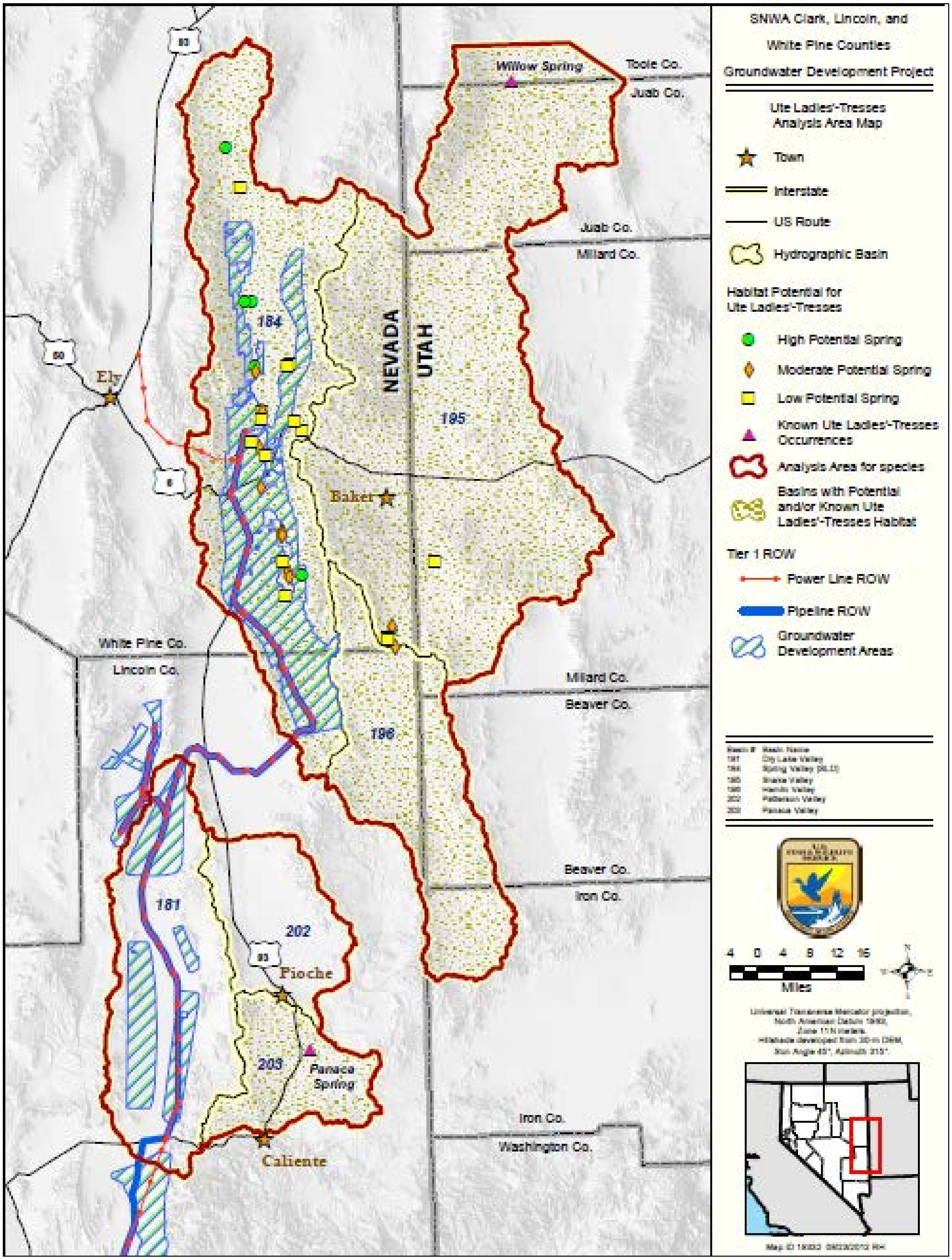

Figure 11-1. Analysis area for Ute ladies'-tresses

11.2 STATUS OF THE SPECIES

11.2.1 Regulatory Status

The Service listed Ute ladies'-tresses as threatened in its entire range under the Endangered Species Act (ESA or Act) on January 17, 1992 (USFWS 1992a). No critical habitat has been designated for the species. A draft recovery plan has been prepared, but not finalized (USFWS 1995). The descriptions that follow are derived from this draft recovery plan, a relatively recent rangewide status review (Fertig et al. 2005) and additional sources as cited below.

11.2.2 Species Description and Taxonomy

Ute ladies'-tresses was first described as a species in 1984 by Dr. Charles J. Sheviak from a population discovered near Golden, Colorado (Sheviak 1984). The species is a perennial orchid (member of the plant family Orchidaceae) that first emerges aboveground as a rosette of thickened leaves that is very difficult to distinguish from other vegetation, especially given the dense herbaceous vegetation in which the species often grows. Its leaves are up to 1.5 centimeter (cm) (0.6 inches) wide and 28 cm (11 inches) long; the longest leaves are near the base. The usually solitary flowering stem is 20 to 50 cm (8 to 20 inches) tall, terminating in a spike of 3 to 15 white or ivory flowers. Flowering is generally from mid-July through August. However, in some locations, it may bloom in early July or may still be in flower as late as early October.

Ute ladies'-tresses looks most similar to hooded ladies'-tresses (*Spiranthes romanzoffina*), but differs in the detailed characteristics of the individual flowers. In Hooded ladies'-tresses (which is more common), each individual flower has petals and sepals that are fused to form a covering, or hood. In Ute ladies'-tresses, these floral parts are not fused, appearing instead to be widely spread, or gaping, open.

11.2.3 Distribution and Status

When it was listed under the ESA in 1992, Ute ladies'-tresses was known from 10 extant populations within portions of only Colorado and Utah (USFWS 1992a). At that time, these 10 populations were estimated to encompass approximately 68.8 hectares (ha) (170 acres) of occupied habitat. At listing, the species was historically known from, but presumed extirpated in, Nevada.

Since listing, Ute ladies'-tresses has been rediscovered in Nevada, and new populations have been discovered in southern Idaho, southwestern Montana, western Nebraska, central and northern Washington, and southeastern Wyoming (Fertig et al. 2005) (Figure 11-2), and south central British Columbia (Bjork 2007). Fertig et al. (2005) assessed 53 populations (encompassing 272–317 ha [674–784 acres] of habitat) as extant across the range of the species; the British Columbia locations were discovered the following year (Bjork 2007). According to Fertig et al. (2005), Utah had the most populations (23), the largest amount of occupied habitat (94.7–124.6 ha [234–308 acres]), and the highest number of reported plants (47,859 individuals) of any state. The Spanish Fork watershed in Utah was assessed as having the highest recorded population estimate (28,825 plants), whereas the Upper Green-Flaming Gorge Reservoir population (which spans the Colorado-Utah border) spanned the most extensive area (47 –51 ha

[117–126 acres]). The majority of known populations (66%) occupied between 0.04 and 4 ha (0.1 and 10 acres), whereas relatively few (4.9%) occupied more than 20.2 ha (50 acres).

Figure 11-2. . Ute ladies'-tresses in the western United States (Source: Fertig et al. 2005, p. 11)

11.2.4 Life History and Population Dynamics

Ute ladies'-tresses is a long-lived perennial herb that is thought to reproduce exclusively by seed (Fertig et al. 2005). Bees are the primary pollinators; however, because Ute ladies'-tresses provides only nectar as a food reward, other pollen-providing plant species must be present to attract and maintain pollinators (Sipes and Tepedino 1995; Sipes et al. 1995; Pierson and Tepedino 2000).

The life cycle of Ute ladies'-tresses consists of four main stages—seedling, dormant, vegetative, and reproductive (flowering or fruiting) (Fertig et al. 2005). Based on studies on other terrestrial orchids (Wells 1981), it has been hypothesized that Ute ladies'-tresses seedlings may develop slowly into larger, dormant mycorrhizal roots or grow directly into aboveground vegetative shoots, but neither has been confirmed in the wild. The Cincinnati Zoo and Botanical Garden have grown plants from seed under laboratory and greenhouse conditions; germination took 6–8 months and development from a protocorm into a plant was slow (Pence 2009). Long-term demographic monitoring studies indicate that vegetative or reproductive Ute ladies'-tresses plants can revert to a belowground existence for as many as four consecutive growing seasons before reemerging above ground (Arft 1995; Allison 2001; Heidel 2001).

Flowering individuals are necessary to reliably distinguish Ute ladies'-tresses from other similar-looking plant species (especially other *Spiranthes* species), and surveys during flowering season maximize the likelihood of detecting Ute ladies'-tresses among dense stands of other herbaceous plant species. However, surveys in which only flowering stems are tallied are of limited value for assessing population trends, given that individual Ute ladies'-tresses plants do not flower consistently from one year to the next, and the relative proportion of individual Ute ladies'-tresses plants in each of the four life stages (seedling, dormant, vegetative, reproductive) can vary widely within and between years and between different colonies (Arft 1995; Pierson and Tepedino 2000; Allison 2001; Heidel 2001; Fertig et al. 2005). Both Arft (1995) and Heidel (2001) conclude that population trends are less variable when inferred from datasets in which all life stages are counted. However, because nonreproductive individuals are inherently difficult and laborious to detect, most surveys tend to focus on the detection (and counting) of flowering individuals (Fertig et al. 2005). As a result, knowledge of Ute ladies'-tresses population trends is severely hindered; available estimates (derived solely from flowering stem counts) are likely to represent conservative estimates of total population size.

With these and other caveats (discussed further in Fertig et al. 2005) in mind, the following statements can be made regarding rangewide abundance and trends in Ute ladies'-tresses. When the species was listed under the ESA in 1992, the rangewide population was estimated to contain fewer than 6,000 individuals (USFWS 1992a). In 1995, the draft recovery plan increased this estimate to 20,500 individuals, primarily because 21 new populations that were discovered over the previous 3 years (USFWS 1995). As of 2005, Fertig et al. estimated 53 populations to collectively contain more than 80,000 (83,316) individuals (Fertig et al. 2005). For these populations, available population estimates ranged in size from 1 to more than 28,000 plants. More than 80% of these populations contained fewer than 1,000 individuals; 38% contained fewer than 100 individuals.

11.2.5 Habitat

When Ute ladies'-tresses was listed in 1992, it was known primarily from sub-irrigated moist meadows on terraces, floodplains, and depressions bordering perennial streams at elevations between 1,310 and 2,090 meters (m) (4,300 to 6,850 feet) (Jennings 1989; Coyner 1990; USFWS 1992a). All remaining populations occurred within agricultural or urban settings, and were presumed to represent relict populations that had persisted only where conditions had yet not been rendered unsuitable for the species as a result of human activity (Jennings 1989; USFWS 1992a).

Surveys since 1992 have documented the species in several additional vegetation and landform types, including seasonally flooded river terraces, sub-irrigated or spring-fed abandoned stream channels and valleys, and lakeshores (Fertig et al. 2005). Numerous populations also have been discovered along irrigation canals, behind berms, within abandoned roadside borrow pits, and along reservoir edges and other human-created or modified wetlands. Across the range of the species, populations are now known to occur at elevations ranging from 220–558 m (720–1,830 feet) in Washington and British Columbia to 2,134 m (7,000 feet) in northern Utah.

Most Ute ladies'-tresses sites have midsuccessional vegetation (well-established grasses and forbs) communities. This vegetation structure and composition was likely maintained historically by flooding, grazing, fire, and other episodic disturbances accompanied by soil and hydrology characteristics not conducive to shrub and tree invasion (Heidel 1998; Moseley 2000; Murphy 2001). Today, historical disturbance regimes have usually been replaced or are augmented by livestock grazing, mowing, ditch and irrigation maintenance, prescribed fire, and other human activities (Allison 2001; Fertig et al. 2005). Ute ladies'-tresses may persist for some time in the grassy understory of woody riparian shrublands, but does not appear to thrive under these conditions (Ward and Naumann 1998).

Nearly all streambank, floodplain, and abandoned oxbow sites have a high water table (usually within 12.5–45 cm [5–18 inches] of the surface) augmented by seasonal flooding, snowmelt, runoff, and often irrigation (Jennings 1989; Arft 1995; Black et al. 1999; Riedel 2002). Along the Snake River in Idaho, Moseley (2000) found that depth to water table averaged somewhat deeper (60 cm [23.6 inches]), but ranged from 1–110 cm (0.39–43.3 inches). In studies along the Green River in Colorado and Utah, Ward and Naumann (1998) found that soils had to be sufficiently stable and moist in the summer flowering season to support the species. Sites located in springs or sub-irrigated meadows appear to be fed by groundwater rather than surface flows; less is known about the average depths to groundwater in these locations, but it is reasonable to assume that (as with locations where groundwater depths have been quantified) groundwater must remain relatively close to the surface in order to sustain the moist soils consistently associated with Ute ladies'-tresses.

11.2.6 Threats to the Species

At listing, the Service identified habitat loss and modification as the primary threat to the species, but also noted that small population sizes and low reproductive rates rendered Ute ladies'-tresses vulnerable to other threats (USFWS 1992a). Our listing rule identified several specific forms of habitat loss and modification as threats to Ute ladies'-tresses, including urbanization, water development and conversion of lands to agriculture, excessive livestock grazing, excessive or inappropriate use of herbicides or other chemicals, and the proliferation of invasive exotic plant species. In addition, we expressed concerns that the species may be subject to over-collection, given its status as an orchid and inquiries from orchid enthusiasts and wildflower collectors. We characterized existing regulatory mechanisms as inadequate to ensure the long-term persistence of Ute ladies'-tresses, given these threats.

Fertig et al. (2005) provide the most recent, rangewide evaluation of threats to Ute ladies'-tresses, including new threats identified since the species was listed. These authors quantified the number and percentage of populations and individuals affected by each threat identified during their review; their tabular summary is depicted in graphical format in Figure 11-3. These authors note that whereas over-collection had not materialized as a specific threat to Ute ladies'-tresses, vegetation succession and losses or reductions in pollinators appeared to be new threats (although they characterize pollinator availability as more of a potential threat). Their synthesis identifies the most pervasive threats as competition from invasive species, vegetative succession, road and infrastructure construction, and changes in hydrology.

Given the nature of the proposed action that is the subject of this consultation, the specific threat of changes in hydrology warrants further mention. Fertig et al. (2005) identify the following human activities as specifically contributing to altered hydrologic regimes across the species' range: conversion of irrigation water to municipal use, flood control, water development or redevelopment (especially water diversion projects), and restoration projects targeting stream and riparian corridors. These authors assessed 21% of known populations, containing 52% of known individuals, as threatened by one or more of these sources of altered hydrology. Their account implicates the net loss of irrigation water within the Utah Lake watershed in the decline of populations within that portion of the species' range, and anticipates future threats to the Panaca Valley population of Ute ladies'-tresses from growing demand for water within the city of Las Vegas.

However, as also acknowledged by Fertig et al. (2005), Ute ladies'-tresses has proliferated in areas with greatly altered, but stable and predictable hydrology. Prominent examples include the Green River along the Colorado–Utah border (Ward and Naumann 1998); Diamond Fork Creek in the Spanish Fork watershed of Utah (Black and Gruwell 2004); the Columbia River in Washington (Cordell-Stine and Pope 2008); and the South Fork Snake River in Idaho (Idaho Conservation Data Center 2007). The species is also frequently encountered along streams and canals and in wet hay pastures in the Uinta Basin of eastern Utah, even though an extensive irrigation canal system was constructed in the early 1900s and natural streams are nearly dry all summer (Fertig et al. 2005; Kendrick 1989). Ute ladies'-tresses has colonized wetlands left behind when peat was mined, and also occurs in drainage ditches alongside roads and railroad tracks (Fertig et al. 2005). In summer 2012, the species was rediscovered in Salt Lake County, Utah, after decades of unsuccessful attempts to relocate an historical collection of the species in this County dating from 1953. The County property on which the orchid was recently found has been managed as a flood control basin with permitted horse grazing for the past 50 years.

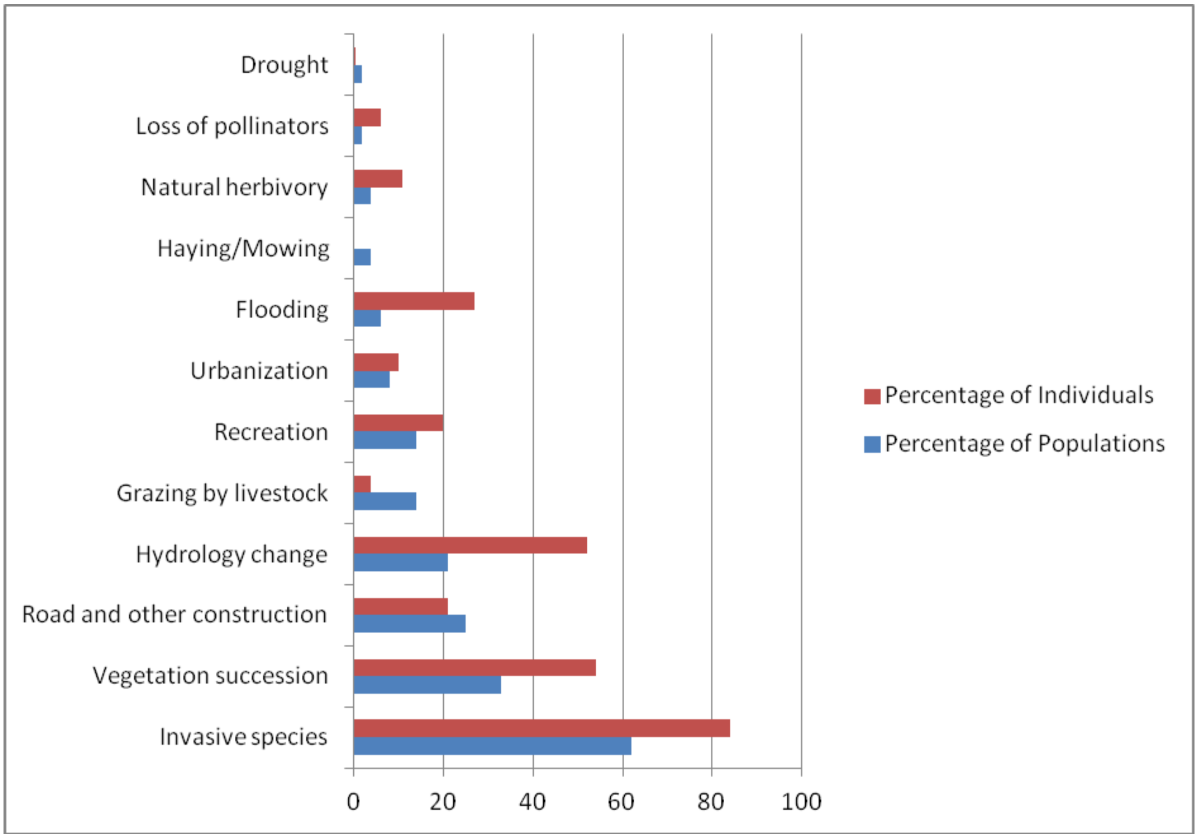

Figure 11-3. Threats to Ute ladies'-tresses. Quantified as a percentage of known populations and known individuals, based on the maximum count ever reported for all subpopulations comprising a given population. (Source: Fertig et al. 2005, p. 81).

In summary, when Ute ladies'-tresses was listed in 1992 the species was thought to remain in a mere 10 populations within 2 states, with a rangewide population estimate of 6,000 individuals (USFWS 1992a). The small number and size of these remaining populations suggested high vulnerability to threats, and supported the assumption that the species was persisting in those few remaining locations where threats were less severe. Since listing, the species has been verified extant at more than 50 populations distributed across 8 U.S. states and 1 Canadian province; these populations collectively contain some 80,000 individuals. Approximately 80% of known populations are associated with lands managed for agriculture or recreation, rivers regulated by dams, or other human-modified habitats (Fertig et al. 2005). Research, monitoring, and management activities have demonstrated that ongoing patterns of land use across the range of the species are capable of mimicking or providing the conditions required for the species' persistence; these observations indicate that the species is considerably less threatened with extinction than when originally listed in 1992.

11.2.7 Conservation Needs

The draft recovery plan for Ute ladies'-tresses identifies the following recovery objectives (USFWS 1995):

- Obtaining information on life history, demographics, habitat requirements, and watershed processes that will allow specification of management and population goals and monitoring progress
- Managing watersheds to perpetuate or enhance viable populations of the orchid
- Protecting and managing Ute ladies'-tresses populations in wet meadow, seep, and spring habitats

Since listing, our knowledge of this species' life history, demographic patterns, and habitat requirements has improved considerably from research and management activities. Long-term monitoring efforts have revealed a tendency for substantial year-to-year fluctuations in flowering steam counts; by contrast, those few efforts to monitor all life stages (seedling, dormant, vegetative, reproductive) suggest that populations not otherwise subject to ongoing habitat loss or degradation may be relatively stable when all individuals within the population are considered. These observations, accompanied by a near 5-fold increase in the number of known populations and the considerable increase in geographic distribution (having been discovered in six additional U.S. states and one Canadian province), suggest that less aggressive effort may be needed to ensure the long-term viability of the species than that envisioned in the species' draft recovery plan.

Additional observations provide insight as to where the remaining conservation effort may need to be focused, at least in the near term. Across the species' range, the largest and seemingly more resilient populations are those associated with larger riparian corridors. Noteworthy examples include populations associated with Boulder Creek in Colorado, the Green River in Colorado and Utah, Diamond Fork Creek and the Uintah River in Utah, and the Snake River in Idaho. These relatively few, but notably large populations comprise the overwhelming majority of known individuals. The species has persisted for decades in these watersheds despite the existence of dams, diversions, and other sources of hydrologic alteration; however, for reasons discussed above, quantitative population trends are not appreciably more certain in these locations than elsewhere across the species' range. By contrast, populations associated with springs and nonriparian wetland habitats are inherently small (in terms of acreage and number of individuals), characterized by large amounts of edge habitat relative to core area, geographically fragmented, and more prone to fluctuate between being reported as present or absent in any given survey. While the resiliency of larger, riparian populations is far from assured given the inherent scarcity of water in the intermountain west and the compounding effects of accelerated climate change, observations over the past several decades suggest that the species' persistence may be even less certain in smaller, more fragmented populations occurring in isolated wetlands associated with springs, or other areas containing suitable hydrologic conditions for the species.

11.3 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR §402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed federal projects in the action area that have already undergone section 7 consultations and the impacts of State and private actions that are contemporaneous with the consultations in progress.

11.3.1 Status of the Species in the Analysis Area

The action area addressed by this consultation lies within the Great Basin and Range Physiographic (GBR) Province. Within this Province, the southern one-third of the project occurs within the Mojave Desert, whereas the northern two-thirds of the project is located within the Great Basin Desert. Ute ladies'-tresses is not currently known from the Mojave Desert and the Service regards the species as unlikely to occur there. By contrast, the species is known from two locations in the Great Basin Desert (Figure 11-2) both of which are located within the action area recognized by the Service (Figure 3-1) and specifically the Ute ladies'-tresses analysis area (Figure 11-1). One of these two locations (Willow Springs) is situated toward the northern portion of the action area, in Tooele County, Utah, near the town of Callao, in Snake Valley. The second location (Panaca Spring) is located in the middle portion of the action area, in Lincoln County, Nevada, near the town of Panaca, in Panaca Valley. These populations were both known but assessed as historical (no longer extant) at the time of listing, but subsequently rediscovered in 1994 (Callao, Utah) and 2005 (Panaca, Nevada). The population at Panaca represents the only known occurrence of the species in Nevada. Although the Callao, Utah, population at Willow Springs has not been resurveyed since its rediscovery in 1994, the Service has no information to suggest that this population has since been extirpated, and thus presumes it to be extant. The Panaca Springs population is also extant, and was last observed in 2012. As noted by others (Fertig et al. 2005), Ute ladies'-tresses may have historically occupied more sites within the Great Basin prior to the widespread conversion of springs and spring-fed wetlands to other uses (especially agriculture); however, the historical distribution of Ute ladies'-tresses within this region will likely never be known.

Given that the GBR Province is at the periphery of the known distribution of Ute ladies'-tresses (Figure 11-2), the Service does not regard it as likely that a substantial number of occurrences or individuals exist within the action area. However, the considerable expansion in the species' known range since it was listed in 1992 reveals that the habitat conditions required by Ute ladies'-tresses exist across a larger geographic area than previously assessed; as a result, the presence of the species within the action area cannot be ruled out on the basis of geography alone.

Across its range, Ute ladies'-tresses occurs in a variety of wetland and riparian habitats, including spring-fed wetlands and sub-irrigated meadows, perennial stream corridors, riverbanks, floodplains, and lakeshores. Both of the known locations for Ute ladies'-tresses in the Great Basin Desert are characterized as spring-fed wetlands (Fertig et al. 2005), indicating that at a minimum, other spring-fed wetlands in the analysis area have the potential to contain the species.

The Biological Assessment (BLM 2012a) identifies potential Ute ladies'-tresses habitat within Spring, Snake, and Hamlin valleys, based upon on-the-ground reconnaissance and targeted Ute ladies'-tresses surveys conducted by BIO-WEST in 2006 and 2007 (BIO-WEST 2007). BIO-WEST asserts that these locations were selected based upon their spatial distribution in these valleys relative to potential groundwater development activities and/or potential impacts. The reconnaissance surveys conducted by BIO-WEST evaluated the potential for a given site to support Ute ladies'-tresses, whereas targeted Ute ladies'-tresses surveys were intended to specifically determine whether or not Ute ladies'-tresses was present at a given site. While Ute ladies'-tresses was not observed at any of these sites, BIO-WEST assessed 17 sites as having moderate (12) or high (5) potential to support Ute ladies'-tresses. Fifteen sites were assessed has having a low potential to support Ute ladies'-tresses. A rating of "none" (meaning no potential) was not used; therefore, no sites surveyed by BIO-WEST were completely eliminated (by BIO-WEST) from further consideration as potentially suitable for Ute ladies'-tresses. These surveys were generally consistent with Service protocols for Ute ladies'-tresses surveys (USFWS 1992b and 2007), with the exception that they consisted of a single flowering-season survey whereas Service protocols recommend three years of survey effort, particularly for projects of larger geographic scope still in the planning stages (such as the proposed action that is the subject of this consultation). BIO-WEST acknowledges these caveats, and the resulting inability to rule out Ute ladies'-tresses (at these or other sites) on the basis of a single flowering season survey (BIO-WEST 2007, p. 4). The Service generally concurs with the methods and conclusions regarding these preliminary surveys as conducted and reported by BIO-WEST (2007), namely that the species has some potential to occur at the 32 sites surveyed. However, the Biological Assessment focuses upon these 32 surveyed sites, and does not analyze potential effects to additional areas that we have herein identified as potentially suitable ULT habitat.

Rather, the Service regards Ute ladies'-tresses as having a reasonable potential to occur within additional portions of the Service action area (Figure 3-2), specifically four hydrographic basins (Spring, Snake, Hamlin, and Panaca) in the Great Basin Desert portion of this area. As discussed in previous sections, two of these basins (Panaca and Snake) each supports an extant population of the species; the Biological Assessment indicates additional areas of potential habitat in Snake Valley (from which the species is known) as well as two other basins (Hamlin and Spring valleys) in which the species is not yet known to occur (BLM 2012a). As explained in the introduction to this chapter, Dry Lake and Patterson valleys have been included in the Ute ladies'-tresses analysis area because groundwater withdrawals occurring in Dry Lake Valley may propagate through Patterson Valley and ultimately affect conditions in Panaca Valley; Ute ladies'-tresses is not currently regarded by the Service as likely to occur in either Dry Lake or Patterson Valley. We are aware of no known occurrences of Ute ladies'-tresses or any reports of surveys suggesting the presence of potentially suitable habitat for the species in the remaining hydrographic basins associated with this consultation. Based upon these factors, these remaining basins have been excluded from the Ute ladies'-tresses analysis area and our evaluation of effects to the species.

Within Spring, Snake, Hamlin, and Panaca valleys, Ute ladies'-tresses would be associated with the same habitats in which it typically occurs elsewhere across its range, namely springs, spring-fed and other wetlands, and perennial stream corridors. Within these habitats, on-the-ground surveys represent the only reliable means of evaluating whether Ute ladies'-tresses habitat indicators or individuals of the species are actually present. The Service Utah Field Office has articulated this premise, along with specific guidance regarding suitable habitat conditions and other elements of adequate survey effort for section 7 purposes, in Ute ladies'-tresses -specific survey protocols issued in 1992 and 2007 (USFWS 1992b, 2007).

Because the Biological Assessment appears to limit its evaluation of Ute ladies'-tresses to the 32 sites surveyed by BIO-WEST (2007), we consulted the Final Environmental Impact Statement (FEIS) (BLM 2012b) and additional information sources regarding the presence of springs, spring-fed or other wetlands, or perennial stream corridors within Spring, Snake, Hamlin, and Panaca valleys. For the reasons above, we regard such habitats within the Ute ladies'-tresses analysis area as having some potential to contain Ute ladies'-tresses, unless and until they have been objectively determined to either lack suitable habitat for the species or fail to contain individuals of the species despite the presence of seemingly suitable habitat. As articulated in survey protocols from the Service Utah Field Office, the latter determination usually requires repeated flowering-season surveys (USFWS 1992, 2007).

Per Appendix F3.3, Table F.3.3.1 of the FEIS (BLM 2012b), Bureau of Land Management (BLM) identifies a total of 100 inventoried (meaning field-verified) springs in Hamlin (5 springs), Panaca (6 springs), Snake (37 springs) and Spring (52 springs) valleys. In considering only those sites surveyed by BIO-WEST (2007), the Biological Assessment restricts its evaluation of effects to Ute ladies'-tresses to less than 32% of the known springs within the four basins in which Ute ladies'-tresses is known to occur or the Service regards the species as potentially present. The FEIS (Figure 3.3.1-3, p. 3.3-6) also acknowledges an unstated number of additional, uninventoried (*i.e.*, not field-verified) springs in Hamlin, Panaca, Snake and Spring valleys. A portion of these springs are perched mountain block springs which, as discussed in Chapter 3, are not likely to be affected by pumping-induced groundwater drawdown from the proposed action. Because all springs have not been field-verified, their actual existence and status as a surface water feature has not yet been determined; however, without additional information, they should not be eliminated from further consideration as potential Ute ladies'-tresses habitat.

Although present (or potentially present) in the Ute ladies'-tresses analysis area (which we have defined by hydrographic basin boundaries), we do not necessarily expect all these springs to be affected by the proposed action. We evaluate whether, and to what degree, these areas of potential Ute ladies'-tresses habitat may be adversely affected by the proposed action in the section entitled *Effects of the Proposed Action*, below. The same distinction applies to the additional areas of potential Ute ladies'-tresses habitat identified in the following paragraphs.

Across its range, Ute ladies'-tresses also exists in wetlands not associated with springs as well as along perennial stream and riparian corridors. To the extent that such areas exist within the Ute ladies'-tresses analysis area, the potential of such habitats to support Ute ladies'-tresses must be evaluated. The FEIS indicates that hydric soils associated with surface water features such as wetlands, springs, seeps and riparian areas exist within Spring, Snake, Hamlin, and Panaca valleys (BLM 2012b). While not a sole indicator of Ute ladies'-tresses habitat, hydric soils (in conjunction with suitable hydrologic regime, vegetation composition and structure, and other factors) indicate areas with the potential to contain the larger set of habitat conditions suitable for the species. The FEIS identifies hydric soils on 10,832 ha (26,766 acres) in Spring Valley (FEIS, p. 3.4-29) and on 42,641 acres in Snake Valley; this document does not indicate the presence and extent of hydric soils within Hamlin or Panaca valleys. Thus, at least 10,832 ha (26,766 acres) in Spring Valley and 17,256 ha (42,641 acres) in Snake Valley have some potential to support Ute ladies'-tresses, although consideration of other factors (especially land cover and vegetation types occurring over these soils) would likely reveal many of these acres to be unsuitable for the species. Furthermore, not all of these acreages are within areas likely to be affected by pumping-induced groundwater drawdown from the proposed action (e.g., in perched mountain block habitats, or outside the area of potential groundwater drawdown or spring flow reduction). Because this assessment is not provided in the Biological Assessment or FEIS, we have no ability to rule out these acres as potential Ute ladies'-tresses habitat.

Finally, based on Figures 3.3.1-4 and 3.3.1-5 in the FEIS (BLM 2012b, pp. 3.3-14 and 3.3-19), there are at least 91 perennial streams in Spring (47) and Snake (44) valleys. Many of these perennial streams are intermittent or diverted once they reach the base of the mountain block. The number of perennial streams in Hamlin and Panaca valleys is not indicated in the Biological Assessment or FEIS, but supplemental information from BLM indicates that there are three perennial streams in Hamlin Valley and two in Panaca Valley (Styles 2012). The Biological Assessment does not acknowledge perennial streams within the action area as potential habitat for Ute ladies'-tresses (BLM 2012a).

We interpret the above information as indicating additional areas of potential Ute ladies'-tresses habitat within Spring, Snake, Hamlin, and Panaca valleys. Therefore, we consider these areas in our evaluation of effects to the species from the proposed action. However, as discussed in the "Effects of the Proposed Action" section, the various components of the proposed action differ in their potential to adversely affect Ute ladies'-tresses; therefore, the potential for adverse effects to Ute ladies'-tresses is not equally distributed across these potential Ute ladies'-tresses habitats occurring within the Ute ladies'-tresses analysis area.

11.3.2 Factors Affecting the Species in the Analysis Area

As noted above, Ute ladies'-tresses is currently known from two locations in the Ute ladies'-tresses analysis area, and has a reasonable potential to occur in additional areas (e.g., springs, groundwater-fed wetlands and perennial streams) in Spring, Snake, Hamlin, and Panaca valleys.

We find no reason to expect that the factors affecting or potentially affecting Ute ladies'-tresses within the analysis area are appreciably different than those influencing the status of this species across its range. BIO-WEST (2007, Table 1) qualitatively noted apparent patterns of disturbance at the 32 sites they surveyed, listing grazing, herbivory, stream incision and channelization, and the construction of berms or roads as existing or potential threats at these locations. These characterizations by BIO-WEST lend support to the Service's assumption that threats within the analysis area are at least coarsely representative of the suite of threats previously identified elsewhere across the range (summarized most recently in Fertig et al. 2005). While surface water diversions and groundwater pumping may be affecting potential Ute ladies'-tresses habitat within the analysis area, because Ute ladies'-tresses is not yet known from these areas, we have no information to inform an analysis of the effects that these factors may actually be having upon the species within this area.

11.3.3 Recent Section 7 Consultations

There have been no prior section 7 consultations evaluating effects to Ute ladies'-tresses within the Ute ladies'-tresses analysis area, nor have there been any prior section 10 permits authorized for Ute ladies'-tresses within this area.

11.4 EFFECTS OF THE PROPOSED ACTION

11.4.1 Analysis Approach

As described in previous sections, our analytical approach for Ute ladies'-tresses deviates substantively from the Biological Assessment, which we regard as underestimating the potential for Ute ladies'-tresses to occur within the action area and similarly the potential for the proposed action to adversely affect this species. More specifically, we define the action area to encompass the two known Ute ladies'-tresses occurrences in Panaca and Snake valleys, and regard the 32 sites identified as potential Ute ladies'-tresses habitat in the Biological Assessment (BLM 2012a, Figure 4-10) as a subset of the potential Ute ladies'-tresses habitat within the action area. Unless and until the presence of Ute ladies'-tresses is ruled out by field surveys or consideration of other factors (such as patterns of land use or hydrology), we regard the remaining springs, spring-fed or other wetlands, and perennial stream corridors within Spring, Snake, Hamlin and, Panaca valleys as potential Ute ladies'-tresses habitat for purposes of this and subsequent consultations regarding this proposed action.

Regulations pursuant to section 7 of the Act define effects of the action as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR § 402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Indirect effects are defined as those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

For our effects analysis, we have examined the potential for Ute ladies'-tresses to be directly or indirectly affected by implementing the proposed action, and if so, the likely nature of these effects. As described in Chapter 1, the Service is conducting a programmatic-level analysis of the overall Groundwater Development (GWD) Project with a project-specific analysis for the first stage (Tier 1 ROW), which is BLM's issuance of a right-of-way (ROW) for the main pipeline and associated facilities. The effects of future facilities and groundwater pumping for development purposes, including the long-term effects of groundwater pumping, are the subject of the programmatic analysis of this Opinion.

For listed species that may be affected by groundwater pumping, two types of analyses were conducted. First, we evaluated the potential for hydrologic impacts to groundwater-dependent ecosystems of interest within the timeframe of the analysis (75 years after full build out, plus a 100-year recovery period) and if possible, we attempted to describe the nature of these effects while recognizing the high level of uncertainty regarding magnitude and timing of impacts. This analysis is presented in detail in Chapter 7. The results of the hydrologic analyses were then used to inform the biological analyses for each species, the results of which are presented in each of the species-specific chapters (Chapters 9–15). At the biological level, the nature of potential effects specific to groundwater withdrawal are described conceptually because we do not know the precise nature, magnitude, and extent of hydrologic impacts and we do not know the precise response of habitat features, individual animals, and populations of listed species to declines in groundwater levels and decreased discharge. We used this conceptual understanding of ecological response to hydrologic (e.g., flow) change, together with our determination of the likelihood of hydrologic change, to decide if a jeopardy or adverse modification situation potentially exists for each species.

11.4.2 Applicant Committed Measures and Bureau of Land Management Mitigation Measures Relevant to Ute Ladies'-tresses

As discussed in Chapter 2, Southern Nevada Water Authority (SNWA) has committed measures (Applicant Committed Measures [ACMs]) to avoid, minimize, and mitigate adverse effects to listed species, including Ute ladies'-tresses. Additionally, BLM has identified Best Management Practices (BMPs) that apply to the GWD Project and will be requiring additional mitigation identified through the National Environmental Policy Act (NEPA) process. As discussed in earlier chapters (e.g., Chapters 2 and 5) and per BLM's request, we are assuming that all BLM-proposed mitigation measures in the FEIS that are within BLM's authority will be brought forward to the Record of Decision, and those measures relevant to Tier 1 will become terms and conditions of the Tier 1 ROW permit.

The complete set of ACMs, BMPs, and BLM mitigation measures associated with the proposed action are presented in detail in the FEIS (BLM 2012b). Below we only discuss those measures that are likely to avoid or minimize adverse effects to Ute ladies'-tresses otherwise likely to result from the proposed action. We refer the reader to BLM (2012a) for more information.

11.4.3 Applicant Committed Measures

The SNWA has identified a suite of potential environmental protection measures that may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to water resources associated with SNWA's groundwater pumping (SNWA 2012a). These measures are presented in full in Section C (Regional Water-Related Effects) of BLM (2012a). Measures likely to avoid or minimize adverse effects to Ute ladies'-tresses are presented below.

11.4.3.1 Applicant Committed Measures Specific to Tier 1 and Future Rights-of-way

The Biological Assessment identifies the following generic (i.e., not species-specific) ACMs as indirectly avoiding or minimizing adverse effects to Ute ladies'-tresses from construction-generated dust, excessive traffic outside of established roads or ROWs, chemical or other spills, and wildfire:

- A.1.3
- A.1.11
- A.1.28 through A.1.37
- A.1.43 through A.1.46
- A.10.1 through A.10.8
- A.1.47

Numerous ACMs pertaining to sensitive plant species (such as Ute ladies'-tresses) from the FEIS were inadvertently omitted from the Biological Assessment (Styles 2012). The BLM has confirmed that these ACMs would be applicable to Ute ladies'-tresses for purposes of this consultation and project implementation, and would therefore serve to avoid or minimize adverse effects to the species in locations where it is known to be present. These ACMs are below.

Sensitive Plant Species within Future Rights-of-way

A.5.9 In areas where sensitive plant species were identified in previous surveys either within or adjacent to the ROW, preconstruction surveys will be conducted during the blooming or fruiting season as needed to verify plant identification. Specific locations of sensitive plants, based on the BLM sensitive plant list in effect at the time, will be recorded for subsequent salvage or seed collection.

A.5.10 SNWA will adjust construction activities as feasible to avoid any identified sensitive plant populations within the ROW. Orange snow fencing will be used to mark the avoidance area, including a reasonable buffer, alerting construction personnel to avoid the area. The onsite Environmental Compliance Representative will ensure these areas are properly monitored and protected. When individual sensitive plant locations are known (coordinates have been surveyed with GPS equipment) prior to construction drawings being prepared, the sensitive plants will be included in the construction drawings.

A.5.11 If the sensitive plant species cannot be avoided, SNWA will implement plant or seed salvage prior to the start of construction. Seeds will be collected from sensitive plants that are located within the ROW. Collection, storage, and handling of seeds will be in accordance with commonly accepted scientific practices. Collected sensitive plant seed will be applied with the seeding program as part of restoration at the completion of construction, and in the same general area as the seeds were initially collected, as appropriate.

A.5.12 If previously unknown special status plant species are discovered within the ROW prior to start of construction, SNWA will consult with the BLM on appropriate plant and/or seed salvage.

A.5.13 If federal or State protected plant species are discovered within the ROW during construction, the on-site biological monitor will have the authority to temporarily halt nonemergency construction activities in order to mark the area with orange snow fencing, including a reasonable buffer, to alert construction personnel to avoid the area or allow time for SNWA to consult with the BLM on appropriate plant and/or seed salvage.

A.5.14 SNWA will avoid exclusion areas created for sensitive plants when spraying herbicides.

11.4.3.2 Applicant Committed Measures specific to Groundwater Development

The following ACMs pertain the selection of site locations and routes for facilities associated with groundwater pumping for development:

ACM B.1.1 Groundwater production well sites will be selected considering

- proximity to main and lateral pipelines;

- proximity to existing roads or utility corridors;
- suitable hydrogeologic conditions, including well yield, groundwater drawdown, and groundwater chemistry, based upon exploratory drilling;
- adequate well spacing;
- avoidance of springs, streams, and riparian/wetland areas;
- avoidance of cultural resources sites eligible for the National Registry of Historic Places; and
- the presence of special status species and their habitat.

ACM B.1.3 Collector pipeline, distribution power line, and secondary substations will be sited, as feasible

- along existing roads or other utility alignments;
- avoiding springs, streams and riparian/wetland areas;
- avoiding cultural resources sites eligible for the National Registry of Historic Places; and
- considering the presence of special status species and their habitat.

The SNWA has prepared a Conceptual Adaptive Management (AM) Framework for consideration at the programmatic level, which can be found in the last section of the ACMs (SNWA 2012a). This framework provides examples of measures that may be considered and implemented through the AM process to address groundwater pumping impacts. Specific criteria for implementing AM measures will be developed as part of future site-specific AM plans (SNWA 2012a). Potential AM mitigation measures that are or could be relevant to Ute ladies'-tresses include the following:

ACM C2.1 In accordance with the [Spring Valley and DDC] Stipulations and any future water right rulings, implement actions to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special status species, such as: (1) geographic redistribution of groundwater withdrawals; (2) reduction or cessation in groundwater withdrawals; (3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and (4) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range.

ACM C2.15 Modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. This modification could be accomplished by changing crop production to a less water-intensive type or changing watering cycles, and then diverting the saved water to the wet meadow areas.

11.4.3.3 APPLICANT COMMITTED MEASURES: Other considerations

The Biological Assessment also characterized the following ACMs as serving to avoid or minimize adverse effects to Ute ladies'-tresses, when in fact these measures are unlikely to serve this function. According to subsequent communications from BLM, the inclusion of these ACMs was in error, and these measures should not be regarded as applicable to Ute ladies'-tresses (Styles 2012):

- C.1.42 (this measure applies to Delamar, Dry Lake and Cave valleys where Ute ladies'-tresses is not expected to occur)
- C.2.6, C.2.16, C.2.18 (these measures apply to spring snails and other species)

11.4.4 Bureau of Land Management Mitigation Measures

The BLM has identified additional mitigation measures through the NEPA process; these are presented in Chapter 3.20 (Monitoring and Mitigation Summary) in the FEIS (BLM 2012b). Mitigation measures for future groundwater development and pumping are general in nature because they are based on the programmatic-level NEPA analysis. These general measures apply to future GWD Project activities, but will be replaced by more specific measures resulting from future tiered NEPA analyses (BLM 2012b). Below, we summarize those components of the BLM mitigation measures that may either directly or indirectly serve to avoid or minimize adverse effects to Ute ladies'-tresses, and are within BLM's jurisdiction.

11.4.4.1 Groundwater Withdrawals for Hydrostatic Testing (Tier 1 and Future Rights-of-way)

ROW-WR-3: Construction Water Supply Plan. A construction water supply plan will be provided to the BLM for approval prior to construction. The plan will identify the specific locations of water supply wells (whether existing or new) that will be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; identify reasonable measures to reuse or conserve water; and identify any additional approvals that may be required. The BLM will review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. The SNWA will provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. The BLM, in consultation with State agencies and the grazing permittee, will review the location of any newly constructed water wells and determine if any will be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to benefit the BLM for multiple use management, the BLM will work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s). The BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. At locations of potential habitat, but where species occurrence has not yet been determined, surveys will be conducted in accordance with appropriate protocol prior to approving the plan. The construction water supply plan will be a component of the SNWA Plan of Development (POD). Prior to approval of the POD, the BLM will coordinate with the Service regarding portions of the POD relating to their regulatory role under the ESA. This process will be used to determine if there would be adverse impacts to listed species or adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary.

11.4.4.2 Groundwater Development

The following measure is proposed to avoid or minimize adverse impacts to Ute ladies'-tresses habitat that may result from future groundwater development and pumping for production:

GW-VEG-2: ***Monitoring within Ute Ladies'-tresses Habitat.*** In concert with GW-WR-3, and on BLM lands, biological and hydrologic monitoring will be required for Ute ladies'-tresses groundwater-dependent habitats in areas that may be affected by groundwater pumping.

The BLM also includes the following additional monitoring and mitigation measures that may indirectly avoid or minimize adverse effects to Ute ladies'-tresses habitat from future groundwater development and pumping activities:

GW-WR-1: ***Spring Inventories:*** Inventories will be conducted in all groundwater development areas to verify and map the location of all springs prior to construction. Construction and development of the groundwater development areas would avoid ground disturbance in the vicinity (i.e., 0.8 kilometer (km) [0.5 miles]) of all verified spring locations.

GW-WR-3a: ***Comprehensive Water Resources Monitoring Plan*****:** Prior to any project pumping in Spring, Delamar, Dry Lake, or Cave valleys, the SNWA would develop a comprehensive water resources monitoring plan (WRMP). This plan has a number of purposes and associated requirements that are too lengthy to list here, but may be found in the FEIS (BLM 2012b, Table 3.20-1).

GW-WR-3b: ***Numerical Groundwater Flow Modeling Requirements*****:** The regional model would be updated and recalibrated at least every 5 years (after pumping is initiated) or sooner if the BLM identifies major differences between the model simulations and monitoring results (GW-WR-3a) and determines that model recalibration is necessary. In addition, the SNWA would develop more detailed (local scale) groundwater flow models designed to simulate the effects of pumping within each specific basin. This measure contains numerous additional requirements related to regional and local modeling that are too lengthy to list here, but may be found in the FEIS (BLM2012b, Table 3.20-1).

GW-AB-1: ***Avoid Disturbance to Springs*****:** Direct disturbance to springs and wetlands with known special status aquatic species in Spring and Snake valleys will be avoided by establishing a 0.8-km (0.5-mile) buffer around these areas.

GW-AB-2: ***Avoid Disturbance to Streams*****:** Wells, new roads, or other linear facilities will not be located within 0.8 km (0.5 miles) of, or parallel to, perennial streams and riparian areas with known special status aquatic species.

11.4.5 Potential Effects to Ute Ladies'-tresses

Our effects analysis in this section is organized by tiers and summarized in Table 11-1.

Table 11-1. Project components and their relative potential to adversely affect Ute ladies'-tresses within the analysis area

Basin	Status of Ute ladies'-tresses within the Basin	Potential for project-related adverse effects to Ute ladies'-tresses		
		Tier 1 activities	Future facilities	Groundwater Pumping for Development
Hamlin Valley	Potential	No	No	Yes
Panaca Valley	Known	No	No	Yes
Snake Valley	Known	No	No	Yes
Spring Valley	Potential	Yes	Yes	Yes

11.4.5.1 Tier 1 Infrastructure and Activities

Ground-disturbing activities associated with the construction and maintenance of main and lateral pipelines, construction staging areas, construction support areas, plant nursery sites, construction camps, borrow pits, power facilities (including sub-stations), pumping stations, regulating tanks, pressure reducing stations, storage reservoirs, water treatment facilities, and access roads have the potential to adversely affect Ute ladies'-tresses if the species is present where these activities occur. Blasting and hydrostatic testing activities also have ground-disturbing components and the potential to adversely affect the species if the species is present within the vicinity. For this analysis, we assume that these activities and their effects will be confined to the Tier 1 ROW. We evaluate these potential effects to Ute ladies'-tresses below.

Two additional types of activities associated with Tier 1 ROW infrastructure—groundwater withdrawals for hydrostatic testing, dust control, pipe bedding, and trench backfill compaction (herein collectively regarded as groundwater withdrawals for construction purposes) and vegetation management, specifically the use of chemicals to control noxious weeds—could potentially adversely affect Ute ladies'-tresses *outside* of the Tier 1 ROW boundary, if the species is present within habitats affected by these activities. Groundwater withdrawals for construction could originate at wells located within the ROW, or from pre-existing wells located outside of the ROW but within the larger groundwater development areas associated with the proposed action. In either case, depending on the location of wells and the volume of water pumped for these purposes, these withdrawals could affect groundwater levels within and/or beyond the ROW boundary, which could adversely affect areas that could contain Ute ladies'-tresses. Vegetation management activities would be confined to the ROW boundary, but chemical drift could extend beyond the ROW boundary and adversely affect potential Ute ladies'-tresses habitat (or the species if present). We also evaluate the likelihood of these effects to Ute ladies'-tresses below.

The Biological Assessment states that Tier 1 activities will have no effect on Ute ladies'-tresses because these activities have been routed to avoid areas of potential habitat for the species (BLM 2012a, Figure 4-10) In addition, the Biological Assessment notes that 32 sites were surveyed by BIO-WEST (2007). Because the Service regards these 32 sites as a subset of potential Ute ladies'-tresses habitat within the analysis area, the Service does not support the conclusion that Tier 1 activities will have no effect on Ute ladies'-tresses. To determine whether Tier 1 activities may adversely affect Ute ladies'-tresses, we evaluated whether Tier 1 activities may affect springs, spring-fed or other wetlands, or perennial stream corridors within the 4 hydrographic basins of the Service's Ute ladies'-tresses analysis area.

The anticipated locations for Tier 1 infrastructure and activities, as well as the spatial extent of ground disturbance (in acreage or miles, as appropriate), associated with Tier 1 ROWs are outlined in Tables 2-1 and 2-2 of this Opinion. According to the Biological Assessment, Tier 1 infrastructure and associated activities will only occur in Spring Valley, which is 1 of the 4 hydrographic basins containing known occurrences of Ute ladies'-tresses (Panaca and Snake valleys) or potential Ute ladies'-tresses habitat (Hamlin, Snake or Spring valleys). Therefore, Tier 1 activities only have the potential to affect Ute ladies'-tresses in Spring Valley, and only to the extent that potential habitat for the species (springs, wetlands, or perennial streams) may be affected by these project activities.

With regard to springs, the Biological Assessment does not state as to whether the Tier 1 ROW will cross or affect springs in Spring Valley (BLM 2012a). However, the FEIS states that no known springs occur within the disturbance footprint associated with the ROW and ancillary facilities (BLM 2012b). According to the BLM, this statement reflects consideration of both field-verified and uninventoried (not yet field verified) springs (Styles 2012).

Field-verified wetland delineations have not been conducted for Spring Valley, yet wetlands within the Service's analysis area have the potential to contain Ute ladies'-tresses. To assess the presence of wetlands that may be located within and affected by Tier 1 ROW activities, we consulted the FEIS (BLM 2012b) and National Wetland Inventory (NWI) maps (USFWS 2010). Specifically, we examined the FEIS for characterizations of land use/cover classification data, associated efforts to map phreatophytic vegetation, and hydric soil data within Spring Valley. Section 3.4 (Soils) of the FEIS indicates that hydric soils do not occur within the disturbance footprint of the Tier 1 ROWs (BLM 2012b, Table 3.4-4). Because hydric soils are defined in the FEIS by their association with surface water features such as wetlands, springs, seeps, and riparian areas, we considered the lack of these soils as evidence that wetlands are not found within the ROW. Section 3.5 (Vegetation) of the FEIS also indicates that areas classified as wetland/meadow vegetation are not crossed by Tier 1 facilities (BLM 2012b, Figures 3.5-3 and 3.5-4). Finally, we consulted NWI maps for the state of Nevada to determine whether the Tier 1 disturbance footprint may intersect with identified wetlands (USFWS 2010). We found no intersection. The SNWA has also asserted that the Tier 1 ROWs do not cross any aquatic or wetland areas (Marshall 2012) based on its review of a high-resolution Spring Valley plant community map (SNWA et al. 2011) and a land cover map for this valley (SNWA 2004).

With regard to perennial streams, the Biological Assessment states that none will be crossed by the pipeline (BLM 2012a, section 2.1.4.2). The FEIS reiterates this statement and also finds that the pipeline and power line ROW will not cross any perennial or intermittent stream reaches (BLM 2012b).

Based on the above considerations, we find it unlikely that potentially suitable habitat for Ute ladies'-tresses (springs, nonspring wetlands, or perennial streams) exists within the Tier 1 ROW, and we believe that Ute ladies'-tresses is unlikely to occur within the Tier 1 ROW.

With regard to Tier 1 activities that could create adverse effects extending beyond the ROW boundary (groundwater withdrawals for construction-related purposes and chemical drift from chemical applications within the ROW), the Biological Assessment, FEIS, and subsequent communications from BLM inform our assessment of this likelihood and whether or not such effects may adversely affect Ute ladies'-tresses. Conservation measure ROW-WR-3 requires the development and approval of a construction water supply plan, and BLM committed it will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Based on this commitment, we regard it as unlikely that groundwater withdrawals for construction purposes would adversely affect potential Ute ladies'-tresses habitat located outside of the ROW boundary. Similarly, with regard for the potential for adverse effects to Ute ladies'-tresses resulting from vegetation management activities occurring within the ROW to extend beyond the ROW boundary (primarily in the form of chemical drift from application within the ROW), we regard the BLM's BMP number 4 for noxious and invasive weed management) and BMP number 3 applicable to weed control in areas of special status species (BLM 2012b, Appendix D) as sufficient to reduce the potential for adverse effects to insignificant (unable to be meaningfully measured) or discountable (extremely unlikely to occur) levels.

11.4.5.2 Subsequent Tier Infrastructure Rights-of-way and Activities

Consistent with the discussion of Tier 1 activities above, Subsequent Tier ROWs infrastructure and associated activities involving ground disturbance within springs, nonspring wetlands, and perennial stream corridors within the Service's analysis area have the potential to adversely affect Ute ladies'-tresses, if present. Examples of ground-disturbing activities include the construction and maintenance of groundwater production wells, collector pipelines, additional pumping stations, distribution power lines, additional secondary substations, communications facilities, and hydroturbines and the long-term maintenance necessary to support the proposed project. Blasting and hydrostatic testing activities have ground-disturbing components and may occur in Subsequent Tier ROWs as well. For this analysis, we assume that Subsequent Tier infrastructure and activities will occur within the areas identified as groundwater development areas in the Biological Assessment (BLM 2012a, Figure 2-8). Because the Biological Assessment does not depict such activities in Snake, Hamlin, or Panaca valleys, we do not anticipate that Subsequent Tier infrastructure will be sited in these basins. However, the Biological Assessment indicates groundwater development areas in Spring Valley (BLM 2012a), where we have identified areas of potential Ute ladies'-tresses habitat (Figure 11-1).

Within Spring Valley, the Biological Assessment identifies several springs located within the groundwater development areas (S. Bastian Spring, East Cleve Creek Springs, and the West Spring Valley Complex) as potential habitat for Ute ladies'-tresses, but concludes that there will be no direct adverse effects to these habitats given the implementation of ACMs B.1.1 and B.1.3 (BLM 2012a). Because these ACMs do not represent absolute avoidance measures—these measures call for potential Ute ladies'-tresses habitat and/or known occurrences of the species to be *considered* and/or avoided where *feasible*—the Service does not regard these measures as an adequate basis upon which to support a conclusion that Subsequent Tier activities will have no direct effect on Ute ladies'-tresses. Thus, adverse effects to Ute ladies'-tresses remain possible within the areas of potential Ute ladies'-tresses habitat identified for Spring Valley in the Biological Assessment and habitat occurring in Spring Valley described in this Opinion (e.g., springs, nonspring wetlands, and perennial stream corridors).

BLM mitigation measure GW-AB-1 requires that the SNWA avoid direct disturbance to springs and wetlands in Spring and Snake valleys with known special status aquatic species by establishing a 0.8-km (0.5-mile) buffer around such areas. This measure requires the presence of Ute ladies'-tresses to be known in order to be avoided; as previously discussed, surveys to determine presence/absence of the species have yet to be conducted throughout those areas recognized as potential Ute ladies'-tresses habitat by the Service. Because the proposed action contains no conservation measure to require flowering-season surveys for Ute ladies'-tresses within these areas, we cannot be certain that measure GW-AB-1 will afford adequate protection to Ute ladies'-tresses within the Service's analysis area.

BLM mitigation measure GW-WR-1 requires conducting a spring inventory within groundwater development areas and implementing a 0.8-km (0.5-mile) construction buffer around these springs. Because this measure calls for avoidance of all springs, regardless of whether they are known to contain Ute ladies'-tresses, this measure should ensure that ground disturbance associated with Subsequent Tier infrastructure in Spring Valley will avoid springs that also may contain potential Ute ladies'-tresses habitat.

The FEIS (BLM 2012b, section 3.21.3.1) states that the final SNWA POD may include a wetland inventory within groundwater development areas (BLM 2012b). This inventory would improve knowledge of the locations in which wetlands are located within these areas, but would not in and of itself ensure avoidance of wetlands located within these areas or any subset of such habitats that may contain potential Ute ladies'-tresses habitat.

The Biological Assessment does not state whether perennial streams exist in future groundwater development areas, yet perennial stream also represent potential Ute ladies'-tresses habitat. The FEIS lists 23 perennial streams and associated mileage within groundwater development areas in Spring Valley under Alternative F (BLM 2012b). Many of these streams are perennial in the mountain block but intermittent or diverted once they reach the groundwater development areas. BLM mitigation measure GW-AB-2 requires the SNWA to avoid disturbing perennial streams known to contain special status species; however, as with measure GW-AB-1 above, measure GW-AB-2 requires the presence of Ute ladies'-tresses to be known in order to be avoided. We can find no evidence that perennial streams in the action area (specifically Spring Valley) have been surveyed for Ute ladies'-tresses, and the proposed action contains no commitment for flowering-season surveys within these habitats. Therefore, we cannot be certain that measure GW-AB-2 will avoid adverse effects to Ute ladies'-tresses. As noted earlier in this chapter, we regard there to be a reasonable potential for the species to be present but undetected in perennial stream corridors within Spring Valley.

The Biological Assessment states that surface disturbance activities near potential Ute ladies'-tresses habitat in Spring Valley could indirectly alter habitat or water quality from construction-generated dust, sedimentation, fuel spill risks, or accidental wildfire (BLM 2012a). The Biological Assessment concludes that these potential effects will be minimized by the following ACMs:

- A.1.3
- A.1.11
- A.1.28 through A.1.37
- A.1.43 through A.1.46
- A.10.1 through A.10.8

- A.1.47

We agree that these ACMs will minimize potential indirect effects to Ute ladies'-tresses that might otherwise result from these activities.

Groundwater withdrawals for hydrostatic testing, dust control, pipe bedding, and trench backfill compaction (i.e., groundwater withdrawals for construction-related purposes) have the potential to generate effects extending beyond the boundaries of the groundwater development areas (BLM 2012a, Figure 2-8), depending on the location of wells and the volume of water pumped for these purposes. As noted above in our evaluation of effects to Ute ladies'-tresses from Tier 1 ROW activities, measure ROW-WR-3 requires the development and approval of a construction water supply plan and BLM committed it will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Based on this commitment, we regard it as unlikely that groundwater withdrawals in support of construction would adversely affect potential Ute ladies'-tresses habitat located inside or outside of the ROW boundary.

Similarly, with regard for the potential for adverse effects to Ute ladies'-tresses from vegetation management activities occurring within the ROW to extend beyond the ROW boundary (primarily in the form of chemical drift from application within the ROW), we regard BLM's BMP number 4 for noxious and invasive weed management and BMP number 3, applicable to weed control in areas of special status species (BLM 2012b) as sufficient to reduce this potential for adverse effects to insignificant (unable to be meaningfully measured) or discountable (extremely unlikely to occur) levels.

11.4.5.3 Groundwater Withdrawal for Development Purposes

Groundwater pumping for development purposes that creates groundwater drawdown or reduces spring discharge in habitats containing Ute ladies'-tresses has the potential to adversely affect the species. Groundwater drawdown may limit the extent of soil saturation as the depth to groundwater (from the surface) increases. As soil moisture is lost, wetland species generally become less vigorous and less able to complete against upland species (BLM 2012b). The specific effects to Ute ladies'-tresses will depend upon the proximity and extent of reduced spring discharge and groundwater drawdown relative to the specific habitats with which this species is associated and Ute ladies'-tresses individuals occurring within these habitats. Effects of groundwater drawdown on Ute ladies'-tresses could range from gradual declines in the vigor or reproduction of individual plants to the mortality of individuals or loss of entire populations, depending on the rate, volume, and permanence of reductions in groundwater levels. Loss of Ute ladies'-tresses individuals or local populations becomes increasingly likely as conditions become more favorable to the colonization and establishment of upland vegetation.

As noted throughout this chapter and explained in the above section "Status of the Species in the Analysis Area," the Service's Ute ladies'-tresses analysis area contains two known locations of the species and additional areas of potential Ute ladies'-tresses habitat. Our evaluation of effects thus encompasses known occurrences of the species and those locations where the species has the potential to occur.

The Biological Assessment characterizes potential effects to Ute ladies'-tresses in terms of that subset of 32 sites surveyed by BIO-WEST (2007) that the Central Carbonate-Rock Province (CCRP) Model predicts will experience a groundwater drawdown of greater than 3 m (10 feet), within either 75 years (the consultation timeframe) or 175 years (the anticipated groundwater recovery period according to BLM's models) following full build out (BLM 2012a). Although the Biological Assessment only mentions drawdown effects to sites characterized by BIO-WEST (2007) as having a moderate or high potential for affecting Ute ladies'-tresses, the Biological Assessment depicts additional sites (primarily those evaluated as having a low but not non-existent potential to contain the species) as occurring within the 10-foot drawdown contours predicted by the CCRP model (BLM 2012a, Figure 4-10). The BLM interprets the CCRP Model as predicting "substantial changes" (reductions) in potential Ute ladies'-tresses sites in Spring Valley and more moderate reductions in potential Ute ladies'-tresses sites in southern Snake Valley (BLM 2012a, Figure 4-10). We summarize the Biological Assessment's characterization of effects from groundwater pumping for development purposes upon potential Ute ladies'-tresses habitat (as defined in that document) in Table 11-2 of this Opinion.

Table 11-2. Project-specific effects of groundwater production for development purposes within the requested consultation timeframe (full build out plus 75 years), according to BLM (2012a). All sites listed represent potential Ute ladies'-tresses habitat, not locations where the species is currently known to occur.

Basin	Site Name[a]	Ute ladies'-tresses potential	Within Drawdown Contour[b]	Likelihood of Drawdown[c]	Qualitative Assessment of Groundwater Reduction[c]
Spring Valley	Four Wheel Drive	Low	Yes		
	Blind Spring	Low	Yes		
	East of Cleve Creek (East)	Moderate	Yes	High	Substantial
	East of Cleve Creek (West)	Low	Yes		
	Keegan Ranch (Middle)	High	No	High	Substantial
	Keegan Ranch (South)	High	No	High	Substantial
	Layton Spring	Low	Yes		
	Millick Spring (North)	Low	Yes		
	Millick Spring (South)	Low	No		
	Minerva Spring #2	Moderate	Yes	High	Substantial
	Minerva Spring #3	Moderate	Yes	High	Substantial
	Rock Spring	Low	Yes		
	The Seep	Low	No		
	Shoshone #1 (Pond)	Moderate	Yes	High	Substantial
	Shoshone #2 (Ponds 1–3)	Moderate	Yes	High	Substantial
	Shoshone #3	Moderate	Yes	High	Substantial
	South Bastian Spring	Moderate	Yes	High	Substantial
	Stonehouse Spring Complex	High	No		
	Swallow Spring	High	Yes	High	Substantial
	Turnley/Woodsman Spring	Low	Yes		
	West Valley Spring Complex (North)	Moderate	No		
	West Valley Spring Complex (South)	Moderate	No		
	Willard Spring	Moderate	Yes	High	Substantial
	Willow Spring	Low	No		
	Unnamed Spring #5	Low	No		

(southern) Snake Valley	Big Springs Complex	Low	No		Some
	Big Springs Pond	Low	No		
	Big Springs Creek	Low	No		
	Clay Springs	Low	No		
	Unnamed #1 North of Big Spring	Moderate	No		
	Unnamed #2 North of Big Spring	Moderate	No		
(northern) Hamlin Valley	Little Spring (South)	Moderate	No		

[a] Site names are as assigned by BIO-WEST (2007), not per the Biological Assessment, which contains some minor alterations of these original site names.

[b] According to visual inspection of Figure 4-10 of the Biological Assessment (BLM 2012a). "Yes" indicates sites within the 10-foot drawdown contour at full build out +75 years. Some sites mapped within this contour (BLM 2012a, Figure 4-10) are not discussed in BLM (2012a).

[c] According to the narrative evaluation of effects to Ute ladies'-tresses in BLM (2012a).

Whereas CCRP Model predictions of drawdown of less than 3 m (10 feet) are not reliable for quantiative purposes per BLM (BLM 2012a, b), we note that drawdown of the magnitude predicted, albeit less than 3 m (10 feet) in some cases, would likely have a considerable impact on the depth to water (elevation of the water table) relative to the root zone of Ute ladies'-tresses and the discharge of springs in Spring, northern Hamlin, southern Snake valleys, and possible northern Snake Valley, up to and including the cessation of flow, within the timeframe of this consultation (see Chapter 7, Spring, Hamlin, and Snake valleys). Additionally, the regional CCRP model may underestimate project-induced drawdown of the water table in Spring Valley and drawdown of the water table in northern Hamlin and southern Snake valleys (see Chapter 7). We note that the CCRP Model predicts a decrease in the elevation of the water table of 1.2 m (4 feet) or more (1.2 to 13 [4 to 45 feet]) throughout Spring Valley (including the margins of the valley) and approximately 0.6 to 0.9 m (2 to 3 feet) in southern Snake Valley due to project pumping to 75 years after full build-out (see Chapter 7). Specifically, the regional model predicts drawdown in the following amounts at 75 years after full build-out: Keegan Springs, 2.4 m (8 feet); South Millick Spring, 1.8 m (6 feet); The Seep, 4.5 m (15 feet); Stonehouse Spring, 1.5 m (5 feet); West Valley Spring Complex, approximately 1.2 m (4 feet); Willow Spring, 2.7 m (9 feet), and substantially more drawdown at other locations in Spring Valley (up to 13.7 m [45 feet]); South Little Spring, 2.1 m (7 feet) (in northern Hamlin Valley); and 0.6 to 0.9 m (2 to 3 feet) in the areas of South Little Spring, Big Springs / Big Springs Pond, Unnamed 1 Spring (north of Big Springs), Unnamed 2 Spring (north of Big Springs), and Big Spring / Lake Creek in southern Snake Valley (SNWA 2012b).

The Biological Assessment references ACM B.1.1 (described above and in BLM 2012a) as capable of minimizing groundwater-pumping effects to habitats in which Ute ladies'-tresses may occur. This measure indicates that groundwater production well sites will be selected with the intent of avoiding springs, streams, riparian/wetland areas, and the presence of special status species and their habitat. We interpret this measure as an intent to consider these resources when selecting the locations (and footprints) of groundwater production wells but not necessarily a commitment to ensure that groundwater pumping from these wells will not affect these resources. This ACM also does not represent an absolute avoidance measure; therefore, the Service does not regard it as sufficient to completely eliminate the potential for adverse effects to Ute ladies'-tresses that may occur in habitats that may be affected by groundwater pumping for development purposes.

The Biological Assessment also references a Conceptual Adaptive Management Framework and Measures, which includes ACMs C2.1 and C2.15. ACM C2.1 states that, in accordance with the Stipulations and any future water right rulings, SNWA will implement actions to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special status species, such as: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and 4) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range. Because no measures exist that require flowering-season surveys for Ute ladies'-tresses within groundwater-dependent habitat, we cannot be certain that this measure will direct mitigation activities toward locations containing the species. According to ACM C2.15, SNWA will modify use of SNWA's agricultural water rights in Spring Valley to offset changes in spring discharges needed to maintain wet meadow areas in the northwest and southeast portions of Spring Valley. If Ute ladies'-tresses are ever determined to be in these areas, this measure should provide the species and its habitat with some protection.

BLM Mitigation Measure GW-VEG-2 requires hydrological and biological monitoring within Ute ladies'-tresses groundwater-dependent habitats occurring on BLM lands that may be affected by groundwater pumping. However, this measure requires the presence of Ute ladies'-tresses to be known in order to be targeted for monitoring. Because no measures exist that require flowering-season surveys for Ute ladies'-tresses within groundwater-dependent habitat, we cannot be certain that this measure will direct monitoring activities toward locations containing the species. In addition, although monitoring can inform subsequent avoidance or minimization strategies, it does not in and of itself avoid or minimize effects.

BLM measure GW-WR-3a requires the development of a Comprehensive Water Resources Monitoring Plan prior to any project pumping in Spring, Delamar, Dry Lake, or Cave valleys. BLM measure GW-WR-3b requires applying the regional groundwater flow model and developing local scale groundwater flows models. As discussed in Chapter 5 ("Treatment of Applicant Committed and BLM Mitigation Measures" section), implementing nonspecific programmatic measures does not assure us that adverse effects to federally listed species will be avoided and/or the extent to which effects may be minimized.

Despite including the above-referenced ACMs and BLM mitigation measures, the Biological Assessment concludes that the project *may affect, and is likely to adversely affect*, Ute ladies'-tresses (BLM 2012a). We agree with this determination of effect and evaluate the magnitude and approximate spatial extent of potential effects to Ute ladies'-tresses below based upon the Biological Assessment and our interpretation of relevant information. In particular, for additional information regarding our assessments of groundwater-related effects likely to result from the proposed action, please refer to Chapter 7.

There are existing BLM and NDOW water rights at their wells at Shoshone Ponds, private rancher water rights on the Big Springs Creek / Lake Creek system, and private rancher water rights on various springs and streams in Spring, Snake, and Panaca valleys, which are existing water rights protected under Nevada water law. Nevada Revised Statute (NRS) 533.482 provides the NSE with the authority to seek injunctive relief to prevent any action that would violate Nevada water law's protection of existing rights or any order or regulation of the NSE. The NSE may even request an injunction before any injury to a water right occurs. The fact that both federal district courts and Nevada state courts have consistently ruled in favor of protecting senior existing water rights from injury indicating spring flows that support these existing water rights may be insulated from adverse effects from the GWD Project.

Spring Valley

We find that all valley floor springs and springs along the margin in Spring Valley are at risk of reduced discharge from groundwater pumping in Spring Valley, including but not limited to the specific locations identified as potential Ute ladies'-tresses habitat in the Biological Assessment (and listed in Table 11-2). We include the flow from artesian wells at Shoshone ponds in this characterization, as well as the additional inventoried and uninventoried springs identified within Spring Valley in BLM (2012b). In addition, all associated wetland habitat, as well as riparian habitat associated with perennial streams, located in the valley floor and valley floor margins is at risk for groundwater level reductions well below the root zone of Ute ladies'-tresses. Although wetland delineations have not been completed for Spring Valley, areas of hydric soils indicated in the FEIS are a reasonable first approximation of habitats having the potential to support the species and, therefore, habitats in which adverse effects may occur. Consequently, we conclude that project-specific groundwater pumping has the potential to adversely affect Ute ladies'-tresses in these locations in Spring Valley.

Snake Valley

Proposed pumping in Spring Valley has the potential to substantially decrease spring discharges in southern Snake Valley. We have assessed the potential for project-related effects to groundwater-dependent habitats as more substantial (refer to Chapter 7) than the BLM characterized these effects in the Biological Assessment (BLM 2012a). According to our assessments, the following sites identified as potential Ute ladies'-tresses habitat in the Biological Assessment have a potential to be substantially affected by the proposed project-related groundwater pumping: Unnamed 1 Spring (north of Big Springs) and Unnamed 2 Spring (north of Big Springs). Where Ute ladies'-tresses may occur at these sites, project-specific groundwater pumping has the potential to adversely affect the species.

We also find that the potential exists for groundwater drawdown to extend beyond the spatial extent projected by the CCRP Model in Snake Valley (a basin in which the species is known to occur), specifically north of the Big Springs drainage up to and including Leland-Harris Spring and/or Gandy Salt Marsh. To our knowledge, the central Snake Valley (in the vicinity of these sites) has not been assessed for potential Ute ladies'-tresses habitats, although the FEIS identifies inventoried and uninventoried springs, as well as areas of hydric soils (BLM 2012a), which could potentially support the species. Therefore, project-specific groundwater pumping has the potential to adversely affect Ute ladies'-tresses in central Snake Valley.

We have no information that suggests the effects of the proposed action will extend to the known location of Ute ladies'-tresses in northern Snake Valley at Willow Springs (near Callao, Utah).

Hamlin Valley

Proposed pumping in Spring Valley has the potential to result in substantial decreases in spring discharge in Hamlin Valley, and specifically at S. Little Spring, identified as potential Ute ladies'-tresses habitat in the Biological Assessment. Consequently, adverse effects to Ute ladies'-tresses are possible at this spring should the species be found there.

As noted earlier (Status of the Species in the Analysis Area section), additional areas of potential Ute ladies'-tresses habitat are present in Hamlin Valley. The FEIS identifies four inventoried springs (BLM 2012b, Table 3.3.1-1A in Appendix F3.3), a number of uninventoried springs (BLM 2012b, Figure 3.3.1-3), and an unstated amount of hydric soils in Hamlin Valley. These habitats have not been evaluated for their potential to contain Ute ladies'-tresses, and have not been evaluated for potential reductions in spring discharge and/or changes in groundwater levels as a result of the proposed action. Without additional information, we cannot eliminate these additional areas as having some potential to contain Ute ladies'-tresses, nor do we have an objective basis upon which to conclude that these habitats will not be affected by the proposed action.

Panaca Valley

Proposed pumping in Dry Lake Valley has the potential to reduce spring discharges at Panaca Spring in Panaca Valley, where Ute ladies'-tresses is known to occur. However, currently available information (see Appendix B, Hydrologic Analysis) does not support a conclusion that project-related reductions in spring discharge at Panaca Spring is likely to result in measurable, biologically meaningful adverse effects to ULT (i.e., we currently regard adverse effects at this site as likely to be insignificant).

11.4.6 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Cumulative effects to the Ute ladies'-tresses under the proposed action would include, but are not limited to, changes in land or water use patterns or practice (including management actions) that may adversely affect Ute ladies'-tresses or its habitat. Within the action area, such actions would be most likely undertaken by the States of Nevada and Utah, County and local governments, and private landholders on lands adjoining or upstream of BLM-administered lands.

We are not aware of any future changes in land use patterns or practices (including management practices) in the action area that are both reasonably certain to occur and likely to affect Ute ladies'-tresses or its habitat, other than those associated with the proposed action. As discussed in Chapter 5 ("Cumulative Effects" section), we are unaware of additional groundwater uses that should be considered reasonably certain to occur. If we later find that we did not consider an action as reasonably foreseeable when we should have, then BLM should request reinitiation of consultation if it results in effects to Ute ladies'-tresses not considered in this Opinion.

The future effects of climate change may act to alter the hydrological regime upon which Ute ladies'-tresses is dependent, thus compounding the potential effects of groundwater pumping under the GWD Project. We address the potential effects of climate change within the action area, including the effects that climate change may have upon Ute ladies'-tresses and its habitats, in Chapter 8 of this Opinion. However, at the present time these effects are not reasonably certain to occur; therefore they are not appropriately regarded as cumulative effects for purposes of ESA effects evaluations.

11.5 CONCLUSION

As required under section 7, we based our overall effects conclusions on the ***aggregate*** effects of the factors analyzed under "environmental baseline," "effects of the action," and "cumulative effects." The BLM provided us with an aggregate effects analysis in support of this consultation, which included results of groundwater flow model (CCRP Model) simulations for their "baseline-plus-proposed action" scenario. Contrary to the Biological Assessment, we do not anticipate appreciable differences in the potential for adverse effects to Ute ladies'-tresses when evaluating the effects of the action (in isolation) as compared to the consideration of the aggregate effects resulting from baseline conditions, effects of the action, and cumulative effects.

It is our opinion that the action, as proposed, is not likely to jeopardize the continued existence of Ute ladies'-tresses. No critical habitat has been designated for this species, therefore none will be affected.

We base this determination primarily upon the following factors, identified and discussed above:

- The action area is situated at the periphery of this species' relatively large range (encompassing 8 U.S. states and 1 Canadian province).
- Although the species is known from two locations within the action area (in Panaca and Snake valleys), we do not expect Tier 1 or future ROW or ancillary facilities (including groundwater pumping for construction purposes) to affect these locations.
- With regard to groundwater pumping for development purposes, we do not expect the proposed action to extend to the known population of Ute ladies'-tresses in Snake Valley (Willow Springs). Although we expect the effects of groundwater pumping (for development purposes) may extend into Panaca Valley and possibly Panaca Springs, we do not expect groundwater reductions at this location to be pronounced enough to result in measurable effects to Ute ladies'-tresses.
- While we have identified more potentially suitable habitat for Ute ladies'-tresses within the action area than indicated within the Biological Assessment, we do not expect the species to be frequent or abundant in this area, primarily because the species is known from a mere two locations within the entire Great Basin Desert (and the Ute ladies'-tresses analysis area represents a subset of this larger area). We merely lack sufficient information to predict which of those locations herein recognized as potential Ute ladies'-tresses habitat are most likely to contain the species.

To the extent that the species may be found within the action area, with the notable exception of the pipeline itself, avoidance and minimization measures committed in association with the project state that the species and its habitat (springs, spring-fed and other wetlands, and perennial streams) will be avoided by the project. To the extent that impacts to the species cannot be avoided, given our expectations that the species is unlikely to occur in substantial numbers or locations within the project, we do not anticipate that the loss of these occurrences or these individuals will appreciably affect the survival or recovery of the species.

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Chapter 12

WHITE RIVER SPRINGFISH AND HIKO WHITE RIVER SPRINGFISH

For this Biological and Conference Opinion (Opinion), we have combined our discussion of the federally listed White River springfish (*Crenichthys baileyi baileyi*) and the Hiko White River springfish (*C. b. grandis*) into one chapter. These 2 subspecies of *C. baileyi* occupy spring systems within the same valley (Pahranagat Valley) and are similar in their life history and ecology.

When referring to the species in general, we use the scientific name *Crenichthys baileyi* or the generic term "springfish." When referring specifically to the subspecies *C. b. baileyi*, we use the common name White River springfish; when referring specifically to the subspecies *C. b. grandis*, we use the common name Hiko White River springfish; and when referring to the 2 subspecies together, we often use the term "Pahranagat Valley springfishes."

12.1 ANALYSIS AREA AND PROPOSED ACTION COMPONENTS

The analysis area for White River springfish and Hiko White River springfish is a subset of the overall action area described in Chapter 3. It encompasses those hydrographic basins (HBs) within the action area that meet one or more of the following criteria: 1) HBs containing either or both of the Pahranagat Valley springfishes and/or their designated critical habitats; 2) HBs in which one or more components of the proposed action have the potential to generate adverse effects to either or both of the Pahranagat Valley springfishes and/or their critical habitats (i.e., project basins); and 3) HBs through which impacts generated in project basins would have to propagate to reach any site having either of the Pahranagat Valley springfishes and/or critical habitat. This third criterion primarily reflects the patterns of hydrologic connectivity (particularly groundwater movement) between HBs within the action area, as described in Chapter 7 of this Opinion. As explained in Chapter 7, groundwater pumping occurring within a given basin may affect groundwater levels within adjacent or even more distant basins. Our analysis area therefore includes those basins in or through which project-related activities (i.e., groundwater development) may ultimately affect these springfish subspecies and/or their critical habitats, in addition to any basin in which these springfish subspecies occur or critical habitat can be found. Below, we provide our rationale for each of the basins included in our analysis area for the springfishes of Pahranagat Valley.

As explained later in this chapter (refer to the "Status of the Species, Distribution and Status" section), Pahranagat Valley is the only basin that meets the first criterion of containing known occurrences and/or critical habitat for the White River springfish and Hiko White River springfish. The project basins included in the analysis area based on criterion 2 are Cave Valley, Dry Lake Valley, and Delamar Valley. The specific project components that we considered for our Pahranagat Valley springfish analysis include the following: 1) construction, operation, and maintenance of any Tier 1 infrastructure (e.g., main pipeline, power lines) in Delamar Valley, which is the closest project basin to the Pahranagat Valley springfishes and their critical habitats; 2) construction, operation, and maintenance of future groundwater development facilities in Delamar Valley (i.e., production wells, collector pipeline, and associated infrastructure); 3) pumping of 6,042 acre-feet per year (afy) in Delamar Valley; 4) pumping of 11,584 afy of groundwater annually in Dry Lake Valley; and 5) pumping of 5,235 afy of groundwater in Cave Valley. Lastly, basins meeting criterion 3 include those basins believed to be in hydrologic connection with the project basins and Pahranagat Valley, where the federally listed springfish subspecies and critical habitat occurs. As described in Chapter 7, groundwater drawdown could propagate from production sites in Delamar, Dry Lake, and Cave valleys to Pahranagat Valley, including by way of intervening valleys such as White River Valley and Pahroc Valley.

Therefore, we have delineated our analysis area for these 2 springfish subspecies to include the following HBs: Pahranagat Valley (basin containing the 2 federally listed springfish subspecies and their critical habitats); Delamar Valley, Dry Lake Valley, and Cave Valley (3 of the project basins); and White River Valley and Pahroc Valley (2 of the intervening basins through which groundwater drawdown could potentially propagate to reach Pahranagat Valley). White River Valley has been included in the analysis area for the Pahranagat Valley species because we conclude that the proposed pumping in Cave Valley is likely to reduce interbasin outflow to White River Valley within the timeframe of our analysis (see Chapter 7, “Hydrologic Analysis for Flag Springs”), and interbasin outflow from White River Valley is believed to occur to Pahroc and ultimately Pahranagat valleys (Eakin 1966; Scott et al. 1971; Harrill et al. 1988; LVVWD 2001; Thomas et al. 2001; Thomas and Mihevc 2007). We focus our effects analysis on those sites occupied by the Pahranagat Valley springfishes and those sites designated as critical habitat. In this analysis, we analyze the potential for interbasin ground water flow between Dry Lake and Delamar Valley, and between Delamar Valley and Pahranagat Valley.

The analysis area for the springfishes of Pahranagat Valley is depicted in Figure 12–1, together with occupied sites and critical habitat.

12.2 STATUS OF THE SPECIES

12.2.1 *Regulatory Status*

The U.S. Fish and Wildlife Service (USFWS or Service) listed both the White River springfish and the Hiko White River springfish as endangered with critical habitat on September 27, 1985 (USFWS 1985). The Service approved the *Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley* (USFWS 1998), which included both of these springfish subspecies, on May 26, 1998.

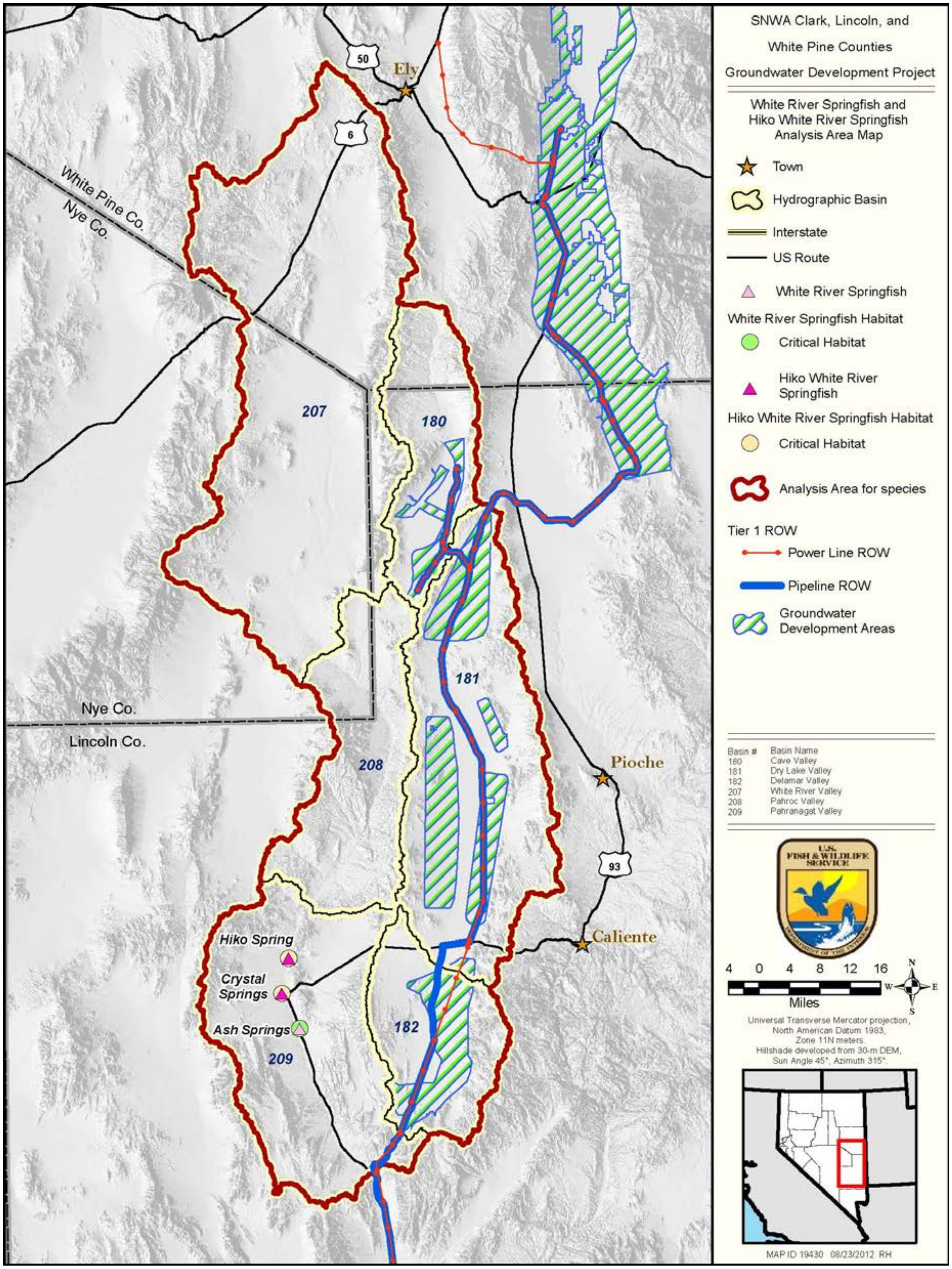

Figure 12–1. Analysis area for the springfishes of Pahranagat Valley

12.2.2 *Species Description and Taxonomy*

Crenichthys baileyi is a member of the Goodeidae family (order Cyprinodontiformes), which consists of approximately 40 freshwater fish species in 18 genera, the majority of which are known from central Mexico (Doadrio and Dominguez 2004; Webb et al. 2004). Only 2 genera of Goodeids—*Crenichthys* (springfish) and its closest relative *Empetrichthys* (poolfish)—are known from the United States, where they are or were restricted to isolated spring systems in southern and eastern Nevada (Miller 1948; La Rivers 1994; Grant and Riddle 1995). Over the past century, springfish and poolfish taxonomy has been controversial and these 2 genera have been aligned with several different families (reviewed by Grant and Riddle 1995). *Crenichthys* and *Empetrichthys* are now considered sister taxa within the subfamily Empetrichthyinae within the family Goodeidae, as proposed by Parenti (1981) and supported by subsequent studies (Grant and Riddle 1995; Doadrio and Dominguez 2004; also see Webb et al. 2004). In addition to their geographic separation, *Crenichthys* and *Empetrichthys* have distinct life history (e.g., egg laying) and ecological traits (e.g., endemic to spring systems) that separate them from other Goodeids (Grant and Riddle 1995; Doadrio and Dominguez 2004; Webb et al. 2004).

Crenichthys baileyi is 1 of 2 species within the genus *Crenichthys*, with the other being *C. nevadae* (Railroad Valley springfish) of Railroad Valley in central Nevada (La Rivers 1994). Originally described by Gilbert (1893) as a subspecies of *Cyprinodon macularius*, *C. baileyi* was later elevated to species status and placed within the newly created *Crenichthys* genus on the advice of Hubbs (La Rivers 1994). Williams and Wilde (1981) later recognized 5 subspecies of *C. baileyi* based on morphometrics, meristics (countable traits), coloration, and temporal isolation. All subspecies occur in isolated thermal springs in southern and eastern Nevada, and include the White River springfish and Hiko White River springfish in Pahranagat Valley, Lincoln County; the Moapa White River springfish (*C. b. moapae*) to the south along the Muddy River, Clark County; the Preston White River springfish (*C. b. albivallis*) to the north in White River Valley near the towns of Preston and Lund, White Pine County; and the Moorman White River springfish (*C. b. thermophilus*) in White River Valley at Moorman Spring and Hot Creek, Nye County. The validity of the 5 subspecific classifications of *C. baileyi* populations has been questioned (Perkins et al. 1997) and additional research is needed to provide a more rigorous evaluation of the subspecific taxonomy of *C. baileyi*. However, Perkins et al. (1997) found a high level of genetic diversity among *C. baileyi* populations, which suggests that individual populations should be the primary ecological units for management.

Like its close relative, the Pahrump poolfish (*Empetrichthys latos*), *C. baileyi* lacks pelvic fins and the dorsal and anal fins are placed far back on the body (Hubbs and Miller 1941; La Rivers 1994; Minckley and Marsh 2009). Body coloration is typically dark olive above and silvery white below with bright silver on the cheek and opercle (Gilbert 1893; Minckley and Marsh 2009). There are 2 rows of dark spots or bands along the side of the body (Gilbert 1893; Hubbs and Miller 1941; La Rivers 1994: Minckley and Marsh 2009), as opposed to the single row or band found on the Railroad Valley springfish (Hubbs and Miller 1941; La Rivers 1994). The Hiko White River springfish is the largest of the 5 subspecies (adults average >40 milimeters [mm] [1.6 inches] Standard Length [SL] and can exceed 65 mm [2.6 inches] SL), and breeding males display a brilliant lemon yellow color on the ventral surface of the head and body that sometimes turns into a deep orange color on the caudal fin (Williams and Wilde 1981; Minckley and Marsh 2009). The White River springfish subspecies is moderate in size compared to the other subspecies: average adult size is <35 mm (1.4 inches) SL (Minckley and

Marsh 2009) with a range of 27.2 to 38.5 mm (1 inch to 1.5 inches) SL based on 30 primarily female specimens; Williams and Wilde 1981).

12.2.3 *Distribution and Status*

Crenichthys baileyi is endemic to (largely) isolated spring systems along the pluvial White River in southeastern Nevada (Williams and Wilde 1981; La Rivers 1994). This species exhibits a relict distribution; it was presumably more widespread when the pluvial White River flowed continuously over 300 kilometers (km) (186 miles) southward to join the Colorado River (Williams and Wilde 1981; Courtenay et al. 1985). With the drying of the pluvial White River in recent geologic time, *C. baileyi* populations likely became isolated where suitable spring habitat remained (Hubbs et al. 1974, cited in Williams and Wilde 1981; Courtenay et al. 1985). The White River springfish and Hiko White River springfish subspecies of *C. baileyi* are endemic to several large thermal spring systems on the valley floor of Pahranagat Valley, Lincoln County, Nevada.

Although historical (pre-1980s) estimates of abundance for the White River springfish and Hiko White River springfish subspecies are generally unavailable, *C. baileyi* was described as typically common wherever found (La Rivers 1994). Recently, a variety of methods have been used to estimate springfish abundance, including ocular observations, snorkel surveys, and mark-recapture surveys. The Nevada Department of Wildlife (NDOW) has been the primary party responsible for monitoring these fishes over the last couple of decades. These surveys are the best available information on status of the Pahranagat Valley springfishes, despite complicating factors that may bias or render population estimates unreliable, as described below.

12.2.3.1 White River Springfish

The White River springfish is endemic to thermal pools and outflows created by Ash Springs in Pahranagat Valley, Lincoln County, Nevada (Williams and Wilde 1981). Historically, the distribution of White River springfish in the outflow of Ash Springs was as far downstream as 8–11 km (5–7miles) north of the town of Alamo (Miller and Hubbs 1960). Much of this outflow stream (west of US Highway 93 [US 93]) is commonly referred to as the Pahranagat Creek or Pahranagat Ditch. Williams and Wilde (1981) described the spring pool population of White River springfish as being separated from the outflow stream population by steep topography that would have prevented migration of springfish in the outflow stream into the spring pool. The outflow stream, on the other hand, may occasionally receive some Hiko White River springfish individuals that are flushed downstream from Crystal Spring to the north (also located within the creek bed) during flooding events (Williams and Wilde 1981).

Historical estimates of White River springfish abundance are generally unavailable. It was reported as common throughout its distribution in 1938 (Miller and Hubbs 1960). By 1959, it still appeared to be "common" in the Ash Springs pool (though in less abundance), and was found in "moderate" numbers to several kilometers downstream (Miller and Hubbs 1960). By the early 1980s, springfish numbers at Ash Spring were reported to be "considerably reduced" from 20 years earlier (Courtenay et al. 1985), and it was reportedly scarce in the Ash Springs outflow (Hardy 1982, cited in Tuttle et al. 1990). Tuttle et al. (1990) estimated number of adult springfish (>25 mm [1 inch] total length [TL]) at Ash Springs during the mid-1980s at between 1,000 and 1,700 individuals based on snorkel surveys; almost all fish were observed in the Ash Springs pool. However, 1994 surveys using mark-recapture methods resulted in considerably higher population estimates (46,275 ± 422 springfish; NDOW 2012).

White River springfish in the Ash Springs system are found primarily in the spring pools and outflow located above (to the east of) U.S. 93, and in limited numbers in the outflow below U.S. 93 to the confluence with Pahranagat Creek (NDOW 2012). The majority (approximately 95%) of the fish's distribution is on private property, with the remaining 5% being on land administered by the Bureau of Land Management (BLM). Population counts or estimates of White River springfish have been inconsistent in methods and frequency throughout its monitoring history because of access issues related to land ownership (i.e., surveys have often been limited to the small portion of the fish's distribution that is on BLM land). In 2005, NDOW was granted permission to access private lands and survey for White River springfish throughout the Ash Springs system for the first time in about 10 years (NDOW 2010a). Visual snorkel surveys conducted in 2006 found springfish to be "abundant" and distributed throughout the BLM and private land portions of the spring and outflow (NDOW 2006). In 2010, NDOW counted 730 springfish during a snorkel survey, and documented fish concentrating near the major spring inflows (NDOW 2010a). A majority of the fish (83%) were greater than 35.5 mm (1.4 inches) TL. Springfish were not observed in the outflow below U.S. 93 during this survey. In February 2012, 1,400 White River springfish were counted during an NDOW snorkel survey. Springfish were observed to be abundant throughout the spring outflow above U.S. 93 and rare in the outflow below the highway during all survey visits between September 2011 and February 2012 (NDOW 2012).

The habitats at Ash Springs are extensive, deep, complicated, and well vegetated and it is certain that many springfish were not counted during recent snorkel surveys, as some areas of the outflow that appeared to support springfish were not surveyed. Therefore, the numbers reported by snorkelers are best interpreted as an observed number, rather than a reliable population estimate. The observed number is likely an underestimate of the actual population size.

12.2.3.2 Hiko White River Springfish

The Hiko White River springfish was historically restricted to the thermal pools and outflows of Hiko and Crystal springs (Williams and Wilde 1981), 2 large thermal springs discharging on the valley floor of Pahranagat Valley north of the town of Alamo. In 1963, Hiko Spring outflow was modified for irrigation, which caused the extirpation of 2 other native fish species from this spring system (Courtenay et al. 1985). The introduction of largemouth bass (*Micropterus salmoides*), mosquitofish (*Gambusia affinis*), and shortfin mollies (*Poecilia mexicana*) into Hiko Spring shortly thereafter (1964–1965) was followed by a decrease in springfish abundance and the extirpation of the species from this site by 1967 (Deacon 1979; Minckley and Deacon 1968; Williams and Wilde 1981; Courtenay et al. 1985). Descendants of springfish collected from Crystal Spring (70 individuals) were transplanted into Hiko Spring in 1984 (USFWS 1998), and the population increased and then remained fairly stable until the year 2000. During this period, the estimated population size reached a high of over 8,000 springfish in 1986 and only occasionally fell below 4,000 fish (NDOW 2011a). However, the Hiko Spring population has decreased substantially since 2000, coinciding with the appearance of red swamp crayfish (*Procambarus clarkii*) in the system (NDOW 2011a). The estimated springfish population at Hiko Spring has been between about 300 and 1,000 fish from 2006 onward.

Early estimates of Hiko White River springfish population size at Crystal Spring are not available, but the species was described as being abundant in the spring pools and common in the outflows during the 1960s (Courtenay et al. 1985). Following the introduction of convict cichlids (*Amatitlania nigrofasciatus*) and shortfin mollies in the 1970s (Williams and Wilde 1981; Courtenay and Deacon 1982), there was a steep decline in the Hiko White River springfish population at this site (Courtenay et al. 1985). Population size estimates based on mark-recapture methods in 1986 and 1987 were <300 individuals, and springfish were restricted to the headwater pools (Tuttle et al. 1990). Surveys conducted by NDOW since 2004 indicate that the species continues to persist at this site, but at low numbers (typically, population estimates are <1,000 individuals in the north and south spring pools combined) (NDOW 2011b).

While a variety of methods have been used to describe and estimate abundance of Hiko White River springfish over the years, NDOW has recently been using mark-recapture surveys to estimate population size and catch per unit effort as an index of abundance. Although some biases may occur in these population estimates due to violation of assumptions set forth in the population estimators, these estimates represent the best available information on population status. Population estimates for Hiko White River springfish at Hiko and Crystal springs during recent survey years are below (taken from NDOW 2010b,c, 2011a,b; high estimates reported when multiple surveys occurred within a given year).

2010 Population Estimates:

- Hiko Spring: 236 springfish with a 95% confidence interval of 156 to 357 fish.
- Crystal Spring:
  - North Pool: 228 springfish with a 95% confidence interval of 156 to 334 fish.
  - South Pool: 490 springfish with a 95% confidence interval of 252 to 681 fish.

2011 Population Estimates:

- Hiko Spring: 247 springfish with a 95% confidence interval of 147 to 448 fish.
- Crystal Spring:
  - North Pool: 111 springfish with a 95% confidence interval of 69 to 191 fish.
  - South Pool: 720 springfish with a 95% confidence interval of 280 to 1,873 fish.

A refuge population of Hiko White River springfish was established at Blue Link Spring in Mineral County, Nevada, in 1984 because of threats to the Hiko and Crystal springs populations (USFWS 1998). This site is on land administered by BLM. A total of 264 fish from Hiko Spring were transplanted to this site, and a population was quickly established and within 3 years was estimated at over 11,000 fish. In 1990, the thermal spring outflows into the reservoir decreased (due to valve failure or vandalism) and the water cooled considerably (NDOW 2011c). This event coincided with a population crash and it is uncertain if the entire population was lost at this time. Although there is no definitive cause of the decline, it may have been caused by the interruption of flow altering the spring temperature, and/or dissolved oxygen. Following repair of the spring box water supply valves, an additional 150 fish from Hiko Spring were transplanted to Blue Link Spring in 1991 (USFWS 1998; NDOW 2011c). The population at this site has since recovered (USFWS 1998). A visual estimate during a July 2011 survey put the population at about 4,000 fish (NDOW 2011c). Although sampling at this site is infrequent and the methods used to estimate abundance are inconsistent, it is believed that the population at Blue Link Spring is doing well (NDOW 2011c).

12.2.4 *Life History*

Very little information is available on the ecology, behavior, and life history of the White River springfish and Hiko White River springfish. However, studies have been conducted on close relatives, such as other *Crenichthys baileyi* subspecies. Based on their close relatedness, *C. baileyi* subspecies likely have similar life histories and habitat requirements (Minckley and Marsh 2009). However, it is important to keep in mind that habitat differences between sites can lead to divergence of life history traits. Additionally, many of these studies occurred either in a laboratory setting or decades ago and conditions may have changed.

Given its small size, *C. baileyi* is probably short lived (3 to 4 years; [Sigler and Sigler 1987]). This species is unique among Goodeids in that it (and other members of the subfamily Empetrichthyinae [*Crenichthys* and *Empetrichthys*]) lay eggs and do not bear live young (Grant and Riddle 1995; Doadrio and Dominguez 2004; Webb et al. 2004). *Crenichthys baileyi* are broadcast spawners, releasing eggs and sperm into open water for external fertilization with no subsequent parental care. Eggs are adhesive and attach firmly to nearby vegetation (Kopec 1949).

Annual *C. baileyi* fecundity (the total number of eggs spawned by a female during a single spawning season) is not known. Most springfish females appear to spawn twice annually (Espinosa 1968; Minckley and Marsh 2009), but produce relatively few eggs per spawning event. Spawning is asynchronous (individual females will spawn at different times of the year [Deacon and Minckley 1974]) and occurs over an extended period or perhaps year-round (Espinosa 1968; Sigler and Sigler 1987; Marsh and Minckley 2009). A peak in spawning may occur during the warm summer months as has been observed for *C. b. moapae* (Scoppettone et al. 1987). The period of spawning activity may be regulated by primary productivity (production of food) in the fish’s habitat (Schoenherr 1981). The number of eggs deposited per spawning event and time to hatching has been reported for springfish held in aquaria. Wild *C. b. moapae* brought into captivity deposited 10–17 eggs per spawning, and these eggs hatched in 5–7 days (Kopec 1949). Espinosa (1968) found the number of ripe ova in *C. baileyi* specimens ranged from 3 to 13 in *C. b. moapae*, 6 to 17 in *C. b. grandis*, and 6 to 18 in *C. b. thermophilus*. Environmental conditions may also influence egg numbers in springfish. For example, female *C. nevadae* in warm lotic (flowing) environments were found to have more eggs than females occupying standing warm springs (Williams 1983, cited in Sigler and Sigler 1987).

Females generally reach sexual maturity between lengths of 24 and 28 mm (0.9 and 1.1 inches) (Espinosa 1968). However, *C. baileyi* populations in environments with exotic (i.e., non-native) aquatic species tend to have females that are smaller at first maturity (defined as the average age at which fish of a given population mature for the first time) than those living without exotics, potentially due to competition for food and overcrowding resulting in growth rate reductions (Espinosa 1968). Because reproductive potential (i.e., egg numbers) is strongly correlated with size of females, a reduction in size at first maturity may result in a reduction in overall population fecundity at sites with exotics (Espinosa 1968). Additionally, non-native species may affect *C. baileyi* mating behavior: it has been observed that White River springfish will attempt to mate with shortfin mollies (Deacon et al. 1980; Hardy 1982).

Important proximate cues for springfish spawning are not well understood, but may be related to seasonal variations in temperature, photoperiod, and light intensity. Further study is needed to understand the effects of these factors on reproductive rhythms of *C. baileyi* (Espinosa 1968).

Crenichthys baileyi are inactive at night and active during the day; this species also tends to exhibit a bimodal pattern of activity during daylight, with activity increasing after sunrise followed by a midday depression in activity and an afternoon peak (Deacon and Wilson 1967; Hubbs et al. 1967; Wilde 1989). The primary stimulus for activity appears to be light (Deacon and Wilson 1967; Hubbs et al. 1967). Periods of activity may be related to feeding behavior (Deacon and Wilson 1967; Deacon and Minckley 1974; Wilde 1989).

Crenichthys baileyi feeds opportunistically and has an omnivorous diet that may include food items such as diatoms, algae, plant parts, detritus, and macroinvertebrates (Deacon et al 1980; Williams and Williams 1982; Wilde 1989; Hobbs 1998). Differences in diet have been observed both seasonally and between populations of *C. baileyi*, which may be contributed to differences in habitat or other factors that affect food item availability. Wilde (1989) found a preponderance of invertebrates, especially amphipods (small crustaceans), in the stomachs of *C. b. thermophilus*; and, Williams and Williams (1982) found *C. b. albivallis* to be primarily herbivorous (plant-eating). Wilde (1989) noted a shift in diet to herbivory in the winter when invertebrates were not abundant. Springfish forage along substrate and in vegetation, as evidenced by the ingestion of bottom-dwelling invertebrates, plant fragments, and detritus (USFWS 1998).

Historically, White River springfish co-occurred to varying degrees with the following native fish at Ash Springs: Pahranagat roundtail chub (*Gila robusta jordani)*; Pahranagat speckled dace (*Rhinichthys osculus velifer*); and the now-exinct Pahranagat spinedace (*Lepidomeda altivelis*) and Pahranagat desert sucker (*Catostomus clarki* ssp.) (Miller and Hubbs 1960). Hiko White River springfish historically co-occurred with the Pahranagat roundtail chub, Pahranagat speckled dace, and Pahranagat desert sucker at Crystal Spring (based on Hubbs' field notes, cited in Williams and Wilde 1981), and possibly co-occurred with all 3 species at Hiko Spring as well (Courtenay et al. 1985). Information on interspecific interactions and habitat partitioning for these native species is generally not available. Gilbert (1893) reported that springfish were associated with speckled dace in the spring pool area of Ash Springs. However, distribution overlap with *C. baileyi* was likely limited for some of these native species due to different tolerances for water temperatures (Courtenay et al. 1985).

The fish community at Ash, Crystal, and Hiko springs has changed considerably from historic conditions due to habitat alterations and the introduction of non-native aquatic species. Today, the fish communities have shifted to predominantly non-native species, including but not limited to, mosquitofish, shortfin mollies, sailfin mollies (*P. latipinna*), convict cichlids (*A. nigrofasciatus*), carp (*Cyprinus carpio*), and tilapia (*Tilapia* spp.) (NDOW 2012). Interactions with these non-native species may influence life history traits of *C. baileyi*, as noted above (e.g., differences in size at first maturity in *C. baileyi* populations with and without exotics). Additionally, non-native fish may cause a shift in habitat use by native fish (Brown and Moyle 1991 and Douglas et al. 1994, cited in Scoppettone et al. 2005).

12.2.5 *Habitat*

To understand and conceptually describe how springfish and its habitat may respond to changes in spring discharge from Groundwater Development Project (GWD Project) pumping, if this were to occur, we have summarized available information on springfish habitat characteristics and habitat use.

Springfish appear to do best in flowing springs with minimal habitat disturbance and in the absence of non-native fishes (Courtenay et al. 1985). Vegetative cover may be important for providing some protection against predation by non-native fishes, such as the convict cichlid. In experimental conditions, Tippie et al. (1991) observed declines in springfish recruitment when convict cichlid was sympatric and suggested it likely resulted from convict cichlid predation on springfish eggs and fry. However, cover positively affected springfish recruitment (Tippie et al. 1991), which suggests that cover reduces predation by the cichlid. Though cover may reduce predation by some exotic species, it can also benefit other potential predators such as red swamp crayfish (Hobbs et al. 2005; NDOW 2007).

Many fish require a variety of habitats to complete their complex life cycle due to differences in resource utilization, predator avoidance, and physiological tolerance among the different life stages (e.g., egg, larva, juvenile, and adult) (Van Horne 1983; Billman et al. 2006). Tuttle et al. (1990) found adult White River springfish (>25 mm TL) using a wide range of total water depths reflective of available water depths at the Ash Springs pool, but adults appeared to be more common in deeper water and were more benthically oriented than other life stages. On the other hand, juvenile (10–25 mm [0.4–1.0 inches] TL) and larval springfish (<10 mm [0.4 inches] TL) generally occurred in shallower water and were more vertically dispersed. In this same study, Hiko White River springfish adults at Crystal Springs also tended to be benthically oriented (Tuttle et al. 1990).

The White River springfish primarily uses areas with little to no velocity, such as pools and near spring vents where current velocity is low (Tuttle et al. 1990; Sada and Deacon 1994). In contrast to this, others have inferred that Hiko White River springfish may prefer higher velocity water and noted that further study is needed (NDOW 2004). Seasonal distributional changes have also been noted for White River springfish, with high concentrations of fish observed near inflowing water and spring vents during winter surveys and higher concentrations of individuals in open (pool) habitats away from the spring heads during fall and summer surveys (NDOW 2012). Such seasonal movements suggest possible thermoregulatory behavior.

Springfish are thermophilic (able to thrive in high temperature springs) and can tolerate low dissolved oxygen levels (Sumner and Sargent 1940; Hubbs and Hettler 1964). While the springs occupied by *C. baileyi* vary considerably in temperature and minimum dissolved oxygen values, these are relatively constant within each spring (Williams and Wilde 1981). The ability of springfish to adaptively thermoregulate by moving in and out of areas of extreme temperatures, which would be lethal under extended exposure, and to live in water with a broad range of temperatures, has enabled them to survive in areas deemed too hostile for other fish species (Hubbs and Hettler 1964). However, while Sumner and Sargent (1940) found that springfish from a warm-water spring were able to survive in a cool-water spring, the converse did not hold true.

White River springfish have been observed inhabiting water temperatures at Ash Springs ranging from 31 to 36 degrees Celsius (°C) (88 to 97 degrees Fahrenheit [°F]) (Hubbs and Hettler 1964;

Garside and Schilling 1979; Courtenay et al. 1985; Tuttle et al. 1990). Crystal and Hiko springs are cooler: 26 to 28 °C (79 to 82 °F) in the spring pools at Crystal Springs (Hubbs and Hettler 1964; Courtenay et al. 1985; Tuttle et al. 1990) and approximately 26 °C (79 °F) at Hiko Spring (Hubbs and Hettler 1964; Courtenay et al. 1985). More recent point-in-time measurements available on the U.S. Geological Survey (USGS), National Water Information System Web site are within these ranges for Ash Springs (3 measurements taken between 1981 and 1987) and Crystal Springs (7 measurements taken between 2003 and 2005), but are lower for Hiko Spring (ranging from approximately 18–24 °C [64 °–75 °F] for 3 point-in-time measurements taken between 2008 and 2010) (USGS 2012).

Dissolved oxygen concentrations at Ash Springs ranged from 1.8 and 5.1 milligrams per liter (mg/L) (1.8 to 5.1 parts per million [ppm]) seasonally, and dissolved oxygen concentrations at Crystal Springs ranged from 1.3 to 6.4 mg/L (or ppm) in the source pool during a mid-1980s study by Tuttle et al. 1990. BIO-WEST (2007) recorded dissolved oxygen concentrations of 1.71 mg/L (or ppm) at the source of Ash Spring and 1.02 mg/L (or ppm) at the source of Crystal Spring in 2005. Dissolved oxygen concentrations at Hiko Spring were recorded at 3.0 mg/L (or ppm) by Hubbs and Hettler (1964) and 3.6 mg/L (or ppm) by BIO-WEST (2007).

12.2.6 *Population Dynamics*

Limited information available is on population dynamics for White River springfish and Hiko White River springfish. Data collected between different organizations and over the years are not always comparable as techniques, personnel, and protocols are different. Recent surveys conducted by the NDOW allow for a better understanding of recent trends for Hiko White River springfish.

Springfish populations at Hiko Spring have fluctuated considerably between years since regular survey efforts began in the mid-1980s, though numbers have been depressed in recent years following the first documentation of red swamp crayfish in the system (population estimates went from over 8,000 to below 300 within a couple of years following the first capture of crayfish in year 2000, and numbers have remained low since; NDOW 2011a). The springfish population at Crystal Springs has also fluctuated considerably over the last 10 years (NDOW 2011b). Information on seasonal abundance patterns is limited. Tuttle et al. (1990) did not document any apparent pattern of seasonal abundance in White River springfish at Ash Springs in a 3-year study during the 1980s.

Crenichthys baileyi likely has a high degree of demographic resilience given what is known of its life history. Small body size, early maturation, short generation time, small clutch size but high reproductive effort due to multiple spawning bouts over a protracted period, and low investment per offspring are characteristics that suggest high intrinsic rates of increase (Winemiller and Rose 1992; Winemiller 2005). However, the prevalence of non-native aquatic species in these spring systems appears to have and continues to adversely affect the springfish populations; and springfish numbers, while apparently stable, are reduced compared to historical levels. Effects of non-native species to the springfish populations are inferred from correlations of declines in springfish abundance and the introduction of non-native aquatic species in these spring systems.

12.2.7 *Threats to the Species*

The decline and endangerment of the White River springfish and the Hiko White River springfish was precipitated primarily by habitat loss and modification from impoundment, diversion, and piping of spring outflows for agricultural uses and recreational purposes, and the introduction of non-native fishes that prey upon and/or compete for resources with the springfishes (Courtenay et al. 1985; USFWS 1985; Tuttle et al. 1990). Spring modifications, including elimination or reduction of riparian and aquatic vegetation and diverting of flow, have resulted in a loss of available springfish habitat and invertebrate food sources (USFWS 1985). At Crystal Springs, alterations have resulted in a substantial drop from the spring pool to its outflow, which acts as a barrier to fish movement.

Non-native fish and other aquatic species have been implicated in the decline or extirpation of *C. baileyi* populations. As mentioned above, the original population of Hiko White River springfish was extirpated from Hiko Spring and its outflow stream following the introduction of non-native fish, and the *C. baileyi* population at Crystal Spring declined precipitously following introduction of non-native species in that system. Non-native species known to occur in Ash, Crystal, and/or Hiko springs and outflows include shortfin mollies, sailfin mollies, mosquitofish, convict cichlids, carp, bullfrogs (*Lithobates catesbeianus*), and red swamp crayfish (NDOW 2010a). In 2010, tilapia (an African cichlid) was first documented in Pahranagat Valley from the Ash Springs outflow near the confluence with Pahranagat Creek (NDOW 2012). The potential for tilapia to become established in springfish habitat is a concern: the occurrence and increase in abundance of tilapia in the Muddy River of southern Nevada coincided with a decline in endemic fishes of that system (Scoppettone et al. 1998).

At Crystal Spring, NDOW began removal of non-native species quarterly in 2002; after many years of intensive efforts to remove non-native aquatic species at this location, the springfish population has not responded (NDOW 2011b). At Hiko Spring, NDOW initiated an intensive non-native species removal project in 2005. Despite recent efforts to remove crayfish from Hiko Spring, the number of springfish has not substantially increased (NDOW 2011a).

The non-native aquatic plant *Ludwigia repens* is prevalent in Pahranagat Valley springs with *C. baileyi* and provides cover for the predaceous red swamp crayfish (NDOW 2011a). The NDOW undertook a *Ludwigia* removal effort in 2005 and 2007 in which the plant was almost completely removed from Hiko Spring. Following this removal in 2005, catch per unit effort of crayfish dropped and springfish appeared to distribute themselves throughout the spring pool more than before (NDOW 2011a). However, as mentioned above, the number of springfish has not substantially increased.

Exotic aquaria fishes may also introduce diseases or parasites to native fishes (USFWS 1985). For example, anchor worms (*Lernaea* spp.), which can cause blood loss, tissue damage, and expose fish to secondary infections (USFWS 1998), were found in Hiko White River springfish specimens coincident with the introduction of mosquitofish, shortfin mollies, and largemouth bass (Deacon 1979). Heavy infestations may cause reduced longevity, reduced fecundity, and even cause direct mortality (USFWS 1998).

Several additional threats have been identified since the Pahranagat Valley springfishes were listed under the Endangered Species Act (ESA), including groundwater withdrawal for municipal needs and climate change (for a detailed discussion of potential climate change impacts, please refer to Chapter 8). All of these threats have the potential to affect water quantity and quality and springfish habitat in Pahranagat Valley.

12.2.8 *Conservation Needs*

The Pahranagat Valley springfishes are extremely limited in their distribution and numbers due to numerous factors, which makes them highly susceptible to extirpation. Refuge populations exist for the Hiko White River springfish, but not the White River springfish. The Service, identified the Dexter National Fish Hatchery, Key Pittman Wildlife Management Area, and Pahranagat National Wildlife Refuge as potential refuge sites for Pahranagt species (USFWS 1998). Recovery objectives include reducing or modifying impacts to the White River springfish and Hiko White River springfish populations and their habitats to the point where these impacts no longer represent a threat of extinction or irreversible population decline.

Non-native aquatic species represent one of the most pressing threats to the persistence of the White River springfish and Hiko White River springfish. Therefore, removing or reducing these non-native species is a high priority (USFWS 1998). The effects of non-native aquatic species on native species may be exacerbated by habitat alterations and disturbances (Moyle and Nichols 1974). Habitat modifications, such as those that result in diminished flow, may lead to reduced habitat heterogeneity and less segregation in habitat use by natives and non-natives (Scoppettone 2007). Therefore, while improving and increasing habitat quantity and quality for springfish is a conservation need in and of itself, it could also potentially reduce the adverse impacts that some non-native aquatic species are thought to have on springfish.

12.3 STATUS OF CRITICAL HABITAT

Critical habitat for both springfishes was designated in 1985 at the time of listing under the ESA (USFWS 1985). Critical habitat for the White River springfish includes Ash Springs, its associated outflows, and surrounding land areas for a distance of 50 feet from the springs and outflows in Pahranagat Valley, Lincoln County, Nevada. Critical habitat for Hiko White River springfish includes Crystal and Hiko springs, their associated outflows, and surrounding land areas for a distance of 50 feet from the springs and outflows in Pahranagat Valley, Lincoln County, Nevada. These 3 spring systems are the largest of the springs discharging on the valley floor of Pahranagat Valley, and are amongst the largest of the regional springs discharging water from the White River Groundwater Flow System, as described in Chapter 4.

The most important elements for survival of the springfishes are the consistent quality and quantity of spring flow (USFWS 1985). Primary constituent elements of critical habitat include warm-water springs and their outflows and surrounding land areas that provide vegetation for cover and habitat for insects and other invertebrates on which springfish feeds.

Ash, Crystal and Hiko springs are the source of water for numerous water rights in Pahranagat Valley. Water is used for irrigation, wildlife, stock watering, and quasi-municipal uses all along the central axis of Pahranagat Valley from Hiko Spring in the north to Lower Pahranagat Lake in the south. These water rights include certificated, permitted, and decreed rights. The diversion rates and annual duties associated with the rights are defined in either the permit terms or specified in the Pahranagat Lake Decree, and are protected under the Pahranagat Lake Decree and Nevada water law (Nevada Revised Statute [NRS] 533.370 and 533.482).

Crenichthys baileyi is currently present in all 3 of the designated critical habitats.

12.3.1 *Ash Springs*

Ash Springs is the southernmost, largest, and warmest of the 3 major spring systems found in Pahranagat Valley. Ash Springs consists of at least 7 springs that originate from a contact between alluvium and bedrock (Garside and Shilling 1979). The springs have a common outflow stream, which has been impounded by construction of U.S. 93 and now forms a large, deep convoluted pool (USFWS 1998). Depths in the pool are controlled by a control gate located adjacent to U.S. 93, which is used to manage outflows used for irrigation. The spring pool provides good stream flow when this gate is open. Below the highway, the outflow stream flows southwest to join the outflow stream from Crystal Spring. From this point on, the stream is referred to as the Pahranagat Creek.

Based on intermittent measurements collected by the USGS, the mean annual discharge of Ash Springs is approximately 18.2 cubic feet per second (cfs) (2004–2012). Over this period of record, discharge measurements ranged from 14.5 to 21.8 cfs at Ash Springs (USGS 2012). Temperature measurements range from approximately 31 to 36 °C (88 to 97 °F) (Hubbs and Hettler 1964; Garside and Schilling 1979; Courtenay et al. 1985; Tuttle et al. 1990; BIO-WEST 2007). Dissolved oxygen concentrations at Ash Springs ranged from 1.8 to 5.1 mg/L (or ppm) seasonally during a study by Tuttle et al. (1990); BIO-WEST (2007) recently recorded dissolved oxygen concentrations of 1.71 mg/L (or ppm) at the source of Ash Spring.

The Ash Springs pool occupies a surface area less than 2 acres in size, and is approximately 0.4 km (0.2 miles) long and 0.5 to 2.0 m (1.6 to 6.6 feet) deep (Tuttle et al. 1990). The bottom consists of sand and silt with locally dense submergent vegetation and algal mats. A thick canopy of willow (*Salix* sp.) and ash trees (*Fraxinus* sp.) border the eastern bank while the west side is more sparsely vegetated with willow, ash, and grasses.

BIO-WEST (2007) performed biological surveys of the BLM managed portion of Ash Springs. Aquatic vegetation documented included: creeping primrose-willow (*Ludwigia repens*), duckweed (*Spirodela* sp.), and horsehair algae (*Chlorophyceae* sp.). Emergent vegetation included Olney’s three square bulrush (*Schoenoplectus americanus*), saltgrass (*Distichlis spicata*), spikerush (*Eleocharis* sp.), and Yerba mansa (*Anemopsis californica*). Shrubs or trees around Ash Springs include salt cedar (*Tamarix* spp., BLM 1989 and observations by Service biologists), cottonwood (*Populus* spp.) and green ash (*Fraxinus pennsylvanica*). Surveys that included the private portion of Ash Springs described the most abundant aquatic plants to include spiny naiad (*Najas marina*), filamentous alga, muskweed, and red ludwigia (*Ludwigia repens*), which was lower in abundance than the previous two (NDOW 2007).

All but a small portion of critical habitat at Ash Springs is on private land; the remainder (approximately 0.04 hectares [ha] [0.1 acre] USFWS 1985) is on land managed by the BLM’s Ely District and Caliente Field Offices as a recreational site, where swimming/bathing is a common activity. This is an area of high disturbance and the NDOW noted turbidity and trash flowing from this high use area on multiple occasions during recent surveys for White River springfish (NDOW 2012). Water quality has been an issue over the years due to the high use of this system for recreation and other activities (BLM 1989). The BLM resource management plan (RMP) for the Ely District (BLM 2008) provides management actions and guidance for protecting Ash Springs and the springfish. The BLM is developing an Ash Springs Recreation Area Management Plan to provide a framework for management direction that addresses issues such as riparian vegetation loss and bank erosion resulting from recreation use (USFWS 2008).

Ash Springs supports many aquatic invasive species, including western mosquitofish, shorfin molly, convict cichlid, and bullfrogs (BIO-WEST 2007). Red swamp crayfish have been documented in low numbers west of U.S. 93 but not east in Ash Springs pool (NDOW 2010a). These non-native species are thought to negatively impact the White River springfish.

12.3.2 *Crystal Springs*

Crystal Springs is the second largest of the 3 major spring systems found in Pahranagat Valley. It consists of at least 2 springs; 1 flows from an orifice in limestone bedrock and 1 from a contact between alluvium and bedrock (Garside and Shilling 1979). This spring system is on private land and has been extensively modified for agricultural use (Courtenay et al. 1985). It consists of 2 impounded headwater pools with outflows that are diverted for agriculture (Tuttle et al. 1990). These pools have abundant aquatic vegetation and a silty bottom (Tuttle et al. 1990). Pool water level is controlled by a gate that directs flow into 1 of 2 outflows. The smaller outflow, created to provide water for nearby agriculture, conveys water intermittently, and thus offers little habitat for the springfish. The main outflow (the historical headwaters of Pahranagat Creek) continues for approximately 900 m (0.6 miles) before flowing into a concrete irrigation channel, with 5 diversion boxes and 7 outlet concrete channels (4 to the east and 3 to the west). The main outflow channel is characterized by dense aquatic vegetation and silt substrate (Tuttle et al. 1990), but the riparian corridor along the main concrete channel is minimal. Farther downstream, the water flows back into an earthen channel. Portions of this channel have previously been trenched, but most areas appear to have been undisturbed for several years. Flow in this channel is periodically interrupted by agricultural diversions; however, these diversions do not commonly cause flow to cease entirely. The last portion of the Crystal Springs outflow is an earthen ditch extending 5.8 km (3.6 miles) and averaging 1 meter (m) (3.3 feet) wide. This portion connects to Ash Springs outflow; however, for much of the year only the upper 4.8 km (3.0 miles) of the ditch contains water.

The entire spring flow of Crystal Springs can be diverted into either the natural channel or the earthen irrigation ditch. The water level in the spring pool is lowered significantly when the natural channel is used, and it fluctuates throughout the irrigation season.

Based on intermittent measurements collected by USGS, the mean annual discharge from Crystal Spring is approximately 12.2 cfs (2004–2012). Over this period of record, discharge measurements ranged from 10.2 to 13.6 cfs (USGS 2012). Water temperature averages about 26 to 28 °C (79 to 82 °F) in the spring pools (Hubbs and Hettler 1964; Courtenay et al. 1985; Tuttle et al. 1990; BIO-WEST 2007). Temperatures were warmer during the earlier part of the century, but the spring has cooled by several degrees in recent years (USFWS 1998). The dissolved oxygen levels in Crystal Spring ranges from 1.3 to 6.4 mg/L (or ppm), depending on the season (Tuttle et al. 1990). The main channel of the outflow has a much greater dissolved oxygen concentration (6.5 to 15.7 m/L [or ppm]) than the created irrigation ditch (3.6 to 5.9 m/L [or ppm]) (Tuttle et al. 1990). BIO-WEST recorded low dissolved concentrations of 1.02 mg/L (or ppm) at the source of Crystal Spring in 2005.

BIO-WEST (2007) performed biological surveys at Crystal Spring in 2005. Aquatic vegetation documented included creeping primrose-willow, watercress (*Nasturtium officinale*), and horsehair algae. Emergent vegetation included Baltic rush (*Juncus articus*), broadleaf cattail (*Typha latifolia*), saltgrass, spikerush, and Yerba mansa. Trees near the spring included Fremont cottonwood (*Populus fremontii*), willow (*Salix* spp.), and the non-native salt cedar (*Tamarix* spp.).

Crystal Springs currently supports many aquatic invasive species, including red swamp crayfish, western mosquitofish, shortfin mollies, convict cichlids, and bullfrogs (BIO-WEST 2007; NDOW 2011b). These non-native species negatively impact the Hiko White River springfish population.

12.3.3 *Hiko Spring*

Hiko Spring is the northernmost, smallest, and coolest of the 3 major spring systems found in Pahranagat Valley. The water issues from a contact between alluvium and dolomite (Garside and Schilling 1979). This spring system is located on private land and has been extensively modified from historical condition. The outflow stream from Hiko Spring was probably first redirected and impounded in 1865 to provide water for the silver stamp mills in the area, and secondarily to create Nesbitt and Frenchy Lakes (Courtenay et al. 1985): 2 lakes that are now part of NDOW's Key Pittman Wildlife Management Area. Today, the water from Hiko Spring is used primarily for agricultural and municipal purposes. Previously diverted into concrete ditches, the entire outflow stream is now captured in underground pipes, which transport the water to nearby agricultural lands. The only surface water remaining is an impoundment at the spring source and a small marsh created by seepage from the spring pool.

Based on intermittent measurements collected by USGS, the mean annual discharge from Hiko Spring is approximately 5.5 cfs (1982–1998). Over this period of record, discharge measurements ranged from 4.0 to 7.2 cfs (USGS 2012). Hiko Spring maintains a temperature of approximately 26 °C (79 °F) (Hubbs and Hettler 1964; Courtenay et al. 1985; BIO-WEST 2007), although a maximum temperature of 32 °C (90 °F) was recorded in 1934 (USFWS 1998). Dissolved oxygen concentrations at Hiko Spring were recorded at 3.0 mg/L (or ppm) by Hubbs and Hettler (1964) and 3.6 mg/L (or ppm) by BIO-WEST (2007).

BIO-WEST (2007) performed biological surveys at Crystal Spring in 2006. Aquatic vegetation documented included horsehair algae, and emergent vegetation included broadleaf cattail, Bermuda grass (*Cynodon dactylon*), spikerush, Olney's three square bulrush, scratchgrass (*Muhlenbergia asperifolia*), sedge (*Carex* sp.), and Yerba mansa. Trees near the spring included several species of willow.

Hiko Spring currently supports many of the same aquatic invasive species found at Ash and Crystal Springs (BIO-WEST 2007; NDOW 2011a).

12.4 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed federal projects in the action area that have already undergone section 7 consultations and the impacts of state and private actions that are contemporaneous with the consultations in progress.

12.4.1 *Status of the Species and Critical Habitat in the Analysis Area*

For this Opinion, the analysis area encompasses the entire global distribution of both the White River springfish and Hiko White River springfish, which is Ash, Crystal, and Hiko springs and their associated outflows in Pahranagat Valley (see Figure 12–1). These 3 spring systems have also been designated as critical habitat; thus, all critical habitats are also located within the analysis area. Because of this, the status of the species and its critical habitat within the analysis area is the same as its range-wide status, which is fully described in the preceding section.

12.4.2 *Factors Affecting the Species and Critical Habitat in the Analysis Area*

All White River springfish occurrences and critical habitat (Ash Springs and outflow) and all Hiko White River springfish occurrences and critical habitat (Crystal and Hiko springs and associated ouflows) fall entirely within the analysis area for this Opinion. Therefore, factors affecting these subspecies and their critical habitats are the same as those described in the preceding sections (see "Threats to the Species and Status of Critical Habitat").

12.4.3 *Recent Section 7 Consultations*

Three recent formal consultations for either or both of the *Crenichthys baileyi* subspecies are relevant to this Opinion. The first is a programmatic biological opinion (File No. 84320-2008-F-0078) issued to BLM on July 10, 2008, for implementation of the 2008 Ely District RMP. This programmatic opinion examined the potential effects of implementing various land management programs in the BLM Ely District to the White River springfish and 4 other listed species. The action area covers 5.6 million ha (11.5 million acres), including springfish (critical) habitat at Ash Springs in Pahranagat Valley, Lincoln County. The programmatic biological opinion has a 10-year term ending in 2018. As part of the formal consultation for the Ely RMP, the Service assessed potential effects to White River springfish resulting from implementing activities in BLM's Weed Management, Travel and Off-Highway Vehicle Management, Recreation, and Fire Management programs. Additionally, BLM requested informal consultation on White River springfish relative to its Lands, Realty, and Renewable Energy program. The RMP included several minimization measures relevant to the White River springfish that were considered in the Service's assessment. The Service concluded that implementing the programmatic activities could adversely affect White River springfish and result in incidental take, but was not likely to jeopardize its continued existence.

In 2012, the Service issued a programmatic biological opinion for BLM's proposed establishment of a Solar Energy Program by amending land use plans in 6 southwestern states, including Nevada (File No. 84320-2012-F-0200). The amendments would identify Solar Energy Zones (SEZs) within which utility-scale solar energy development would be a priority use. Seventeen SEZs are currently proposed. The Biological Assessment identified 17 species, including White River springfish and Hiko White River springfish, as likely to be adversely affected by solar development and associated groundwater development within the SEZs. The Service found that the proposed action is not likely to jeopardize the continued existence of White River springfish and Hiko White River springfish, and is not likely to destroy or adversely modify designated critical habitat for these fish. The Service did not exempt take of any federally listed species incidental to the BLM Solar Program in this opinion because establishment of the program, by itself, would not result in incidental take. Site-specific actions undertaken in compliance with BLM's Solar Program will go through further review, including formal consultation under the ESA if the actions might result in the take of endangered or threatened species.

On September 26, 2008, the Service issued a biological opinion for the issuance of a Section 10(a)(1)(A) enhancement of survival (i.e. Safe Harbor Agreement) permit to the NDOW, and issued the permit (TE-195202). The purpose of the Safe Harbor Agreement is to promote conservation of multiple listed species and enhance their survival and recovery through a cooperative government–private partnership. The Permit authorized incidental take of White River springfish and Hiko White River springfish, as well as southwestern willow flycatcher and Pahranagat roundtail chub, on enrolled lands. To date, no private land owners have enrolled to be covered under the Safe Harbor Agreement.

12.5 EFFECTS OF THE PROPOSED ACTION

Regulations define effects of the action as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR § 402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Indirect effects are defined as those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

For our effects analysis, we have examined the potential for both the White River springfish and the Hiko White River springfish and their designated critical habitats to be directly or indirectly affected by implementation of the proposed action, and if so, the likely nature of these effects. As described in Chapter 1, our analysis includes a site-specific assessment of the effects of BLM's issuance of a right-of-way (ROW) for the main and lateral pipelines and associated facilities (Tier 1 ROW) and a programmatic (conceptual) assessment of the effects associated with BLM's issuance of ROWs for future groundwater development facilities (Subsequent Tier ROWs) and groundwater pumping. The Service is not exempting take of endangered or threatened species incidental to the programmatic portions of this Opinion. Future site-specific actions that are analyzed broadly under the programmatic portions of this Opinion and that might result in the incidental take of endangered or threatened species will undergo separate formal consultation before any take would be able to occur.

We have also evaluated the ability of applicant committed measures (ACMs) and BLM monitoring and mitigation measures to avoid, minimize, or mitigate effects to the White River springfish and Hiko White River springfish and their designated critical habitats. These measures are presented below, in some cases in summary form and we refer readers to the Final Environmental Impact Statement (FEIS) for the entire text of the measures (BLM 2012b, Chapter 3.20 and Appendix E). As described in Chapter 5, some measures are very specific while others set up a process for monitoring, managing, and mitigating impacts from future activities, such as groundwater pumping. Any mitigation measure that is specific in terms of how and when it will be applied was considered in our effects analysis. We also recognized and considered those programmatic measures that are more process-oriented (i.e., establishing a framework for developing plans), especially if the intent behind the measure is (at least in part) to protect threatened and endangered species and their habitats. However, because developing specific mitigation measures for programmatic activities (and an analysis of the effectiveness of such measures) has been deferred to future National Environmental Policy Act (NEPA)/ESA consultations, we cannot ascertain if adverse effects will be completely avoided and/or the extent to which adverse impacts will be lessened by implementation of such measures. Therefore, for our programmatic analyses, we begin by assessing potential impacts of the proposed action absent these measures, and then recognize that impacts may (or likely will) be minimized based on implementation of these programmatic measures. But, absent site-specific project information, we do not assume that effects from programmatic activities will or can be completely avoided or entirely mitigated by these programmatic mitigation measures (see Chapter 5 for more information on our analytical approach).

As described in Chapter 1, future site-specific actions that are analyzed programmatically herein will go through further review once project details are identified, including consultation pursuant to section 7 of the Act as appropriate. These additional reviews create opportunities to modify an action before that action might result in the take of endangered or threatened species.

12.5.1 *Applicant Committed Measures Relevant to the Springfishes*

The project applicant, Southern Nevada Water Authority (SNWA), has identified a suite of potential environmental protection measures that may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to water resources associated with proposed groundwater pumping (SNWA 2012a; BLM 2012b). These measures are described in Section B (Programmatic Measures, Future ROWs) and Section C (Regional Water-Related Effects) of SNWA's ACMs, which are located at the end of SNWA's Conceptual Plan of Development in Appendix E of the FEIS (BLM 2012b). Measures specific to the springfishes are presented or summarized below.

ACM B.1.1 Groundwater production well sites will be selected considering 1) suitable hydrogeologic conditions, including well yield, groundwater drawdown, and groundwater chemistry, based upon exploratory drilling; 2) avoidance of springs, streams, and riparian/wetland areas; and 3) the presence of special status species and their habitat. [This represents a partial list of those elements of the measure that are relevant to the springfishes.]

Commitments by the SNWA under the Delamar, Dry Lake, and Cave Valleys (DDC) Stipulation are addressed in ACM C.1.31–C.1.42. The delineated Area of Interest for the DDC Stipulation covers the entirety of Pahranagat Valley. Ash and Crystal Springs are identified in the DDC Stipulation as sites at which spring discharge is being monitored (continuously) through a funding agreement between the SNWA, USGS, and the Nevada Division of Water Resources (NDWR). If this funding agreement changes, terminates, or expires, the SNWA will continue discharge monitoring at Ash and Crystal springs if agreed upon by the Stipulation Parties and if access can be gained to private land. Hiko Spring is identified in the DDC Stipulation as a site to potentially monitor spring discharge, pending further evaluation and granting of access. The DDC Stipulation also recognizes all 3 of these springs as potential biological monitoring sites, if selected by the Stipulation's Biological Resources Team (BRT) for monitoring and if access can be obtained. Hydrologic and biological monitoring plans have been developed by the Technical Review Panel and Biological Review Team (TRP and BRT), and these have been accepted by the Stipulation's executive oversight committee and the Nevada State Engineer (NSE). Initial committed measures can be found in the 2009 DDC Hydrologic Monitoring and Mitigation Plan (SNWA 2009) and the 2011 DDC Biological Monitoring Plan (BRT 2011), which includes 1) continuous discharge monitoring at Ash, Crystal, and Hiko springs; 2) four new monitoring wells, including one on the east side of the Hiko Range in Sixmile Flat in Pahranagat Valley and the one near the southern boundary of Delamar Valley within a structural feature of the Pahranagat Shear Zone (SNWA 2012b); 3) monitoring of White River springfish at Ash Springs, Crystal Spring, and Hiko Spring through incorporation of NDOW fish surveys; 4) monitoring of specific springfish habitat components (e.g., water temperature and quality; water depth, velocity, and extent; macroinvertebrates; vegetation) ; and 5) sixteen existing monitoring wells across DDC, White River, and Pahranagat valleys (SNWA 2012b).

The DDC Stipulation requires a minimum of 2 years of hydrologic monitoring, and the NSE requires a minimum of 2 years of baseline (biology and hydrology) data collection. SNWA has committed to 3 years of biological baseline monitoring (an initial site characterization followed by 2 years of monitoring according to established protocols), and will continue monitoring during ground water withdrawal.

The SNWA has prepared a Conceptual Adaptive Management (AM) Framework for consideration at the programmatic level (SNWA 2012a). The AM Framework sets out a potential process for implementing adaptive management measures to address adverse environmental impacts associated with SNWA groundwater withdrawals for the GWD Project. Examples of adaptive management measures that may be considered and implemented and which are relevant to the White River springfishes include, but are not limited to the following:

ACM C.2.1 In accordance with the Spring Valley and DDC Stipulations and any future water right rulings, the following actions may be implemented to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special status species: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and 4) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat. [This represents a partial list of those elements of the measure that are relevant to the springfishes.]

ACM C.2.9 Work with the NDOW and private land owners at and downstream of Hiko, Crystal, and Ash springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove non-native species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub.

ACM C.2.10 Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish.

ACM C. 2.21 Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit water right holders or sensitive biological areas (e.g., routing excess surface water to subirrigate wet meadows, or creating containment ponds to store flood waters for use in recharging the aquifer).

Additionally, SNWA has developed a new Cave Valley ACM (Appendix C). In this ACM, SNWA has committed to develop groundwater in Cave Valley in a staged (phased) approach. Staged development will be accompanied by hydrologic monitoring and the setting of decision-making triggers, which will be approved by BLM and FWS and included in future consultations and NEPA analyses prior to initiation of groundwater pumping in Cave Valley.

12.5.2 *BLM Mitigation Measures Relevant to the Springfishes*

The BLM has identified additional mitigation measures through the NEPA process, which are presented in Chapter 3.20 (“Monitoring and Mitigation Summary”) in the FEIS (BLM 2012b). Mitigation measures for future groundwater development and pumping are general in nature because they are based on the programmatic-level NEPA analysis. These general measures apply to future GWD Project activities, but will be replaced by more specific measures resulting from future tiered NEPA analyses (BLM 2012b). Below, we summarize those components of the BLM mitigation measures that are (or potentially are) 1) relevant to the White River springfish and Hiko White River springfish and their critical habitats and 2) within BLM’s jurisdiction.

ROW-WR-3: ***Construction Water Supply Plan.*** A construction water supply plan will be provided to the BLM for approval prior to construction. The plan will identify the specific locations of water supply wells (whether existing or new) that will be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; identify reasonable measures to reuse or conserve water; and identify any additional approvals that may be required. The BLM will review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. The SNWA will provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. The BLM, in consultation with State agencies and the grazing permittee, will review the location of any newly constructed water wells and determine if any will be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to benefit the BLM for multiple use management, the BLM will work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s). The BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. At locations of potential habitat, but where species occurrence has not yet been determined, surveys will be conducted in accordance with appropriate protocol prior to approving the plan. The construction water supply plan will be a component of the SNWA Plan of Development (POD). Prior to approval of the POD, the BLM will coordinate with the Service regarding portions of the POD relating to their regulatory role under the ESA. This process will be used to determine if there would be adverse impacts to listed species or adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary.

GW-WR-3a: ***Comprehensive Water Resources Monitoring Plan.*** This mitigation measure requires that SNWA develop a comprehensive Water Resources Monitoring Plan (WRMP) prior to project pumping that specifies hydrologic monitoring requirements to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variation, and other non-project related groundwater pumping activities. Monitoring would include 1) water sources essential to federally listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or State lands; 2) wells sited on the northern boundary between Delamar and Pahranagat valleys, and in northern Pahranagat Valley to monitor groundwater elevations between the project pumping in Dry Lake and Delamar valleys and the regional spring discharge in northern Pahranagat Valley (i.e., Hiko, Crystal, and Ash springs); and 3) well(s) sited in the Pahranagat Shear Zone at the boundary between southern Delamar and southern Pahranagat valleys to monitor groundwater elevations between the groundwater production well field in Delamar Valley and the perennial water resources in southern Pahranagat Valley (i.e., Pahranagat National Wildlife Refuge). The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for a period of at least 5 years prior to initiation of pumping.

GW-WR-3b: ***Numerical Groundwater Flow Modeling Requirements.*** This mitigation measure requires that the SNWA update and recalibrate the regional groundwater flow model at least every 5 years after pumping is initiated, and that the SNWA develop basin-specific models to be approved by BLM prior to tiered NEPA for specific groundwater development activities. The BLM would use the basin-specific models to critically evaluate the effects of pumping and the effectiveness of the proposed mitigation measures, ACMs, and other measures proposed through the AM process. BLM would establish a Technical Review Team to review the model on a periodic basis.

GW-WR-7: ***Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights.*** This mitigation measure addresses BLM action in the event that monitoring or modeling information provided in accordance with **GW-WR-3a** indicates that impacts to federal resources from groundwater withdrawal are occurring or are likely to occur, and the GWD Project is the likely cause or a contributor to the impacts. The BLM would evaluate available information and determine if emergency action and/or a site-specific mitigation plan is required. If the BLM determines that emergency action is required, the BLM could serve a temporary suspension order that identifies actions to be taken to avoid, minimize, or offset impacts. If a site-specific mitigation plan is needed, BLM could require that specific measures be implemented per the schedule specified in the plan to avoid, minimize, or offset impacts to federal resources or federal water rights, including but not limited to 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) flow augmentation to maintain flow in specific water sources; 4) recharge projects to offset local groundwater drawdown; and 5) other on-site or off-site improvements.

GW-AB-3: ***Flow Change Mitigation.*** This measure specifies that the BLM will identify detailed mitigation measures during subsequent NEPA for those springs and streams with special status aquatic species where flow or water level changes are identified during modeling or monitoring. Mitigation ideas are identified at the programmatic level in the ACMs, BLM's comprehensive monitoring, management, and mitigation plan (COM Plan), and mitigation measure GW WR-7 above.

GW-MN-AB-2: ***Spring and Aquatic Biological Monitoring.*** This measure requires the SNWA to monitor flows in moderate and high risk springs (as defined by the BLM) with special status species where potential pumping effects could occur (as determine by the BLM).

GW-MN-AB-3: ***Flow/Habitat Determination***. This measure requires the SNWA to study flow or water level-habitat relationships in selected streams and springs to determine minimum flow or water levels needed to support critical life stages of aquatic species in these habitats. The sites at which these studies would occur would be selected from the list being monitored as part of the Stipulations or additional waterbodies recommended for measures GWD-MN-AB-1 (relevant to game species) and GWD-MN-AB-2 (relevant to special status species).

Because the BLM does not identify sites in Pahranagat Valley as being at moderate or high risk from GWD Project pumping, we assume that it is unlikely that the BLM will require monitoring or studies as specified in GW-MN-AB-2 and GW-MN-AB-3 for White River springfish and/or Hiko White River springfish habitat at this point in time. However, we also assume that if BLM's risk assessment for these springs changes at future tiers (i.e., from low risk to moderate or high risk), then these measures would apply to these fish where it occurs on public or State land. Additionally, GW-WR-3a requires monitoring of water sources essential to federally listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or State lands. Again, none of the springfish sites currently satisfy the criterion of being considered "at risk" by the BLM. Additionally, most of the springfish's distribution in Pahranagat valley is on private lands. As discussed above, monitoring is occurring in Pahranagat Valley under the DDC Stipulation.

The BLM is also developing its own COM Plan that addresses all hydrographic areas and all facilities associated with the GWD Project (BLM 2012b). The intent of the COM Plan is to protect federal resources and federal water rights that may be impacted by the GWD Project, including avoiding adverse impacts that could cause jeopardy to listed species or destruction or adverse modification of designated critical habitat. The BLM will develop this plan based on SNWA's final Plan of Development and in coordination with other agencies, and Notices to Proceed will not be issued until the COM Plan has been completed (BLM 2012b). The COM Plan for Tier 1 will outline a process for developing additional mitigation, monitoring, and management requirements for future ROW grants, and will identify baseline and data gap information needs to better inform subsequent NEPA analysis for groundwater development. Groundwater development-specific COM Plans may be developed for subsequent tiers of the GWD Project, or the COM Plan for Tier 1 may be amended. The COM Plan(s) will also include development of triggers for management action and AM thresholds (BLM 2012b).

12.5.3 *Analysis Approach*

Please refer to Chapter 5 for a detailed discussion of our approach for analyzing effects related to Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping. The hydrologic analyses form the backbone of the effects analyses for all federally listed species that rely on groundwater-dependent ecosystems. The hydrologic analyses can be found in Chapter 7, and is referenced in this chapter as appropriate. Below, we focus primarily on describing 1) potential project effects to the springfishes and their critical habitats and 2) potential cumulative effects. Lastly, we present our determination as to whether the proposed action is likely to jeopardize the continued existence of the Pahranagat Valley springfishes and/or result in the destruction or adverse modification of critical habitat.

As explained in Chapters 5 and 7, there is uncertainty associated with the Central Carbonate-Rock Province (CCRP) modeling results, especially the predictions of spring and stream flow discharge. Therefore, we did not rely entirely on the model predicted decreases in spring flow for our analysis of impacts to the White River springfish or Hiko White River springfish. We did, however, use the CCRP Model as a starting point for our analysis of potential groundwater drawdown impacts. We then assessed whether the model likely over- or underpredicted drawdown in the carbonate aquifer at Ash, Crystal, and Hiko springs.

12.5.4 *Effects to White River Springfish and Hiko White River Springfish*

12.5.4.1 *Tier 1 Rights-of-way (Main Pipeline and Associated Facilities)*

We do not anticipate any direct or indirect construction-related effects to either White River springfish or Hiko White River springfish associated with Tier 1 ROWs. Ash, Crystal, and Hiko springs in Pahranagat Valley are located approximately 18 miles or more away from the nearest Tier 1 ROW in Delamar Valley (BLM 2012a) (Figure 12–1). At this distance, the 2 Pahranagat Valley springfishes would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Indirect effects from groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) are examined separately in the paragraphs that follow.

We do not anticipate that pumping of groundwater in Delamar, Dry Lake, or Cave valleys for construction purposes will adversely affect the 2 springfishes in Pahranagat Valley. The SNWA anticipates that at most about 27 acre-feet (or 8.7 million gallons) of water will be needed for every mile of pipeline. There are approximately 37 km (23 miles) of Tier 1 pipeline in Delamar Valley (BLM 2012a), so we estimate that 621 acre-feet of water will be needed for construction purposes in this valley. The specific locations of the construction water supply wells and the specific groundwater aquifer that will be used is not known, but the SNWA assumes that this water will be obtained from existing wells or exploratory wells that are available at the time of construction and that a construction water supply well will be needed approximately every 10 miles along the pipeline alignment (BLM 2012a).

This pumping will be temporary, is a relatively small quantity, and will likely be located a considerable distance from springfish habitat in Pahranagat Valley since the nearest Tier 1 ROW is approximately 18 miles away. Also, the BLM is requiring the SNWA to develop a construction water supply plan that the BLM will review and approve prior to construction (ROW-WR-3) and BLM committed it will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Based on all of these factors, we do not anticipate that pumping for GWD Project construction in Delamar Valley or more distant locations (e.g., Dry Lake and Cave valleys) will affect the springfish in Pahranagat Valley. If it is determined later that adverse effects could occur to the springfishes that were not considered in this consultation, then the BLM should request reinitiation of section 7 consultation.

12.5.4.2 Subsequent Tier Rights-of-way (Groundwater Development Areas)

We do not anticipate any direct effects to the White River springfish or the Hiko White River springfish from construction, operation, and maintenance activities associated with future groundwater development facilities (Subsequent Tier ROWs). We also do not anticipate any indirect construction-related effects associated with future groundwater development facilities. Springfish sites in Pahranagat Valley are located approximately 14–16 miles away from the nearest groundwater development area in Delamar Valley (Figure 12–1). At these distances, the springfishes would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) is examined separately in the paragraphs that follow.

The length of future collector pipelines is not known, but has been estimated by the SNWA based on assumptions regarding number of future groundwater production wells and known geologic and hydrologic conditions. The SNWA estimates that up to 96.5 km (60 miles) of collector pipeline could be built in Delamar Valley in order to develop and transport groundwater at quantities granted by the NSE in 2012 (BLM 2012a). Based on the assumptions discussed above regarding water needs for construction purposes, we anticipate that SNWA will need up to 1,620 acre-feet of water for construction purposes in Delamar Valley.

The location of wells that will supply construction water, the source aquifer (basin fill, volcanic, or carbonate), pumping rates, and exact quantities of water needed are not currently known. However, given the temporary nature of this pumping; the large intervening distance between the identified groundwater development areas and springfish habitat at Ash, Crystal, and Hiko springs and BLM’s commitment to not approve a construction water supply plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow, we do not anticipate impacts to the springfishes in Pahranagat Valley from temporary groundwater pumping in Delamar Valley for construction purposes. Similarly, we do not anticipate that temporary pumping for construction purposes in even more distant locations, (e.g., Dry Lake or Cave valleys) will affect the Pahranagat Valley springfishes or their habitats. This conclusion will be re-evaluated for any tiered consultation involving ROWs in Delamar, Dry Lake, and Cave valleys, based on updated project information provided at that point in time.

12.5.4.3 Groundwater Pumping

It is our opinion that the discharge at Ash, Crystal, and Hiko springs may be adversly affected (as defined under the ESA) by the proposed pumping in Dry Lake and Delamar valleys (and potentially Cave Valley) within the timeframe of our analysis (see Chapter 7), but we are unsure of the likelihood or magnitude of such effects. Significant, as defined under the Act, refers to effects that can be meaningfully measured, detected, or evaluated. While we believe that hydrologic effects may be significant, we cannot quantify what these effects will be. However, we believe that the CCRP Model, which predicts minimal to negligible effects to Ash, Crystal, and Hiko springs, likely underestimates project-induced drawdown in the regional carbonate aquifer at the location of these regional springs and likely underestimates the amount that spring flow could be reduced.

As described above, Ash, Crystal, and Hiko springs are the source of water for numerous water rights in Pahranagat Valley. Water is used for irrigation, wildlife, stock watering, and quasi-municipal uses all along the central axis of Pahranagat Valley from Hiko Spring in the north to Lower Pahranagat Lake in the south. These existing water rights are protected under the Pahranagat Lake Decree and Nevada water law (NRS 533.370 and 533.482). NRS 533.482 provides the NSE with the authority to seek injunctive relief to prevent any action that would violate Nevada water law’s protection of existing rights or any order or regulation of the NSE. The NSE may even request an injunction before any injury to a water right occurs. The fact that both federal district courts and Nevada state courts have consistently ruled in favor of protecting senior existing water rights from injury indicates that flows from Ash, Crystal and Hiko springs that support these existing water rights may be insulated from adverse effects from the GWD Project.

Given the uncertainty associated with the likelihood or magnitude of drawdown related effects to springs flow, we cannot rule out the possibility of significant (as defined under the ESA) impacts to the Pahranagat Valley springfishes from GWD Project pumping within the timeframe of our analysis. Therefore, we do not concur with BLM’s “may affect, not likely to adversely affect” determination for White River springfish and Hiko White River springfish.

A flow-ecological response model that describes the relationship between hydrologic variability and ecological response has not been developed for the Pahranagat Valley springfishes and their habitats. The complexity of ecosystem processes makes it difficult to predict *specifically* how diminished flow, if it occurred, would affect the springfish. This prediction is further complicated by our incomplete knowledge of springfish life history, habitat requirements or preferences, food preferences, and individual and population-level responses to diminished water quantity and quality. However, we can postulate and generally describe potential consequences of decreased spring flow to the Pahranagat Valley springfishes.

Springfish appear to do best in flowing springs with minimal habitat disturbance and in the absence of non-native fishes (Courtenay et al. 1985), even though springfish are currently associated with spring pool habitat due to distribution restriction. Therefore, we anticipate that a decrease in spring flow at Ash, Crystal, and/or Hiko springs could negatively affect springfish populations and the potential for recovery in Pahranagat Valley by altering habitat and/or affecting the ability of natives and non-native species to segregate habitat. The degree to which habitat would be affected would be influenced primarily by the magnitude and duration of any flow change, factors for which the likelihood or magnitude are currently unknown.

If sustained decreases in flow of sufficient magnitude were to occur, we would expect a reduction in water volume in the spring ponds (e.g., reduced wetted area and/or water depth), diminished extent of the outflow streams, and a reduction in overall habitat heterogeneity. Additionally, an overall reduction in water volume could affect springfish growth and reproduction. Freshwater fish are known to scale in size to the water volume inhabited (Smith 1981). Additionally, larger fish tend to be more fecund; this relationship has been demonstrated for numerous freshwater fish species (e.g., Johnson et al. 1995; Scoppettone et al. 1992). Therefore, we infer that lower water volume could result in smaller and less fecund springfish, which would consequently reduce reproductive potential. Additionally, Scoppettone et al. (1992) found significant differences in the length frequencies between adult Moapa dace inhabiting different water volumes in the Muddy River system, with the largest, most fecund fish in areas of the system with the greatest stream flow.

If reduced flows occurred, they could result in water quality and temperature changes, which can be stressful for fish (Instream Flow Council 2002, cited in Bradford and Heinonen 2008). Small changes in water temperature can have considerable consequences for freshwater fishes, affecting life history (e.g., reproduction, feeding), behavior (e.g., predator avoidance, migration, and spawning), and physiology (e.g., metabolism, growth, body condition) (as reviewed in Carveth et al. 2006). The White River springfish and Hiko White River springfish are thermophilic and generally remain in warm water (William and Wilde 1981). In thermal spring systems, water cools as it moves downstream (Scoppettone 1993); and, the size and rate of spring flow influences the area of thermal stability downstream from the spring head (Hubbs 2001). Therefore, decreased spring flow could possibly restrict future distribution of springfish within these thermal springs (Scoppettone 2007).

Lowered water levels in the spring pools could also lead to an overall deterioration of water quality, which could stress the springfish. Crowding of fish into a smaller volume of water could result in oxygen depletion and a concentration of metabolites. Nutrients (such as nitrogen and phosphorus) and pollutants may become more concentrated, leading to excessive growth of aquatic plants and algae.

Significant reductions in spring outflow could result in lowered water tables that could adversely affect riparian vegetation growing adjacent to Ash, Crystal, and Hiko springs, particularly in arid regions, shallow groundwater, seeps, and springs that provide a more constant source of water to riparian vegetation than occasional flooding (Goodwin et al. 1997). If water tables are lowered sufficiently, riparian plants that require access to subsurface water may be negatively impacted (Brand et al. 2010). Therefore, we anticipate that over the timeframe of our analysis, pumping-induced decreases in spring flow (if they occur) could potentially decrease the recruitment and survivorship of riparian plant species that provide shade, cover, insects (fish food), and organic input into these spring systems, which would then be expected to negatively affect the springfish populations.

As described above, non-native fishes and other non-native aquatic species (crayfish, bullfrogs) are common in the spring systems occupied by the Pahranagat Valley springfishes and are one of the most pressing threats for persistence of these springfish. While these systems are extremely altered from natural conditions, further hydrologic alterations (e.g., diminished spring flow) could exacerbate the effects of non-native species on native fishes by decreasing habitat complexity and the ability of species to segregate habitat (Scoppettone 2007; Helfman 2007, cited in USFWS 2011). Flow regime modifications in other aquatic systems are thought to have facilitated competitive dominance of non-native species that have relatively high environmental tolerances or are from waters naturally similar to the disturbed (modified) conditions (Hoagstrom et al. 2010). Alternatively, the restoration of natural processes in aquatic systems can be expected to help maintain native fish populations (Marchetti et al. 2004). For example, Scoppettone et al. (2005) found that improving outflow of a Mojave Desert spring resulted in aquatic habitat changes (from standing water to flowing water), which resulted in changes to the overall fish community from predominantly non-native fishes (mollies) to predominantly native fishes (Amargosa pupfish [*Cyprinodon nevadensis nevadensis*]). We infer from these findings that decreasing spring flow from current conditions at Ash, Crystal, or Hiko springs could result in further habitat changes that could be favorable for certain non-native aquatic species, potentially at the expense of the springfish.

12.5.5 *Effects to Critical Habitat*

12.5.5.1 Tier 1 Rights-of-way (Main Pipeline and Associated Facilities)

We do not anticipate any direct or indirect construction-related effects to springfish critical habitat at Ash, Crystal, or Hiko springs associated with Tier 1 ROWs. The potential for direct or indirect construction-related effects to springfish critical habitat at these 3 springs, including pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing), was fully described in the preceding section (“Effects to White River Springfish and Hiko White River Springfish”).

12.5.5.2 Subsequent Tier Rights-of-way (Groundwater Development Areas)

We do not anticipate any direct or indirect construction-related effects to springfish critical habitat at Ash, Crystal, or Hiko springs associated with Subsequent Tier ROWs. The potential for direct or indirect construction-related effects to springfish critical habitat at these 3 springs, including pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing), was fully described in the preceding section (“Effects to White River Springfish and Hiko White River Springfish”).

Groundwater Pumping

We do anticipate that springfish critical habitat at Ash, Crystal, and Hiko springs could be adversely affected by declining groundwater levels in the carbonate aquifer and pumping-induced decreases in spring flow, if such effects occurred. As described in detail in Chapter 7, we anticipate that there could be significant (i.e., measurable) drawdown in the regional carbonate aquifer at the location of Ash, Crystal, and/or Hiko springs that results in decreased spring discharge within the timeframe of our analysis, but the likelihood and magnitude of such effects occurring are uncertain.

The primary constituent elements (PCEs) of critical habitat are warm-water springs and their outflows and surrounding land areas that provide vegetation for cover and habitat for insects and other invertebrates on which the springfishes feed. Above, we have described how a decrease in spring flow at Ash, Crystal, and Hiko springs could affect springfish habitat, including water quality and temperatures and the overall extent of springfish habitat within the system. We also discussed how decreased spring discharge and alluvial groundwater levels could adversely affect riparian vegetation, which would then have negative consequences for macroinvertebrate (fish food) production and the thermal environment of the spring-fed habitat. The degree to which critical habitat for the springfishes will be adversely affected will depend largely on the magnitude of the flow reduction, for which there is uncertainty.

12.5.6 *Analysis of Effects to Pahranagat Valley Springfishes with Implementation of Applicant-committed and BLM-committed Mitigation Measures*

The Service anticipates that the ACMs and BLM mitigation measures described in this chapter would reduce the potential for and magnitude of such effects to the Pahranagat Valley springfishes and their critical habitats from programmatic activities by requiring development and implementation of a broad monitoring, management, and mitigation plan designed to 1) provide early warning of potential adverse impacts; 2) establish decision-making triggers; 3) avoid, minimize, or mitigate adverse impacts to groundwater-dependent ecosystems and biological communities; 4) monitor the effectiveness of mitigation measures in achieving expected outcomes and reducing impacts; and 5) allow for adaptability and flexibility in management of the GWD Project (a more detailed list of COM Plan goals and objectives can be found in Chapter 3.20 of the FEIS [BLM 2012b]). However, in the absence of a developed COM Plan and site-specific project information/mitigation measures to further evaluate the potential effects of groundwater withdrawal, the Service anticipates that adverse effects may occur from GWD Project pumping. The BLM and Service will re-evaluate site-specific effects when project details related to groundwater development are known and proposed by the project applicant, at which time we will again determine if adverse effects to listed species and their critical habitats are likely to occur, and follow the appropriate consultation procedures.

12.5.7 *Cumulative Effects*

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

We believe that there are future groundwater uses that are reasonably certain to occur in the action area. The BLM considered these future groundwater uses as part of their baseline assessment, so we account for them in the conclusion section under aggregate effects. See Chapter 5 (“Cumulative Effects” section).

12.6 CONCLUSION

We have evaluated the aggregate effects of environmental baseline, project effects, and cumulative effects for the species. Another source of uncertainty with respect to cumulative effects is climate change. Climate change has the potential to exacerbate the effects of decreased discharge from GWD Project pumping on fish and fish habitat. Potential climate change impacts are discussed in detail in Chapter 8 of this Opinion. In summary, higher air temperatures, more winter precipitation in the form of rain than snow, and earlier snowmelt could result in increased evapotranspiration and shifts in the timing and/or amount of groundwater recharge and runoff (EPA 1998), potentially resulting in decreased summer flows in springs and streams. These changes could result in altered thermal regimes in springs, reduced extent of the stable springhead environment, reduced springbrook length, reduced heterogeneity of the aquatic environment, and reduced soil moisture (Sada and Herbst 2008). However, predicting local climate change impacts is difficult due to substantial uncertainty in trends of hydrological variables (e.g., natural variability can mask long-term climate trends); limitations in spatial and temporal coverage of monitoring networks; and differences in the spatial scales of global climate models and hydrological models (Bates et al. 2008). Thus, while climate change may affect spring flow here, the attributes that will be affected and/or the timing, magnitude, and rate of change is uncertain. Future tiered analyses for groundwater development and pumping will provide us with opportunities to update the cumulative effects analysis based on current climate change information and/or local-scale model predictions for climate change.

After reviewing the current status of the White River springfish and Hiko White River springfish and their designated critical habitats, environmental baseline for the analysis area, effects of the proposed action, and cumulative effects, it is the Service's opinion that the action, as proposed, is not likely to jeopardize the continued existence of the White River springfish and Hiko White River springfish, and that the proposed action is not likely to adversely modify designated critical habitat for these *C. baileyi* subspecies. While adverse impacts to critical habitat could occur, we do not anticipate that such alterations will appreciably diminish the value of critical habitat for both the survival and recovery of the Pahranagat Valley springfishes.

However, we anticipate that the GWD Project could adversely affect the White River springfish and Hiko White River springfish and their critical habitats. We have reached these conclusions for the following reasons:

- Our hydrologic analyses (see Chapter 7) suggest that potential exists for significant impacts (as defined by the ESA; i.e., measurable) to the discharge of Ash, Crystal, and Hiko springs due to the proposed pumping in Dry lake and Delamar valleys within the timeframe of our analysis.
- However, we cannot rule out the possibility of significant effects (as defined by the ESA) to the Pahranagat Valley springfishes and their critical habitats.
- Springfish habitat (including critical habitat) at Ash, Crystal, and Hiko springs is already severely degraded from historic conditions due to modification of the spring outflows for irrigation and the establishment of non-native aquatic species. Pumping-induced decreases in spring discharge, if it occurred, could further degrade springfish (critical) habitat and adversely affect the White River springfish and Hiko White River springfish populations. The extent to which this occurs would primarily depend on the likelihood and magnitude of such reductions in spring discharge, for which considerable uncertainty exists.
- We anticipate that impacts to White River springfish and Hiko White River springfish and their critical habitats can be minimized by implementing the ACMs and BLM mitigation measures, but the extent to which this would occur is unknowable at this time.

In the absence of site-specific project information about groundwater development—and, given unknowns regarding the response of the hydrologic system to pumping stresses, response of springfishes and their habitats to decreased flow, and potential climate change impacts—the Service believes that it is in fact, not extremely unlikely that these springfishes and their critical habitats could be adversely affected from groundwater development under the proposed action. However, available information does not indicate that the GWD Project will appreciably reduce the survival and recovery of the Pahranagat Valley springfishes and/or adversely modify critical habitat

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Chapter 13
PAHRANAGAT ROUNDTAIL CHUB

13.1 ANALYSIS AREA AND PROPOSED ACTION COMPONENTS

The analysis area for the Pahranagat roundtail chub (*Gila robusta jordani*) is a subset of the overall action area described in Chapter 3 (Action Area). It encompasses those Hydrographic Basins (HBs) within the action area that meet one or more of the following criteria: 1) HBs containing known occurrences of the species, 2) HBs in which one or more components of the proposed action have the potential to generate adverse effects to the species and/or its habitat (i.e., project basins), and 3) HBs through which impacts generated in project basins would have to propagate to reach any site where the species and its habitat occurs. This third criterion primarily reflects the patterns of hydrologic connectivity (particularly groundwater movement) among HBs within the action area, as described in Chapter 7 of this Biological and Conference Opinion (Opinion). As explained in that chapter, groundwater pumping occurring within a given basin may affect groundwater levels within adjacent or even more distant basins. Our analysis area therefore includes those basins in or through which project-related activities (i.e., groundwater development) may ultimately affect the Pahranagat roundtail chub and its habitat, in addition to any basin in which the species and its habitat occurs. Below, we provide our rationale for each of the basins included in our analysis area for the chub.

As explained later in this chapter (refer to the “Status of the Species, Distribution and Status” section), Pahranagat Valley is the only basin that meets the first criterion of containing known occurrences of the Pahranagat roundtail chub within the overall action area. The project basins that meet the second criterion are Cave Valley, Dry Lake Valley, and Delamar Valley. The specific project components that we considered for our Pahranagat roundtail chub analysis include the following: 1) construction, operation, and maintenance of any Tier 1 infrastructure (e.g., main pipeline, power lines) in Delamar Valley, which is the project basin closest to the chub and its habitat in Pahranagat Valley; 2) construction, operation, and maintenance of future groundwater development facilities in Delamar Valley (i.e., production wells, collector pipeline, and associated infrastructure); 3) pumping of 6,042 acre-feet per year (afy) in Delamar Valley; 4) pumping of 11,584 afy of groundwater annually in Dry Lake Valley; and 5) pumping of 5,235 afy of groundwater in Cave Valley. Lastly, basins meeting the third criterion include those basins believed to be in hydrologic connection with the project basins and Pahranagat Valley, where the chub occurs. As described in Chapter 7 (Hydrologic Analyses), groundwater drawdown could propagate from production sites in Delamar, Dry Lake, and Cave (DDC) valleys to Pahranagat Valley, including by way of intervening valleys such as White River Valley and Pahroc Valley.

Therefore, we have defined our Pahranagat roundtail chub analysis area to include the following HBs: Pahranagat Valley (the only basin within the action area in which the chub occurs); Delamar Valley, Dry Lake Valley, and Cave Valley (3 of the project basins); and White River Valley and Pahroc Valley (2 of the intervening basins through which pumping-induced drawdown could propagate to reach Pahranagat roundtail chub sites). White River Valley has been included in the analysis area for the Pahranagat roundtail chub because we conclude that the proposed pumping in Cave Valley is likely to reduce interbasin outflow to White River Valley within the timeframe of our analysis (see Chapter 7, Hydrologic Analysis for Flag

Springs), and interbasin outflow from White River Valley is believed to occur to Pahroc Valley and ultimately Pahranagat Valley (Eakin 1966; Scott et al. 1971; Harrill et al. 1988; LVVWD 2001; Thomas et al. 2001; Thomas and Mihevc 2007). We focus our effects analysis on those sites with Pahranagat roundtail chub habitat and known occurrences of the species.

The analysis area for the Pahranagat roundtail chub is depicted in Figure 13-1, together with occupied sites. Cottonwood Spring, which is located on Pahranagat National Wildlife Refuge (NWR) and is also depicted in Figure 13-1, was the focus of a recent (2011) translocation effort that failed. We included this site on the map because it is discussed in this chapter and may be looked at again in the future as a translocation site.

13.2 STATUS OF THE SPECIES

13.2.1 Regulatory Status

The Pahranagat roundtail chub was listed as an endangered species on October 13, 1970, under the Endangered Species Preservation Act of 1966 (USFWS 1970). Its endangered status was retained with the passage of the Endangered Species Act (ESA) in 1973. The U.S. Fish and Wildlife Service (USFWS or Service) approved the *Recovery Plan for the Aquatic and Riparian Species of Pahranagat Valley*, which included the Pahranagat roundtail chub, on May 26, 1998 (USFWS 1998).

No critical habitat has been designated for this species.

13.2.2 Species Description and Taxonomy

Pahranagat roundtail chub are taxonomically aligned with the roundtail chub (*Gila robusta*) complex of the Colorado River drainage (Miller 1946; Minckley 1973; Smith 1978). Tanner (1950) originally granted the Pahranagat roundtail chub species-level recognition; it was later redefined as a subspecies due to its similarity to other roundtail chub (La Rivers 1994; Hubbs et al. 1974).

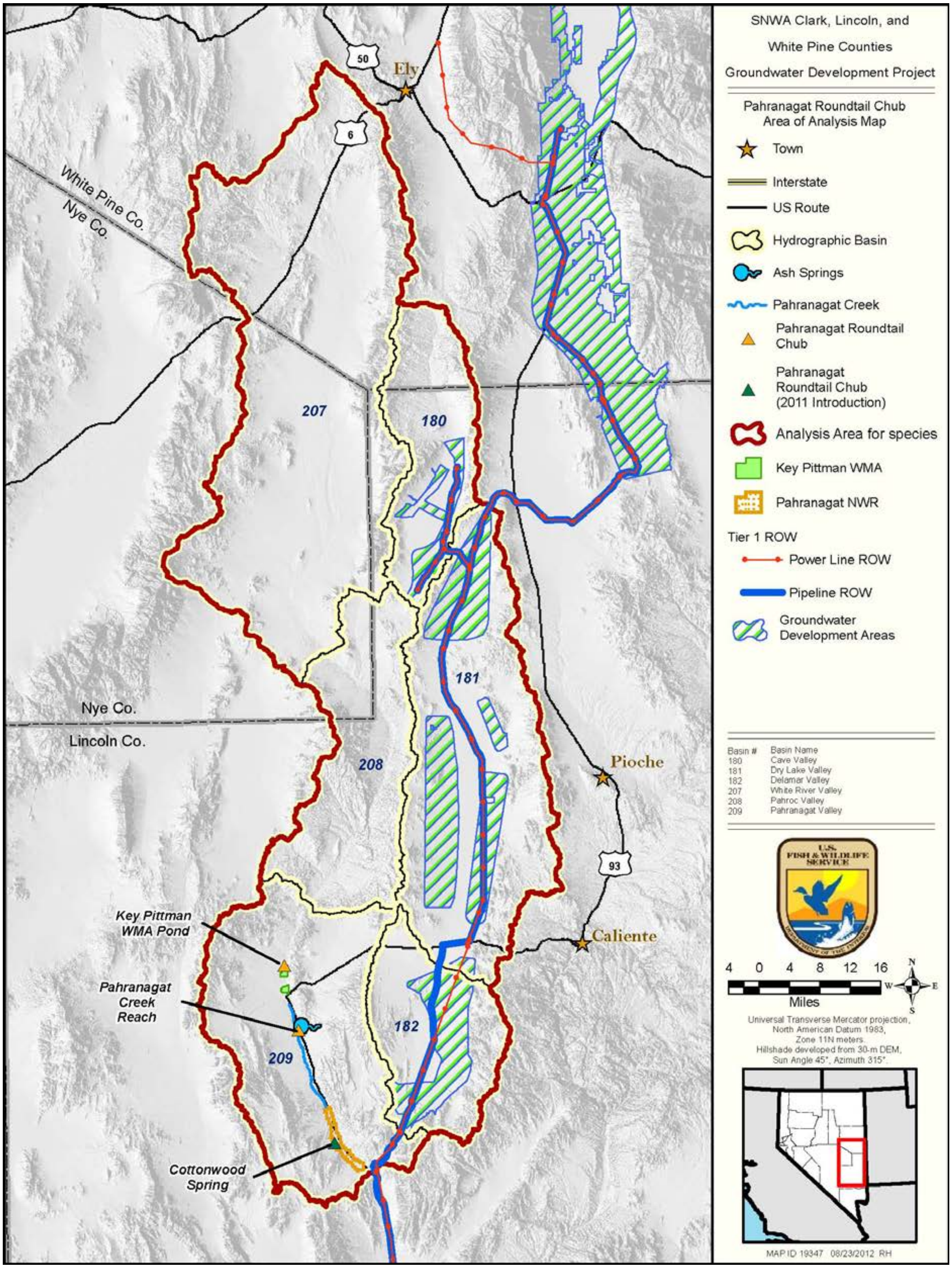

Figure 13-1. Analysis area for Pahranagat roundtail chub

The Pahranagat roundtail chub is an elongate fish with a narrow caudal peduncle and deeply incised caudal fin (USFWS 1998). It is most similar to roundtail chub inhabiting the Colorado River and its larger tributaries, but with more scales in, above, and below the lateral line; and a less elongate body that is greenish in color with black blotches (Tanner 1950; La Rivers 1994). Spawning colors are displayed by both sexes in the form of a red tinge on their anal fin, pelvic fins, and pectoral fins, and on the ventral side of their body (Tuttle et al. 1990).

13.2.3 Distribution and Status

13.2.3.1 *Historical Distribution and Abundance*

The Pahranagat roundtail chub is endemic to Pahranagat Valley, Lincoln County, Nevada. The species likely became isolated in the warm spring systems of Pahranagat Valley when flows in the pluvial White River receded due to a warming and drying climate (Hubbs et al. 1974; Williams and Wilde 1981) approximately 10,000 years ago (R. R. Miller, cited in Williams and Wilde 1981).

The amount of habitat historically occupied by the Pahranagat roundtail chub is estimated to be 30 kilometers (km) (18.6 miles) of stream, including Ash, Crystal, and Hiko springs and their outflows; Pahranagat Creek; and Maynard Lake at the southern end of Pahranagat Valley (USFWS1998). However, uncertainties surround the historical distribution of Pahranagat roundtail chub in Pahranagat Valley because much of the surface water in the valley was manipulated for agricultural use before a thorough inventory of the valley was conducted (Courtney et al. 1985; Townley 1973). The Pahranagat Indians were the first to manipulate these springs for agriculture, before European settlement of Pahranagat Valley occurred (Courtney et al. 1985). Manipulations to the outflows continued after the settlement of Pahranagat Valley in 1865.

Collections made in the 1940s found the species to be present in Crystal Spring, Hiko Spring, and Pahranagat Creek (Tanner 1950). Reports that the fish were used for aquaculture and sold to restaurants in the vicinity indicate that the species may have once been more abundant than it is now (Ferris 1991). In 1950, Tanner (1950) reported the fish to be rare and its existence jeopardized. Since 1950, the chub has not been observed in either Crystal or Hiko springs, and suitable lotic (i.e., flowing water) habitat has been reduced or eliminated in both springs (USFWS 2008). Studies in the 1980s reported low numbers of Pahranagat roundtail chub: 37–45 adults inhabited approximately 2.3 km (1.4 miles) of Pahranagat Creek in 1982 (Hardy 1982); and depending on season, 150–260 adults (>100 millimeter [mm] [3.9 inches] Fork Length [FL]) were found in the Ash Springs system during a 3-year study (1986–1989) conducted by the National Fisheries Research Center, Reno Substation (Tuttle et al. 1990).

13.2.3.2 *Recent Distribution and Abundance*

The Pahranagat roundtail chub is currently confined to 3.5 km (2.2 miles) of their historic habitat in Pahranagat Creek, starting at the confluence of Ash and Crystal springs and ending at the concrete-lined Highland Ditch and earthen East Ditch (USFWS 1998). A refuge population is located at the Nevada Department of Wildlife's (NDOW) Key Pittman Wildlife Management Area (WMA) in a well-fed pond, and a captive population is being maintained at the Dexter National Fish Hatchery in New Mexico. In 2011, approximately 1,000 Pahranagat roundtail chub were taken from Dexter National Fish Hatchery and stocked at the Pahranagat NWR in Cottonwood Spring, after the spring was excavated, in an attempt to establish another refuge population (NDOW 2011b). The introduced population at Cottonwood Spring was unsuccessful, and no chub are currently found there.

The NDOW conducted regular snorkel surveys between 1997 and 2012 in Pahranagat Creek and documented between 2 and 2,849 individuals in Pahranagat Creek, depending on the year (Table 13-1). Between years 2002 and 2005, no survey information is available for this species. In 2006, NDOW continued conducting snorkel surveys and documented between 2 and 84 fish in Pahranagat Creek between the years of 2006 and 2012 (Table 13-1). The definitive reason for decreasing chub numbers is unknown. Some have suggested that instream temperatures may be a factor; however, actual temperature thresholds for the Pahranagat roundtail chub are unknown (Tuttle et al. 1990; NDOW 2011a). Between 2010 and 2012, the NDOW set temperature data-loggers to gather year-round information on stream temperature (NDOW 2011a). Once the data are compiled, they can be compared with past and future changes in the temperature regime of Pahranagat Creek.

During snorkel surveys, individuals are counted, and a size estimate is recorded. Chub are grouped into 4 size classes, presumably based on estimates of Total Length (TL), which is the standard used by NDOW: Class A (0–50 mm [0–1.9 inches]), Class B (50–99 mm [1.9–3.9 inches]), Class C (100–149 mm [3.9–5.9 inches]), and Class D (150+ mm [5.9+ inches]) (NDOW 2006). Size has been used to distinguish between juveniles and adults, with fish less than 100 mm (3.9 inches) being considered juveniles and fish greater than 100 mm (3.9 inches) being considered adults (Tuttle et al. 1990).

13.2.4 Life History

Much of what we know about the life history and habitat requirements of the Pahranagat roundtail chub is from a 3-year (1986–1989) ichthyofauna survey and study conducted by the National Fisheries Research Center, Reno Substation. Pahranagat roundtail chub have an omnivorous diet (e.g., insects, crustaceans, plant material, and fish) and forage primarily through drift feeding (Tuttle et al. 1990). Drift feeding involves the alignment of the body facing upstream while striking forward and upward at food items carried by the current. Chub have also been observed feeding off the surface of submerged objects, and in one instance, preying directly upon a mosquito fish.

Rates of adult drift feeding vary, with more food consumed in the winter than in the summer. The lower food consumption rate during the summer corresponds to a reduced availability of food items (Tuttle et al. 1990). The summer appears to be a period of austerity for adults, characterized by high metabolic demands due to warmer water temperatures and low food availability. Large Pahranagat roundtail chub may feed more selectively during periods of increased water temperature, preferring bigger prey items. During winter, retrieval of smaller prey items in cooler water requires the expenditure of less metabolic energy.

Table 13-1. Nevada Department of Wildlife snorkel surveys 1997–2012

Survey Date	Size Class A	Size Class B	Size Class C	Size Class D	Total
January 1997	0	18	61	62	141
May 1997	90	278	107	93	568
March 1998	0	55	120	38	213
June 1998[b]	1,797	799	164	89	2,849
June 1999	18	114	127	49	308
January 2000	0	33	77	23	133
July 2000	40	28	33	35	138
July 2001	3	8	5	9	25
April 2006[c]	0	0	1	1	2
October 2006[d]	1	34	8	5	48
December 2006	0	29	44	11	84
October 2009	0	1	2	1	4
June 2010	0	2	0	0	2
May 2012	4	21	13	9	47

Note: Data is from Nevada Department of Wildlife (NDOW) Field Trip Reports prepared with funding under section 6 of the ESA; this table depicts the number of individuals (categorized by size class) encountered by NDOW during snorkel surveys from 1997–2012 (NDOW 2001, 2006, 2009, 2010, 2012).

[b] Represents an estimate extrapolated from survey transects (NDOW 2006).

[c] Visibility was poor, and survey ended after a few hours (NDOW 2006).

[d] Incomplete survey (NDOW 2006).

Pahranagat roundtail chub have been observed spawning in Pahranagat Creek during January and February (Tuttle et al. 1990). Adult Pahranagat roundtail chub begin to congregate in mid-January, although spawning generally does not start until late January. Peak daytime spawning activity generally occurs during early to mid-February, and although congregations persist through March, spawning usually does not occur after mid-February.

Pahranagat roundtail chub use a broadcast spawning strategy and lay eggs over gravel substrate (Tuttle et al. 1990). Spawning occurs in relatively fast water in gravel-covered pool bottoms at water depths ranging from 0.58 to 1.04 meters [m] (1.9 to 3.4 feet), with water velocity ranging from 0.08 to 0.54 meters per second (m/s) (0.25 to 1.2 feet per second [ft/s]) (Tuttle et al. 1990). Water temperatures during the spawning months range from 17.0 to 24.5 °C (63 to 76 °F), and dissolved oxygen concentrations range from 5.2 to 6.3 milligrams per liter (m/L) (parts per million [ppm]). Larvae reach “swim up” stage approximately 28 days after eggs are deposited in the gravel bed. Larvae leave the spawning beds within 28–53 days, with peak emigration occurring on the 30th day.

13.2.5 Habitat

Adult (>100 mm [3.9 inches]) and juvenile (25–100 mm [1–4 inches]) Pahranagat roundtail chub in Pahranagat Creek typically inhabit pools below a riffle, but adults are also found in deeper pools, closer to the stream bottom, and in faster water (Tuttle et al. 1990). Larval Pahranagat roundtail chub occur in slack water, near the water surface, and along the creek’s edge. Adult

Pahranagat roundtail chub occurred in water depths ranging from 0.4 to 1.4 m (1.3 to 4.6 feet), with a mean of 0.8 m (2.6 feet), and water velocities ranging from 0.00 to 0.80 m/s (0.0 to 2.6 ft/s), with a mean of 0.32 m/s (1.04 ft/s). Pahranagat roundtail chub juveniles occupied areas with water velocities of 0.00 to 0.60 m/s (0.0 to 2.0 ft/s), with a mean of 0.20 m/s (0.7 ft/s). Larval Pahranagat roundtail chub occurred in essentially still water (0.00 to 0.30 m/s [0.0 to 1 ft/s]), with a mean of 0.06 m/s (0.2 ft/s). Habitat use among the 3 life stages varies, indicating juvenile and larval Pahranagat roundtail chub function as ecologically separate entities (Tuttle et al. 1990).

Adult Pahranagat roundtail chub occupy deeper and slower water in summer than in spring or winter. This shift is partially attributable to reduced summer water flow but may also be part of a behavioral response to increased metabolic demands associated with warmer water. Summer water temperatures (29.2–32.2 °Celsius (°C) [85–90 °Fahrenheit (°F)]) in Pahranagat Creek may be stressful for Pahranagat roundtail chub and potentially lethal. Along with inhabiting areas of lower water velocity during the summer, Pahranagat roundtail chub also reduce their active metabolism. During the summer season, Pahranagat roundtail chub tail beats were only 75% of those counted during the winter. This reduction suggests that the Pahranagat roundtail chub may move into slower water during the summer to reduce energy expenditures (Tuttle et al. 1990).

13.2.6 Population Dynamics

Limited information is available to analyze Pahranagat roundtail chub population dynamics in Pahranagat Creek. Some uncertainty exists regarding historical population information because this system was manipulated for agriculture before thorough fish surveys could be conducted. Data collected by different organizations are not always comparable, since techniques, personnel, and protocols are different. Recent surveys conducted by NDOW and the National Fisheries Research Center, Reno Substation, allow for a better understanding of recent trends.

Between 1986 and 1989, the National Fisheries Research Center, Reno Substation, estimated between 150 and 260 individuals, depending on season (Tuttle et al. 1990). Between 1997 and 2001, NDOW conducted snorkel surveys and reported between 25 and 568 direct observations of Pahranagat roundtail chub, depending on the year (Table 13-1). Using an extrapolation of survey transects (rather than direct observation), NDOW estimated 2,849 individuals in June 1998. Surveys conducted by NDOW between 2006 and 2012 have reported between 2 and 84 direct observations, depending on the year (Table 13-1).

These NDOW surveys show considerable fluctuations in population size between 1997 and 2012, including a low of 2 direct observations by NDOW (reported in April 2006 and June 2010) and a high of an estimated 2,849 individuals (reported in June 1998). The most recent data collected by NDOW (2006–2012) reported between 2 and 84 direct observations depending on the year. Additionally, some size class information is available that shows seasonal fluctuation in the adult/juvenile ratio (Table 13-1).

13.2.7 Threats to the Species

The greatest threats to the Pahranagat roundtail chub in their native habitat (Pahranagat Creek) are habitat modification from diversion and piping of spring outflows, for agricultural uses and recreational purposes, and the introduction of nonnative fishes. The well feeding water into the Key Pittman WMA pond is considered a chronic problem as it has failed multiple times.

Habitat modification has greatly restricted available habitat for the chub to 3.5 km (2.2 miles) of Pahranagat Creek. A portion of the spring outflows are diverted away from Pahranagat Creek during the irrigation season, some of the diverted flow may run off back into the creek, and the creek bed has been physically altered (e.g., ditched). Nonnative species that have become established in Pahranagat Creek include common carp (*Cyprinus carpio*), mosquito fish (*Gambusia affinis*), sailfin mollies (*Mollienesia lienesia latipinna*), and convict cichlids (*Archocentrus nigrofasciatus*). These nonnative species compete with Pahranagat roundtail chub for resources.

Several additional threats have been identified since the Pahranagat roundtail chub were listed under the ESA, including groundwater withdrawal for municipal needs and climate change (for a detailed discussion of potential climate change impacts, please refer to Chapter 8, Climate Change Analysis). All of these threats have the potential to affect water quantity and quality and habitat in Pahranagat Valley.

13.2.8 Conservation Needs

The Service's recovery plan for Pahranagat roundtail chub specifies conservation measures that must be met before downlisting and delisting can occur. The species may be considered for downlisting when 1) Pahranagat Creek contains water pools with temperatures cool enough for chub to persist through the summer months; 2) a self-sustaining population (comprising 3 or more age classes, a stable or increasing population size, and documented reproduction and recruitment) is present in a combined total of approximately 75% of either 6.8 km (4.7 miles) of Crystal Spring outflow stream through its confluence during the winter months with the Ash Springs outflow stream, or 10 km (6.2 miles) of Pahranagat Creek/Ditch below the confluence for 3 complete generations (or a minimum of 15 consecutive years); and 3) impacts to the species and its habitat have been reduced or modified to the extent that they no longer represent a threat of extinction or irreversible population decline (USFWS 1998). Additionally, the Pahranagat roundtail chub may be considered for downlisting when 1) a minimum year-round in-stream flow of 1.75 cubic feet per second (cfs) is present at the point where Pahranagat Ditch starts; 2) the riparian corridor along the outflow stream of Crystal Spring has been enhanced; 3) all impacts to chub habitat have been neutralized or reduced sufficiently for species and land uses to coexist; and 4) a Pahranagat roundtail chub population as defined in the downlisting criteria inhabits approximately 75% of the 6.8 km (4.7 miles) of Crystal Spring outflow stream through its confluence during the winter months with the Ash Spring outflow stream and approximately 75% of the 10 km (6.2 miles) of Pahranagat Creek/Ditch from the beginning of Crystal and Ash springs outflows to Upper Pahranagat Lake.

13.3 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR § 402.02) define the environmental baseline as the past and present impacts of all federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed federal projects in the action area that have already undergone section 7 consultations and the impacts of state and private actions that are contemporaneous with the consultations in progress.

Ash, Crystal and Hiko springs are the source of water for numerous water rights in Pahranagat Valley. Water is used for irrigation, wildlife, stock watering, and quasi-municipal uses all along the central axis of Pahranagat Valley from Hiko Spring in the north to Lower Pahranagat Lake in the south. These water rights include certificated, permitted, and decreed rights. NDOW also has three permitted groundwater rights at a well on Key Pittman WMA. Two are irrigation water rights (a water right for 405 afy and a supplemental water right for 270 afy, from April–October each year), to be used for irrigation in the Nesbitt/Frechy Lake area. The third is a wildlife water right for 407 afy, to be used to feed the refuge pond where Pahranagat roundtail chub occur and then flow into Nesbitt and Frenchy Lakes. The diversion rates and annual duties associated with these rights are defined in either the permit terms or specified in the Pahranagat Lake Decree, and are protected under the Pahranagat Lake Decree and Nevada water law (Nevada Revised Statute [NRS] 533.370 and 533.482).

13.3.1 Status of the Species in the Analysis Area

For this Opinion, the analysis area encompasses nearly the entire global distribution of the Pahranagat roundtail chub in the wild, which consists of 3.5 km (2.2 miles) of Pahranagat Creek and a single pond located at the NDOW-managed Key Pittman WMA. A captive population of Pahranagat roundtail chub also occurs in Dexter National Fish Hatchery, but is not included in this analysis. These sites are depicted in Figure 13-1. Therefore, the status of the species is nearly the same as its range-wide status, which is fully described in the preceding section.

13.3.2 Factors Affecting the Species in the Analysis Area

All Pahranagat roundtail chub occurrences (i.e., Pahranagat Creek, Key Pittman WMA) fall entirely within the analysis area for this Opinion. Therefore, factors affecting the species are the same as those described in the preceding section under *Threats to the Species*.

In September 2011, the Service conducted an informal intraservice consultation for a federally funded fish passage project on Pahranagat Creek/Drain (File No. 84320-2011-I-0411). The restoration project involved the installation of a water control structure and step pools, which enable movement of Pahranagat roundtail chub between the Pahranagat Ditch and Pahranagat Creek and thereby prevent the loss of chubs from the system. We anticipate that this project will have long-term beneficial effects for the Pahranagat roundtail chub.

13.3.3 Recent Section 7 Consultations

We are aware of one recent formal consultation for the Pahranagat roundtail chub in the analysis area relevant to this Opinion. In September 2008, the Service consulted on a Safe Harbor Agreement for Pahranagat Valley Species (File No. 84320-2008-F-0070). This agreement encourages proactive management by nonfederal landowners to benefit endangered and threatened species. Landowners enroll individually through a Cooperative Agreement; to date, no private landowners have enrolled.

13.4 EFFECTS OF THE ACTION

Regulations define effects of the action as “the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline” (50 CFR § 402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Indirect effects are defined as those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

For our effects analysis, we have examined the potential for the Pahranagat roundtail chub to be directly or indirectly affected by implementation of the proposed action and the likely nature of any potential effects. As described in Chapter 1 (Introduction), our analysis includes a site-specific assessment of the effects of the Bureau of Land Management’s (BLM’s) issuance of a right-of-way (ROW) for the main and lateral pipelines and associated facilities (Tier 1 ROW); and a programmatic (conceptual) assessment of the effects associated with BLM’s issuance of ROWs for future groundwater development facilities (Subsequent Tier ROWs) and groundwater pumping. The Service is not exempting take of endangered or threatened species incidental to the programmatic portions of this Opinion. Future site-specific actions that are analyzed broadly under the programmatic portions of this Opinion and that might result in the incidental take of endangered or threatened species will undergo separate formal consultation before any take would occur.

Our assessment of project effects includes an evaluation of the effectiveness of applicant committed measures (ACMs) and BLM monitoring and mitigation measures—that is, how well these measures avoid, minimize, or mitigate effects to the Pahranagat roundtail chub. These measures are presented below, in some cases in summary form; we refer readers to the Final Environmental Impact Statement (FEIS) for the entire text of the measures (BLM 2012b, Chapter 3.20 and Appendix E). As described in Chapter 5 (Analytical Approach), some measures are very specific, while others set up a process for monitoring, managing, and mitigating impacts from future activities, such as groundwater pumping. Any mitigation measure that is specific in terms of how and when it will be applied was considered in our effects analysis. We also recognized and considered those programmatic measures that are more process-oriented (i.e., establishing a framework for developing plans), especially if the intent behind the measure is (at least in part) to protect threatened and endangered species and their habitats. However, because development of specific mitigation measures for programmatic activities (and an analysis of the effectiveness of such measures) has been deferred to future National Environmental Policy Act (NEPA)/ESA consultations, we are uncertain of the likelihood or magnitude of adverse effects and/or the extent to which they would be lessened by implementation of process-oriented measures. Therefore, for our programmatic analyses, we begin by assessing potential impacts of the proposed action absent these measures, and then recognize that if impacts occur, they may (or likely will) be minimized through implementation of these programmatic measures. However, absent site-specific project information, we do not assume that effects from programmatic activities will be completely avoided (see Chapter 5 for more information on our analytical approach).

13.4.1 Applicant Committed Measures Relevant to the Pahranagat Roundtail Chub

The project applicant, Southern Nevada Water Authority (SNWA), has identified a suite of potential environmental protection measures that may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to water resources associated with proposed groundwater pumping (SNWA 2012a; BLM 2012b). These measures are described Section B (Programmatic Measures, Future ROWs) and Section C (Regional Water-Related Effects) of SNWA's ACMs, which are located in Appendix E of the FEIS (BLM 2012b), and measures specific to the Pahranagat roundtail chub are presented or summarized below.

ACM B.1.1 Groundwater production well sites will be selected considering 1) suitable hydrogeologic conditions, including well yield, groundwater drawdown, and groundwater chemistry, based upon exploratory drilling; 2) avoidance of springs, streams, and riparian/wetland areas; and 3) the presence of special-status species and their habitat. [This represents a partial list of those elements of the measure that are relevant to the Pahranagat roundtail chub.]

Commitments by SNWA under the Delamar, Dry Lake, and Cave valleys Stipulation are addressed in ACM C.1.31–C.1.42 and the new Cave Valley ACM (Appendix C). The delineated Area of Interest for the DDC Stipulation covers the entirety of Pahranagat Valley. The DDC Stipulation identifies Ash and Crystal springs as a site where spring discharge is being monitored (continuously) through a funding agreement between SNWA, U.S. Geological Survey (USGS), and the Nevada Division of Water Resources (NDWR). If this funding agreement changes, terminates, or expires, SNWA will continue discharge monitoring at Ash and Crystal springs if agreed upon by the Stipulation parties and if access can be gained to private land. The DDC Stipulation also recognizes Ash, Crystal, and Hiko springs and Key Pittman WMA as potential biological monitoring sites, if selected by the Stipulation's Biological Resources Team (BRT) for monitoring and if access can be obtained. Hydrologic and biological monitoring plans have been developed by the Stipulation hydrology and biology technical work groups (Technical Review Process [TRP] and Biological Review Team [BRT]), and these plans have been accepted by the Stipulation's executive oversight committee and the Nevada State Engineer (NSE). Initial committed measures can be found in the 2009 DDC Hydrologic Monitoring and Mitigation Plan (SNWA 2009) and the 2011 DDC Biological Monitoring Plan (BRT 2011), which together include 1) continuous discharge monitoring at Ash, Crystal, and Hiko springs; 2) four new monitoring wells, including one on the east side of the Hiko Range in Sixmile Flat in Pahranagat Valley and one near the southern boundary of Delamar Valley within a structural feature of the Pahranagat Shear Zone (SNWA 2012b); 3) monitoring of Pahranagat roundtail chub in the Ash Springs outflows through incorporation of NDOW fish surveys; 4) monitoring of specific chub habitat components (e.g., water temperature and quality; macroinvertebrates; aquatic and riparian vegetation); and 5) 16 existing monitoring wells across DDC, White River, and Pahranagat valleys (SNWA 2012b).

The DDC Stipulation requires a minimum of 2 years of baseline hydrologic and biological monitoring data prior to water withdrawal and continued monitoring during withdrawal. The NSE requires a minimum of 2 years of baseline (biology and hydrology) data collection. SNWA has committed to 3 years of biological baseline monitoring (an initial site characterization followed by 2 years of monitoring according to established protocols), and will continue monitoring during ground water withdrawal. Portions of the hydrologic monitoring plan (SNWA 2009) have already been implemented.

Additionally, SNWA has developed a new Cave Valley ACM (Appendix C). In this ACM, SNWA has committed to develop groundwater in Cave Valley in a staged (phased) approach. Staged development will be accompanied by hydrologic monitoring and the setting of decision-making triggers, which will be approved by BLM and FWS and included in future consultations and NEPA analyses prior to initiation of groundwater pumping in Cave Valley.

The SNWA has prepared a Conceptual Adaptive Management (AM) Framework for consideration at the programmatic level (SNWA 2012a). The AM Framework sets out a potential process for implementing adaptive management measures to address adverse environmental impacts associated with SNWA groundwater withdrawals for the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project). Examples of adaptive management measures that may be considered and implemented and which are relevant to the Pahranagat roundtail chub include but are not limited to the following:

ACM C.2.1 In accordance with the Spring Valley and DDC Stipulations and any future water right rulings, the following actions may be implemented to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special-status species: 1) geographic redistribution of groundwater withdrawals, 2) reduction or cessation in groundwater withdrawals, 3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources, and 4) acquisition of real property and/or water rights dedicated to the recovery of special-status species within their current and historic habitat range.

ACM C.2.9 Work with NDOW and private landowners at and downstream of Hiko, Crystal, and Ash springs, as allowed, in Pahranagat Valley to conduct habitat restoration and remove nonnative species to benefit Hiko White River springfish, White River springfish, and Pahranagat roundtail chub.

ACM C.2.10 Work with the irrigation district in Pahranagat Valley to develop system efficiencies and manage water releases to benefit native fish.

ACM C. 2.21 Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit water right holders or sensitive biological areas (e.g., routing excess surface water to subirrigate wet meadows, or creating containment ponds to store floodwaters for use in recharging the aquifer).

13.4.2 Bureau of Land Management Mitigation Measures Relevant to Pahranagat Roundtail Chub

The BLM has identified additional mitigation measures through the NEPA process, which are presented in detail in Chapter 3.20 (Monitoring and Mitigation Summary) in the FEIS (BLM 2012b). Mitigation measures for future groundwater development and pumping are general in nature because they are based on the programmatic-level NEPA analysis. These general measures apply to future GWD Project activities but will be replaced by more specific measures resulting from future tiered NEPA analyses (BLM 2012b). Below, we summarize those components of the BLM mitigation measures that are (currently or potentially are) 1) relevant to the Pahranagat roundtail chub and 2) within BLM's jurisdiction.

ROW-WR-3: ***Construction Water Supply Plan.*** A construction water supply plan will be provided to the BLM for approval prior to construction. The plan will identify the specific locations of water supply wells (whether existing or new) that will be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; identify reasonable measures to reuse or conserve water; and identify any additional approvals that may be required. The BLM will review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. The SNWA will provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. The BLM, in consultation with State agencies and the grazing permittee, will review the location of any newly constructed water wells and determine if any will be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to benefit the BLM for multiple use management, the BLM will work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s). The BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. At locations of potential habitat, but where species occurrence has not yet been determined, surveys will be conducted in accordance with appropriate protocol prior to approving the plan. The construction water supply plan will be a component of the SNWA Plan of Development (POD). Prior to approval of the POD, the BLM will coordinate with the Service regarding portions of the POD relating to their regulatory role under the ESA. This process will be used to determine if there would be adverse impacts to listed species or adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary.

GW-WR-3a: ***Comprehensive Water Resources Monitoring Plan (WRMP)*****.** This mitigation measure requires that SNWA develop a comprehensive WRMP prior to project pumping that specifies hydrologic monitoring requirements to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variation, and other nonproject-related groundwater pumping activities. Monitoring would include 1) water sources essential to federally listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or state lands; 2) wells sited on the northern boundary between Delamar and Pahranagat valleys, and wells in northern Pahranagat Valley, to monitor groundwater elevations between the project pumping in Dry Lake and Delamar valleys and the regional spring discharge in northern Pahranagat Valley (i.e., Hiko, Crystal, and Ash springs); and 3) well(s) sited in the Pahranagat Shear Zone at the boundary between southern Delamar and southern Pahranagat valleys to monitor groundwater elevations between the groundwater production wellfield in Delamar Valley and the perennial water resources in southern Pahranagat Valley (i.e., Pahranagat NWR). The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for a period of at least 5 years prior to initiation of pumping.

GW-WR-3b: ***Numerical Groundwater Flow Modeling Requirements.*** This mitigation measure requires that SNWA update and recalibrate the regional groundwater flow model at least every 5 years after pumping is initiated, and that SNWA develop basin-specific models to be approved by BLM prior to tiered NEPA for specific groundwater development activities. BLM would use the basin-specific models to critically evaluate the effects of pumping and the effectiveness of the proposed mitigation measures, ACMs, and other measures proposed through the AM process. BLM would establish a Technical Review Team to review the model on a periodic basis.

GW-WR-7: ***Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights.*** This mitigation measure addresses BLM action in the event that monitoring or modeling information provided in accordance with GW-WR-3a indicates that impacts to federal resources from groundwater withdrawal are occurring or are likely to occur and that the GWD Project is the likely cause or a contributor to the impacts. The BLM would evaluate available information and determine if emergency action and/or a site-specific mitigation plan is required. If BLM determines that emergency action is required, BLM could serve a “Cease and Desist” order identifying actions to be taken to avoid, minimize, or offset impacts. If a site-specific mitigation plan is needed, BLM could require that specific measures be implemented (per the schedule specified in the plan) to avoid, minimize, or offset impacts to federal resources or federal water rights; examples of such measures include 1) geographic redistribution of groundwater withdrawals, 2) reduction or cessation in groundwater withdrawals, 3) flow augmentation to maintain flow in specific water sources, 4) recharge projects to offset local groundwater drawdown, and 5) other on-site or off-site improvements.

Per BLM (10/04/2012), language in the ROD for this measure will be changed to state that BLM could serve a “Temporary Suspension” order pursuant to 43 CFR 2807.16-18, if needed, and not a “Cease and Desist” order.

GW-AB-3: ***Flow Change Mitigation.*** This measure specifies that BLM will identify detailed mitigation measures during subsequent NEPA analyses for those springs and streams with special-status aquatic species where flow or water level changes are identified during modeling or monitoring. Mitigation ideas are identified at the programmatic level in the ACMs, BLM’s comprehensive monitoring, management, and mitigation plan (COM Plan), and mitigation measure GW-WR-7 above.

GW-MN-AB-2: ***Spring and Aquatic Biological Monitoring.*** This measure requires SNWA to monitor flows in moderate- and high-risk springs (as defined by BLM) with special-status species where potential pumping effects could occur (as determined by BLM).

GW-MN-AB-3: ***Flow/Habitat Determination***. This measure requires SNWA to study flow or water level-habitat relationships in selected streams and springs to determine minimum flow or water levels needed to support critical life stages of aquatic species in these habitats. The sites where these studies would occur would be selected from the list of sites being monitored as part of the Stipulations or from additional waterbodies recommended for measures GWD-MN-AB-1 (relevant to game species) and GWD-MN-AB-2 (relevant to special-status species).

BLM does not identify sites in Pahranagat Valley as being at moderate or high risk from GWD Project pumping. Therefore, we assume that BLM is not likely to require monitoring or studies as specified in GW-MN-AB-2 and GW-MN-AB-3 for Pahranagat roundtail chub habitat. However, we also assume that if BLM's risk assessment for springs in Pahranagat Valley were to change at future tiers (i.e., move from "low risk" to "moderate risk" or "high risk"), then these measures would apply to the chub where it occurs on public or State land. Additionally, GW-WR-3a requires monitoring of water sources essential to federally listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or State lands. Again, none of the chub sites satisfy the criterion of being considered "at risk" by BLM. Additionally, much of the chub's current distribution is on private land (i.e., Pahranagat Creek). As discussed above, monitoring is occurring in Pahranagat Valley under the DDC Stipulation.

The BLM is also developing its own COM Plan that addresses all hydrographic areas and all facilities associated with the GWD Project (BLM 2012b). The intent of the COM Plan is to protect federal resources and federal water rights that may be impacted by the GWD Project, including avoiding adverse impacts that could cause jeopardy to listed species or destruction or adverse modification of designated critical habitat. The BLM will develop this plan based on SNWA's final Plan of Development and in coordination with other agencies, and Notices to Proceed will not be issued until the COM Plan has been completed (BLM 2012b). The COM Plan for Tier 1 will outline a process for developing additional mitigation, monitoring, and management requirements for future ROW grants and will identify baseline and data gap information needs to better inform subsequent NEPA analysis for groundwater development. COM Plans specific to groundwater development may be developed for subsequent tiers of the GWD Project, or the COM Plan for Tier 1 may be amended. The COM Plan(s) will also include development of triggers for management action and AM thresholds (BLM 2012b).

13.4.3 Approach to Analysis

Please refer to Chapter 5 (Analytical Approach) for a detailed discussion of our approach for analyzing effects related to Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping. The hydrologic analysis forms the backbone of the effects analysis for all federally listed species that rely on groundwater-dependent ecosystems. The hydrologic analyses can be found in Chapter 7 and are referenced in this chapter as appropriate. Below, we focus primarily on describing 1) potential project effects to the Pahranagat roundtail chub and 2) potential cumulative effects. Lastly, we present our determination as to whether or not the proposed action is likely to jeopardize the continued existence of the Pahranagat roundtail chub.

As explained in Chapter 7, various uncertainties are associated with the Central Carbonate-Rock Province (CCRP) modeling results; the model was developed as a tool to predict potential hydrologic change at a regional scale, not a site-specific scale. However, we must conduct a site-specific analysis for threatened and endangered species that may be affected by the proposed action. Thus, we have used the CCRP Model as one of several tools for assessing potential impacts to the Pahranagat roundtail chub. For our hydrologic analysis, we assessed whether the CCRP Model likely over- or underpredicted drawdown in the carbonate aquifer at the regional springs in Pahranagat Valley and in the vicinity of Pahranagat Wash and Key Pittman WMA.

13.4.4 Effects to Pahranagat Roundtail Chub

13.4.4.1 *Tier 1 ROWs (Main Pipeline and Associated Facilities)*

We do not anticipate any direct or indirect construction-related effects to Pahranagat roundtail chub associated with Tier 1 ROWs. Tier 1 activities are located approximately 17–18 miles from Pahranagat Creek or Key Pittman WMA (Figure 13-1). At this distance, the Pahranagat roundtail chub would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Indirect effects from groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) are examined separately in the paragraphs that follow.

Additionally, we do not anticipate that pumping of groundwater in Delamar Valley for construction purposes will adversely affect the Pahranagat roundtail chub that occur in Pahranagat Creek or Key Pittman WMA. The SNWA anticipates that at most 27 acre-feet (or about 8.7 million gallons) of water will be needed for every mile of pipeline. There will be approximately 37 km (23 miles) of Tier 1 pipeline in Delamar Valley (BLM 2012a), so we estimate that 621 acre-feet (200 million gallons) of water will be needed for construction purposes in this valley. The specific locations of the construction water supply wells and the specific groundwater aquifer that will be used are still unknown, but SNWA assumes that this water will be obtained from existing wells or exploratory wells that are available at the time of construction and that a construction water supply well will be needed approximately every 16 km (10 miles) along the pipeline alignment.

This pumping will be temporary and will involve a relatively small quantity of water; in addition, pumping will likely be at considerable distance from chub habitat in Pahranagat Valley since the nearest Tier 1 ROW is approximately 29 km (18 miles) away from Ash Springs. Furthermore, BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will review and approve prior to construction (ROW-WR-3), under which BLM will not approve a plan that that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Considering all of these factors, we do not anticipate that pumping for GWD Project construction in Delamar Valley or more distant locations (e.g., Dry Lake and Cave valleys) will affect chub habitat in Pahranagat Valley. If later determinations indicate that adverse effects could occur to the chub that were not considered in this consultation, then BLM should request reinitiation of section 7 consultation.

13.4.4.2 *Subsequent Tier ROWs (Groundwater Development Areas)*

We do not anticipate any direct effects to the Pahranagat roundtail chub from construction, operation, and maintenance of production wells, collector pipeline, and any other future groundwater development facilities (Subsequent Tier ROWs). Pahranagat Creek and Key Pittman WMA are located approximately 22.5 km (14 miles) away from the nearest Groundwater Development Area in Delamar Valley (Figure 13-1). At this distance, the species would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) is examined separately in the paragraphs that follow.

The length of future collector pipelines is not known but SNWA has made an estimate based on assumptions regarding the number of future groundwater production wells and known geologic and hydrologic conditions. The SNWA estimates that up to 96.5 km (60 miles) of collector pipeline could be built in Delamar Valley in order to develop and transport groundwater at quantities granted by the NSE in 2012 (BLM 2012a). Considering the assumptions discussed above regarding water needs for construction purposes, we anticipate that SNWA will need up to 1,620 acre-feet of water for construction purposes in Delamar Valley, which is the closest project basin to chub habitat in Pahranagat Valley.

The location of wells that will supply construction water, the source aquifer (basin-fill, volcanic, or carbonate), pumping rates, and exact quantities of water needed are still unknown. However, we do not anticipate impacts to the chub in Pahranagat Valley from groundwater pumping in Delamar Valley for construction purposes; we base our conclusion on the following factors: the temporary nature of the pumping; the large intervening distance between the identified groundwater development areas and springfish habitat at Ash, Crystal, and Hiko springs; and BLM's commitment to not approve a construction water supply plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Similarly, we do not anticipate that temporary pumping for construction purposes in even more distant locations (i.e., Dry Lake or Cave valleys) will affect the Pahranagat roundtail chub or its habitat. This conclusion will be reevaluated for any tiered consultation involving ROWs in DDC valleys, using any updated project information that may be provided.

13.4.4.3 *Groundwater Pumping*

It is our opinion that the discharge from regional springs on the valley floor of Pahranagat Valley (e.g., Ash and Crystal springs), and the groundwater levels in the vicinity of Pahranagat Creek and the well-fed pond on Key Pittman WMA, may be adversely affected by the proposed pumping in Dry Lake and Delamar valleys (and potentially Cave Valley) within the timeframe of our analysis (see Chapter 7), but we are unsure of the likelihood or magnitude of such effects. After reviewing the best available information, it is our opinion that these hydrologic effects are most likely not discountable (i.e., not extremely unlikely to occur) within the timeframe of our analysis, and we believe that adverse impacts would not be insignificant (i.e., the size of hydrologic impact would be such that one would be able to meaningfully measure, detect, or evaluate the impact). We acknowledge that State water law should preclude unreasonable effects on senior water rights at springs. Also, Key Pittman WMA water rights are intended to help conserve chubs there.

As described above, Ash, Crystal, and Hiko springs are the source of water for numerous water rights in Pahranagat Valley. Water is used for irrigation, wildlife, stock watering, and quasi-municipal uses all along the central axis of Pahranagat Valley from Hiko Spring in the north to Lower Pahranagat Lake in the south. NDOW also has permitted groundwater rights at a well on Key Pittman WMA, which contributes water to the refuge pond where Pahranagat roundtail chub occurs. These existing water rights are protected under the Pahranagat Lake Decree and Nevada water law (NRS 533.370 and 533.482). NRS 533.482 provides the NSE with the authority to seek injunctive relief to prevent any action that would violate Nevada water law's protection of existing rights or any order or regulation of the NSE. The NSE may even request an injunction before any injury to a water right occurs. The fact that both federal district courts and Nevada state courts have consistently ruled in favor of protecting senior existing water rights from injury underscores the fact that flows from Ash, Crystal and Hiko springs that support these existing water rights are insulated from adverse effects from the GWD Project.

Given the uncertainty associated with the likelihood or magnitude of drawdown-related impacts to spring flow, we cannot rule out the possibility that 1) pumping associated with the GWD Project could result in adverse effects to Pahranagat roundtail chub and 2) the size of the impact could be significant (i.e., one would be able to meaningfully measure, detect, or evaluate the impact, and "take" may occur) within the timeframe of our analysis. Therefore, we do not concur with BLM's "may affect, not likely to adversely affect" determination for this species.

Pahranagat Creek

If declines in discharge from Ash and Crystal springs result from GWD Project pumping in Dry Lake, Cave, and Delamar valleys, water velocities, depths, temperature, and quality in Pahranagat Creek may be adversely affected. Ash and Crystal springs outflows combine to form Pahranagat Creek, which is the only native habitat remaining for Pahranagat roundtail chub. Ash Spring is the principal headwater for Pahranagat Creek and Upper Lake in Pahranagat NWR, while Crystal Spring provides outflow to these sites outside of the summer irrigation season. Irrigation diversion activity can confound accurate measurement of flow volumes in different parts of the drainage. It is noted that Pahranagat roundtail chub habitat in Pahranagat Creek is currently altered and experiences fluctuations due to management (e.g., extensive irrigation diversions).

Due to the complexity of ecosystem processes, we cannot predict *specifically* how groundwater drawdown or diminished spring flow would affect Pahranagat roundtail chub at Pahranagat Creek, if such water conditions occurred. Attempts at prediction are further complicated by a lack of information on the impacts of decreased discharge on spring-fed streams and associated fauna and our incomplete knowledge of chub life history, habitat requirements, food preferences, and individual and population-level responses to diminished water quantity and/or quality. Below, we describe the potential consequences of decreased spring flow to the Pahranagat roundtail chub; this information is best viewed as a set of hypotheses (based on the best available information) about the responses of chub habitat and the fish itself to diminished flow.

Relatively small changes in flow could result in rather substantial ecological responses; this relationship has been documented in other aquatic systems ranging from larger runoff-fed streams or rivers to spring systems (Hubbs 2001; Lloyd et al. 2003). Decreased flows could result in diminished spring brook length, wetted width, water depth, and water velocity (Bradford and Heinonen 2008), with reduced velocity frequently being one of the largest and more apparent changes (Dewson et al. 2007). Stream habitats (pool, riffle, glide, run) would be affected differently, with shallower and/or swifter-flowing waters (e.g., riffles and margins of the system) being more adversely affected and impacted sooner by decreased flows than pool habitats would be (Dewson et al. 2007; Bradford and Heinonen 2008; Kollaus and Bonner 2012). But pool environments would eventually be impacted by continued low flows (Bond et al. 2008; Bradford and Heinonen 2008). The overall result of diminished flow could be a decrease in aquatic habitat diversity and complexity.

The Pahranagat roundtail chub uses complex habitats within Pahranagat Creek (Tuttle et al. 1990). The chub appear to use or need different aquatic habitats (pools, riffles, etc.) in different seasons and/or life stages, and their ability to access these habitats is likely essential to successful feeding, spawning, and recruitment. Therefore, we anticipate that if changes in discharge that adversely affect habitat extent and diversity/complexity occur, they could have substantial consequences for the Pahranagat roundtail chub.

Additionally, reduced flows are known to result in water quality and temperature changes, which can be stressful for fish (IFC 2002, cited in Bradford and Heinonen 2008). Small changes in water temperature can have considerable consequences for freshwater fishes, affecting life history (e.g., reproduction, feeding), behavior (e.g., predator avoidance, migration, and spawning), and physiology (e.g., metabolism, growth, body condition) (Carveth et al. 2006). Reduced water volume and loss of riparian trees due to ground- and stream-water drawdown could result in increased daily and annual water temperature fluctuations (Carveth et al. 2006; Whitledge et al. 2006). If shallow waters are exposed to high ambient temperatures and direct sun during summertime, water temperatures could rise to levels detrimental to Pahranagat roundtail chub.

While Pahranagat roundtail chub is a thermal tolerant species, it likely needs cool water pools to persist through summer months when higher water temperatures in Pahranagat Creek may be stressful to fish. As mentioned above (“Status of the Species–Habitat”), adult roundtail chub occupy deeper and slower water in summer, which may be a behavioral response to increased metabolic demands associated with warmer water. Decreased discharge, if it occurred, could result in shallower pools, which could alter the vertical temperature gradient in these pools, with a relatively greater proportion of the water column exposed and affected by air temperatures and the sun.

Lower current velocities and reduced water volume may reduce the foraging efficiency and/or availability of drifting aquatic insects for Pahranagat roundtail chub (Sada and Deacon 1994; Scoppettone 2007). Drift feeding fish, such as the chub, need slow water that allows them to conserve energy while sighting drift items in adjacent faster water that transports these food items. Because the Pahranagat roundtail chub is a larger-bodied fish than other native species discussed in this Opinion (e.g., spinedace), it may require an even larger body of water to forage efficiently on drift (Scoppettone 2007).

Lower current velocities could result in increased sedimentation and increased growth of macrophytes (aquatic plants—submergent, emergent, or floating). These changes could result in a decrease in clean gravel and sand substrates, thus reducing chub spawning habitat and/or habitat for stream benthic macroinvertebrates (Sada and Deacon 1994). An increase in submerged macrophytes, which can be common in spring-fed streams (especially those with little riparian vegetation cover), could affect water quality (e.g., by reducing vertical mixing and consuming oxygen in the aquatic ecosystem at night) and water velocities and depths (e.g., reducing stream velocities and increasing stream depth by essentially "damming" water) (Allen and Hay 2011, and references therein). Flow reductions of sufficient magnitude and duration would ultimately lead to a reduction in water level in spring-fed streams, but the overall response of water level to reduced flow in these systems would have a hump (Allen and Hay 2011).

An overall reduction in water volume could affect growth and reproduction of the Pahranagat roundtail chub. Freshwater fish are known to scale in size to the water volume inhabited (Smith 1981). Additionally, larger fish tend to be more fecund; this relationship has been demonstrated for numerous freshwater fish species (e.g., Johnson et al. 1995; Scoppettone et al. 1992). Therefore, we infer that lower water volume, if it occurred, could result in smaller and less fecund chub, which would consequently reduce reproductive potential of the population.

As mentioned above, declines in spring flow could result in reduced groundwater levels in adjacent riparian areas, which would eventually alter the composition, cover, and distribution of riparian plant communities that provide shade, cover, food (i.e., macroinvertebrates), and allocthonous (organic matter) input into Pahranagat Creek. Reduced flow could also result in proliferation of filamentous algae, which could lead to poorer water quality (Reiser et al. 2004, cited in Allen and Hay 2011).

As described above, nonnative fishes and other nonnative aquatic species (crayfish, bullfrogs) are common in Ash Springs and Pahranagat Creek and are one of the most pressing threats for persistence of the chub. Pahranagat Creek is extremely altered from natural conditions, and if further hydrologic alterations (e.g., diminished flow) occur, they could exacerbate the effects of nonnative species on native fishes by decreasing habitat complexity and the ability of species to segregate habitat (Scoppettone 2007; Helfman 2007, cited in USFWS 2011). Flow regime modifications in other aquatic systems are thought to have facilitated competitive dominance of nonnative species that have relatively high environmental tolerances or are from waters naturally similar to the disturbed (modified) conditions (Hoagstrom et al. 2010). On the other hand, the restoration of natural processes in aquatic systems can be expected to help maintain native fish populations (Marchetti et al. 2004; also see Scoppettone et al. 2005). We infer from this that if spring flow decreased from current conditions at Ash Springs, the decrease could result in further habitat changes that could be favorable for certain nonnative aquatic species, potentially at the expense of the chub.

Key Pittman Wildlife Management Area

The Key Pittman WMA is a refuge pond is maintained by the NDOW. Effects on the pond from pumping are likely to be different from those in Pahranagat Creek. The pond is well-fed rather than spring-fed like Pahranagat Creek. The well is perforated 18–121 m (60–400) feet below ground surface. Therefore, as long as the well is maintained and operational, the well should be able to provide water to the refuge pond as long as groundwater elevation at the well is above approximately 121 m (400 feet) below ground surface. The refuge pond is a simple system and lacks much of the habitat complexity found in Pahranagat Creek, though chubs may be common in the pond. The well that supplies water to the pond could be affected by GWD Project pumping if groundwater levels drop.

13.4.5 Analysis of Effects to Pahranagat Roundtail Chub with Implementation of Applicant-committed and Bureau of Land Management-committed Mitigation Measures

The Service anticipates that the programmatic ACMs and BLM monitoring and mitigation measures described in this chapter would reduce the potential for or magnitude of effects to the Pahranagat roundtail chub from programmatic activities by requiring development and implementation of a broad monitoring, management, and mitigation plan. This plan will be designed to 1) provide early warning of potential adverse impacts; 2) establish decision-making triggers; 3) avoid, minimize, or mitigate adverse impacts to groundwater-dependent ecosystems and biological communities; 4) monitor the effectiveness of mitigation measures in achieving expected outcomes and reducing impacts; and 5) allow for adaptability and flexibility in management of the GWD Project (a more detailed list of COM Plan goals and objectives can be found in Chapter 3.20 of the FEIS; BLM 2012b). However, in the absence of a fully developed monitoring, management, and mitigation plan for groundwater development—and in the absence of site-specific project information, including site-specific mitigation measures, which could be used to further evaluate the potential effects of groundwater withdrawal—the Service anticipates that adverse effects may still occur as a result of GWD Project pumping. The BLM and Service will reevaluate site-specific effects when project details related to groundwater development are known and proposed by the project applicant, at which time we will again determine if adverse effects to listed species and their critical habitats are likely to occur, and follow the appropriate consultation procedures. The well that feeds the Key Pittman WMA refuge pond where Pahranagat roundtail chub occur is perforated 60–400 feet below ground surface. Therefore, as long as the well is maintained, the well should be able to provide water to the refuge pond as long as groundwater elevations are sufficient.

For a detailed discussion of how we treated programmatic-level ACMs and BLM measures in our programmatic analysis, please refer to Chapter 5 (Analytical Approach).

13.4.6 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Act.

We believe that future groundwater uses are reasonably certain to occur in the action area. The BLM considered these future groundwater uses as part of their baseline assessment, so we account for them in the conclusion section under aggregate effects. See Chapter 5 ("Analytical Approach, Cumulative Effects").

13.5 CONCLUSION

We have evaluated the environmental baseline, project effects, and cumulative effects for the species. Another source of uncertainty with respect to effects on the species is climate change. Climate change has the potential to exacerbate the effects of decreased discharge from GWD Project pumping on fish and fish habitat. Potential climate change impacts are discussed in detail in Chapter 8 of this Opinion. In summary, higher air temperatures, more winter precipitation in the form of rain rather than snow, and earlier snowmelt could result in increased evapotranspiration and shifts in the timing and/or amount of groundwater recharge and runoff (EPA 1998), potentially resulting in decreased summer flows in springs and streams. These effects could result in altered thermal regimes in springs, reduced extent of the stable springhead environment, reduced springbrook length, reduced heterogeneity of the aquatic environment, and reduced soil moisture (Sada and Herbst 2008). However, predicting local climate change impacts is difficult due to substantial uncertainty in trends of hydrologic variables (e.g., natural variability can mask long-term climate trends), limitations in spatial and temporal coverage of monitoring networks, and differences in the spatial scales of global climate models and hydrologic models (Bates et al. 2008). Thus, while climate change may affect chub habitat in Pahranagat Valley, the attributes that will be affected and/or the timing, magnitude, and rate of change are uncertain. Future tiered analyses for groundwater development and pumping will provide us with opportunities to update the cumulative effects analysis, using the latest climate change information and/or local-scale model predictions for climate change.

After reviewing the current status of the Pahranagat roundtail chub, the environmental baseline for the analysis area, the effects of the proposed action, and the cumulative effects, it is our opinion that the action, as proposed, could adversely affect the Pahranagat roundtail chub but is not likely to jeopardize the continued existence of this species. We have reached this conclusion for the following reasons:

- Our hydrologic analyses (see Chapter 7) indicate that it is <u>not</u> extremely unlikely for measurable impacts to occur to the discharge of regional springs on the valley floor of Pahranagat Valley (e.g., Ash and Crystal springs), and to the groundwater levels in the vicinity of Pahranagat Creek and the well-fed pond on Key Pittman WMA, during the timeframe of our analysis, due to the proposed pumping in Dry Lake and Delamar valleys (and potentially Cave Valley).
- Because measureable impacts from proposed pumping could occur in chub habitat, we cannot rule out the possibility of GWD Project pumping resulting in measurable impacts to Pahranagat roundtail chub during the timeframe of our analysis.
- Pahranagat roundtail chub is extremely limited and reduced in its distribution and abundance within Pahranagat Valley compared to what we know of historic conditions. Protection of the chub in its last native habitat in the outflows of Ash Springs is of utmost importance to recovery of the species. We note, therefore, that even relatively small impacts may have significant effects on the species.

- Pahranagat roundtail chub habitat in the outflows of Ash Springs is already severely degraded from historic conditions due to the modification of spring outflows for irrigation and the establishment of nonnative aquatic species. The roundtail chub refuge pond on Key Pittman WMA has had chronic water problems, and habitat needs to be stabilized. Pumping-induced decreases in spring discharge and groundwater levels could further degrade Pahranagat roundtail chub habitat and adversely affect these chub populations. The extent to which this occurs will depend primarily on the magnitude and duration of reductions in groundwater levels and spring discharge, for which uncertainty exists.
- We anticipate that impacts to the Pahranagat roundtail chub and its habitat can be minimized by implementation of the ACMs and BLM monitoring and mitigation measures, but the extent to which this will occur is unknowable at this time.

In the absence of site-specific project information about groundwater development—and considering unknowns regarding the response of the hydrologic system to pumping stresses, the response of Pahranagat roundtail chub and its habitat to decreased flow and groundwater levels, and potential climate change impacts—the Service believes that, in fact, it is not extremely unlikely that this species will be adversely affected as a result of groundwater development under the proposed action. However, available information does not indicate that adverse effects resulting from implementation of the GWD Project will appreciably reduce the likelihood of both the survival and recovery of the Pahranagat roundtail chub.

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Chapter 14
SOUTHWESTERN WILLOW FLYCATCHER

This chapter provides our Biological and Conference Opinion (Opinion) regarding potential effects of the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) to the federally listed southwestern willow flycatcher (*Empidonax traillii extimus*). The chapter includes a conference opinion on proposed (revised) critical habitat for this subspecies of willow flycatcher.

14.1 ANALYSIS AREA AND PROJECT COMPONENTS

The analysis area for the southwestern willow flycatcher (flycatcher) is a subset of the overall action area described in Chapter 3 (Action Area) and encompasses those Hydrographic Basins (HBs) within the action area that meet one or more of the following criteria: 1) HBs with known breeding occurrences of the flycatcher and/or proposed critical habitat for the subspecies; 2) HBs in which one or more components of the GWD Project have the potential to generate adverse effects to the flycatcher and/or its proposed critical habitat; and 3) HBs through which impacts generated in project basins would have to propagate to reach any site with breeding flycatchers and/or proposed critical habitat. This third criterion primarily reflects the patterns of hydrologic connectivity (particularly groundwater movement) among HBs within the action area, as described in Chapter 7 (Hydrologic Analyses) of this Opinion. As explained in that chapter, groundwater pumping occurring within a given basin may affect groundwater levels within adjacent or even more distant basins. Our analysis area therefore includes those basins in or through which project-related activities (i.e., groundwater development) may ultimately affect the flycatcher and/or its proposed critical habitat, in addition to any basin with breeding flycatchers or in which proposed critical habitat can be found. Below we provide our rationale for each of the basins included in our analysis area.

As explained later in this chapter (refer to Status of the Species, Distribution and Status), 3 basins within the action area (Pahranagat Valley, Muddy River Springs Area, and Lower Meadow Valley Wash) meet the first criterion of containing known breeding occurrences and/or proposed critical habitat for the flycatcher. The project basins included in the analysis area based on the second criterion are Cave Valley, Dry Lake Valley, and Delamar Valley. The specific project components that we considered for our flycatcher analysis include the following: 1) construction, operation, and maintenance of any Tier 1 infrastructure (e.g., main pipeline, power lines) in Delamar Valley, which is the closest project basin to flycatcher breeding habitat and/or critical habitat; 2) construction, operation, and maintenance of future groundwater development facilities in Delamar Valley (i.e., production wells, collector pipeline, and associated infrastructure); 3) pumping of 6,042 acre-feet of groundwater per year (afy) in Delamar Valley; 4) pumping of 11,584 afy of groundwater annually in Dry Lake Valley; and 5) pumping of 5,235 afy of groundwater in Cave Valley. Lastly, basins meeting the third criterion include those basins believed to be in hydrologic connection with the project basins and basins where the flycatcher and/or critical habitat occurs. As described in Chapter 7, groundwater drawdown could propagate from production sites in Delamar, Dry Lake, and Cave valleys to sites with known flycatcher breeding habitat or proposed critical habitat by way of intervening valleys.

Therefore, we have defined our analysis area for the southwestern willow flycatcher to include the following HBs: Delamar Valley, Dry Lake Valley, and Cave Valley (3 of the project basins), as well as Pahranagat Valley, Lower Meadow Valley Wash, and Muddy River Springs Area (basins with breeding willow flycatchers and/or proposed critical habitat); the analysis area also includes the following intervening valleys through which groundwater drawdown could potentially propagate to reach flycatcher habitat: White River Valley, Pahroc Valley, Kane Springs Valley, and Coyote Springs Valley. White River Valley has been included in the flycatcher analysis area because we conclude that the proposed pumping in Cave Valley may reduce interbasin outflow to White River Valley within the timeframe of our analysis (see Chapter 7, Hydrologic Analysis for Flag Springs), and interbasin outflow from White River Valley is believed to occur to Pahroc Valley and ultimately Pahranagat Valley (Eakin 1966; Scott et al. 1971; Harrill et al. 1988; LVVWD 2001; Thomas et al. 2001; Thomas and Mihevc 2007). Kane Springs Valley has been included in the analysis area because we conclude that the proposed pumping in Delamar Valley may result in drawdown of the water table, although the timing and magnitude of the drawdown is not known at this time, at the location of flycatcher habitat in northern Lower Meadow Valley Wash within the timeframe of this analysis (see Appendix B, Lower Meadow Valley Wash). Coyote Springs Valley has been included in the analysis area because we conclude that the proposed pumping in Dry Lake and Delamar valleys (and potentially Cave Valley) may result in the propagation of drawdown through the regional carbonate aquifer to the location of flycatcher habitat in the Muddy River Springs Area, although impacts would not likely be significant within the timeframe under consideration (see Appendix B, Muddy River Springs Area).

The analysis area for the southwestern willow flycatcher is depicted in Figure 14-1, together with confirmed breeding sites and proposed critical habitat.

14.2 STATUS OF THE SPECIES

14.2.1 *Regulatory Status*

The flycatcher was listed as endangered on February 27, 1995 (USFWS 1995). The U.S. Fish and Wildlife Service (Service or USFWS) approved a recovery plan for this subspecies on August 30, 2002 (USFWS 2002).

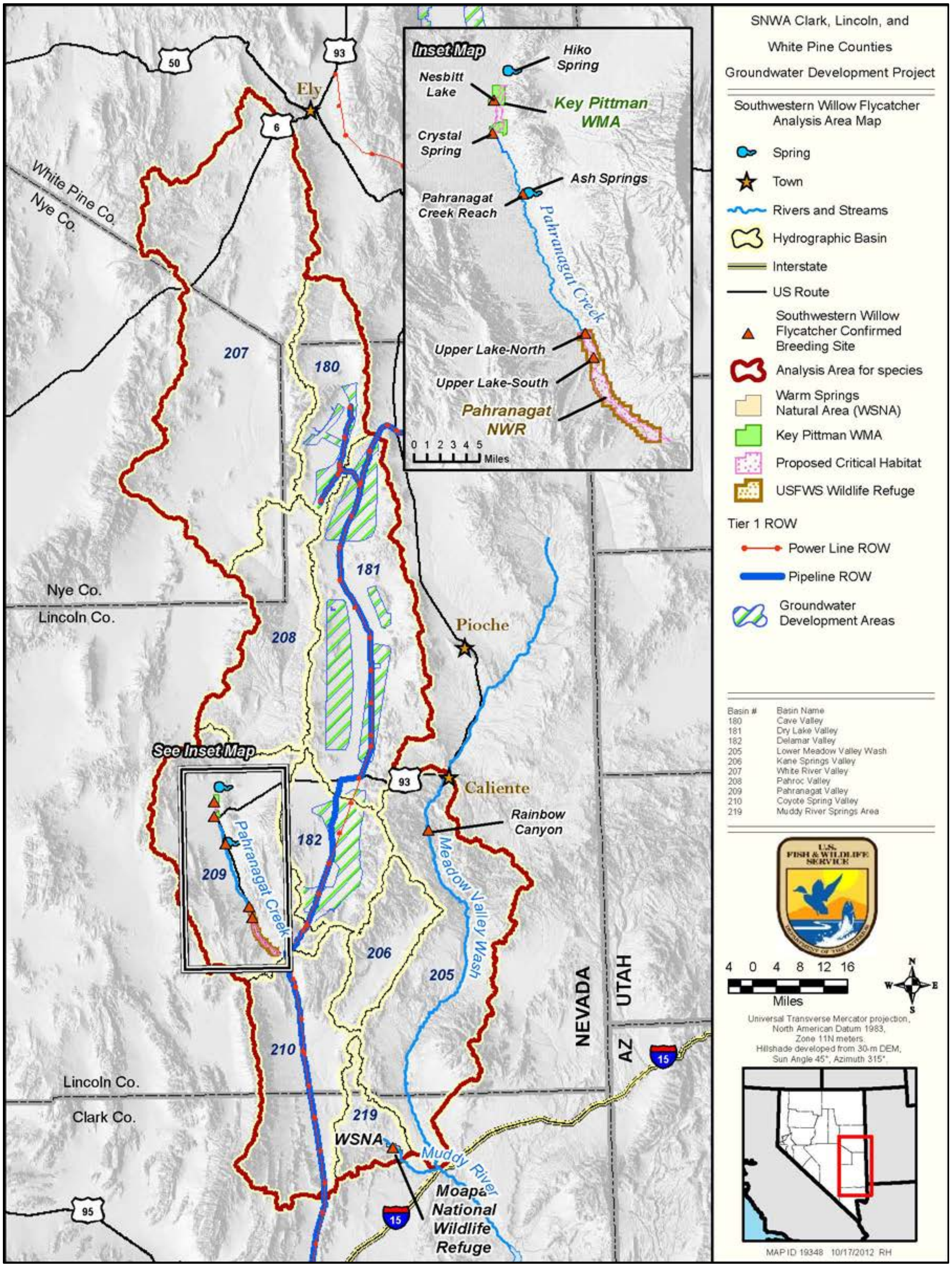

Figure 14-1. Analysis area for southwestern willow flycatcher

14.2.2 *Species Description and Taxonomy*

The southwestern willow flycatcher is a small grayish green passerine bird (family Tyrannidae) measuring approximately 14.61 centimeters (cm) (5.75 inches). The song is a sneezy “fitz-bew” or a “fit-a-bew”; the call is a repeated “whitt.” It is 1 of 4 subspecies of the willow flycatcher currently recognized (Phillips 1948; Unitt 1987; Browning 1993) and is considered genetically distinct from other willow flycatcher subspecies (Paxton 2000). The southwestern willow flycatcher subspecies is distinguished primarily by subtle differences in color, morphology, and habitat use.

14.2.3 *Distribution and Status*

The southwestern willow flycatcher is a neotropical migrant that breeds in the southwestern United States and migrates to Mexico, Central America, and possibly northern South America during the nonbreeding season (Phillips 1948; Stiles and Skutch 1989; Peterson 1990; Ridgely and Tudor 1994; Howell and Webb 1995). The historical breeding range of the southwestern willow flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, southern Nevada, and northwestern Mexico (Sonora and Baja) (Unitt 1987). The current breeding range is similar to the species’ historical range; however, the extent of habitat within this range has declined over time.

From 1993 to 2007, there were 288 known southwestern willow flycatcher breeding sites and an estimated 1,299 territories in California, Nevada, Arizona, Utah, New Mexico, and Colorado, where a resident willow flycatcher were detected (Durst et al. 2008) (Table 14-1). The total number of flycatcher territories cannot be determined because not all sites are surveyed annually. Numbers have increased since the bird was listed, and some habitat remains unsurveyed; however, after nearly a decade of intense surveys, the existing numbers are just past the upper end of Unitt’s (1987) estimate of 20 years ago (500–1,000 pairs). This increase may be due in part to increased survey efforts. Over 66% of the territories estimated throughout the subspecies’ range are located within 3 drainages: 1) Gila River in Arizona and New Mexico (30.1%); 2) Rio Grande River in New Mexico (23.3%); and 3) San Pedro River in Arizona (13.2%) (Durst et al. 2008).

Historical distribution and status of the flycatcher in Nevada is not well known. Although accounts of breeding flycatcher locations date back to 1987, when Unitt reported flycatcher breeding at Indian Springs, Corn Creek, and the Colorado River (NDOW 1997), many areas with suitable breeding habitat for flycatchers were not surveyed until the early 2000s. Subsequent surveys have confirmed breeding at Ash Meadows National Wildlife Refuge (NWR), the Lake Mead Delta, Meadow Valley Wash, the Muddy River, Pahranagat Valley, and the Virgin River. Many of these areas do not support breeding flycatchers on an annual basis, but sites in the Pahranagat Valley and at the Muddy River and Virgin River have remained relatively stable over the last 5 years and have supported more than 95% of the breeding pairs of flycatchers in Nevada, with approximately 50% of these breeding pairs using sites in Pahranagat Valley (SWCA 2012).

14.2.4 *Life History*

Southwestern willow flycatchers typically reach their breeding grounds between early May and early June, with males arriving first to establish territories (USFWS 2002). Flycatchers demonstrate strong fidelity to breeding areas although movement among sites within and between years has been documented (USFWS 2002). After a breeding territory is established, females take 4–7 days to build a small, open cup nest, typically in a small-diameter fork of a tree. An average-size clutch contains 3–4 eggs (Sogge et al. 2010; SWCA 2012). Incubation takes 12–13 days, and chicks fledge from the nest at 12–15 days of age. Adults continue to care for fledglings for approximately 2 weeks post fledging (Sogge et al. 2010). A second nest may be attempted following a successful nest or if a nest is lost or abandoned due to predation, parasitism, or disturbance. Nest and fledging success are highly variable between years and sites. The majority of nests are completed by mid-July. Flycatchers depart breeding areas from the end of July through August to migrate to southern Mexico, Central America, and northern South America for the winter.

Table 14-1. Southwestern willow flycatcher breeding sites and territories by state[a]

State	Number of Sites	Percentage of Total Sites	Number of Territories[b]	Percentage of Total Territories
Arizona	124	43.1	459	35.3
California	96	33.3	172	13.2
Colorado	11	3.8	66	5.1
Nevada	13	4.5	76	5.9
New Mexico	41	14.2	519	40.0
Utah	3	1.0	7	0.5
Total	288	100	1,299	100

[a] Durst et al. 2008.

[b] The estimated number of territories (1,299) includes 930 detected during 2007 surveys plus 369 territories in sites that were last surveyed through 2006.

Data from banding records of southwestern willow flycatchers indicate most flycatchers likely live 1–3 years, with many living 4 years, and some individuals surviving 5 to at least 8 years (E. Paxton and M. Whitfield, unpublished data in USFWS 2002). These estimates are similar to those documented in Nevada (SWCA 2012).

Survivorship estimates are difficult because they assume all living flycatchers are detected in a given year, and individuals not detected are assumed to have died, unless detected elsewhere. SWCA (2012) estimated flycatcher survivorship to be 57% for adults and 13% for juveniles along the Lower Colorado River and its tributaries from 2010 to 2011.

Southwestern willow flycatchers are insectivores, preying on small to large items, including flying ants, bees, wasps, beetles, butterflies, caterpillars, and dragonflies (USFWS 2002). Flycatchers employ various methods to catch their prey, including flying, hovering, gleaning, and “sit and wait” tactics (Prescott and Middleton 1988; USFWS 2002).

Predation of adult flycatchers is not well understood, but predation of eggs and nestlings has been documented. Predators include snakes, raptors, corvids, small mammals, and mesocarnivores. Brown-headed cowbirds (*Molothrus ater*) also function as predators when they remove flycatcher eggs during parasitism; this behavior may result in nest failure or lowered fledging success. Parasitism rates of flycatcher nests by brown-headed cowbirds can vary annually and between sites.

14.2.5 *Habitat*

The southwestern willow flycatcher breeds in dense riparian habitats from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado. Historical egg and nest collections and species' descriptions throughout its range describe the southwestern willow flycatcher's widespread use of willow (*Salix* spp.) for nesting (Phillips 1948; Phillips et al. 1964; Hubbard 1987; Unitt 1987; San Diego Natural History Museum 1995). Currently, flycatchers primarily use Geyer willow (*Salix geyeriana*), coyote willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), boxelder (*Acer negundo*), saltcedar (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolia*), and live oak (*Quercus arifolia*) for nesting. Other plant species less commonly used for nesting include buttonbush (*Cephalantha* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* spp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Four basic vegetation communities provide flycatcher habitat: monotypic willow, monotypic exotic, native broadleaf-dominated, and mixed native/exotic (Sogge et al. 2010).

Saltcedar (also known as tamarisk) is a significant component of the flycatcher's nesting, foraging, and migratory habitat throughout the bird's range. In 2006, 68% of known flycatcher nests in Arizona were built in saltcedar trees (Graber et al. 2007). The value of saltcedar in providing quality flycatcher habitat is disputed in the scientific community. However, comparisons of flycatcher breeding in native versus nonnative vegetation show no significant differences in reproductive performance (USFWS 2002), prey populations (Drost et al. 2001), and physiological conditions (Owen and Sogge 2002; Owen et al. 2005).

While breeding areas can vary in patch size and vegetation composition, age, and configuration, slow-moving or standing water or saturated soils must be present in or adjacent to all nesting sites at least at the beginning of the nesting season (USFWS 2002). Nests are often located in plants rooted in or overhanging standing water (Whitfield and Enos 1996; Sferra et al. 1997). Without this water component, the habitat cannot be considered suitable for breeding and will not be occupied by breeding flycatchers.

Southwestern willow flycatchers use riparian habitat along major drainages in the Southwest during migration (Sogge et al. 1997; Koronkiewicz et al. 2004). Many of the willow flycatchers migrating are detected in riparian habitat or patches (small areas of riparian vegetation) that would be unsuitable for nest placement (the vegetation structure is too short or sparse, or the patch of vegetation is too small). In these drainages migrating flycatchers may use a variety of riparian habitats, including ones dominated by native or exotic riparian plant species, or mixture of both (USFWS 2002). Southwestern willow flycatchers, like most small migratory, insect-eating birds, require food-rich stopover areas in order to replenish energy reserves and continue their northward and southward migration (Finch et al. 2000; USFWS 2002). Migration stopover areas are likely critically important for flycatcher productivity and survival (Sogg et al. 1997; Yong and Finch 1997; USFWS 2002).

14.2.6 *Population Dynamics*

Fluctuations in flycatcher population size and structure are not well understood in Nevada or across the flycatcher's distribution. Changes in the spatial distribution of suitable flycatcher habitat influence flycatcher occurrence both temporally and spatially, which makes attaining annual estimates difficult (USFWS 2002). Adding to this challenge, many sites in Nevada were not surveyed until the late 1990s or early 2000s, and not all sites are surveyed in all years, leaving gaps in abundance and occurrence data. Therefore, population dynamics for southwestern willow flycatchers cannot be accurately assessed at this time.

14.2.7 *Threats to the Species*

Threats to the southwestern willow flycatcher and its habitat are numerous and interrelated. Although these threats vary in severity over the flycatcher's distribution, they have remained constant from when the flycatcher was first listed in 1995 (USFWS 1995) to the current proposed revision of designated critical habitat (USFWS 2011). Specific threats include development for industrial, agricultural, and urban uses; construction of dams and reservoirs; diversions and groundwater pumping; channelization and bank stabilization; phreatophyte control; livestock grazing; recreation; and fire. Many of these threats are interdependent and can influence other factors (e.g., brood parasitism by brown-headed cowbirds, predation by domestic cats, occurrence of nonnative vegetation) affecting the flycatcher and its habitat. The ultimate effect of these threats is increased loss, modification, and degradation of riparian habitat from the direct removal and conversion of riparian vegetation and the alteration of river and stream hydrology, flooding regimes, and water table levels.

14.2.8 *Conservation Needs*

Recovery of the southwestern willow flycatcher, as identified in the Service's 2002 Recovery Plan, will entail maintaining a total known population of 1,950 territories (approximately 3,900 individuals) that are geographically distributed to allow proper function of a metapopulation (see Table 10; USFWS 2002) and creating and securing sufficient habitat to ensure maintenance of these populations and habitats over time (USFWS 2002).

Recovery objectives include but are not limited to 1) increasing and improving occupied, suitable, and potential breeding habitat; 2) improving demographic parameters; 3) minimizing threats to wintering and migration habitat; 4) surveying and monitoring populations; 5) conducting research; and 6) providing public education and outreach (USFWS 2002).

Within the analysis area, the main conservation needs for the flycatcher are to maintain, improve, and increase the quantity of nesting habitat. In addition, monitoring of breeding flycatchers should continue in breeding sites within the Pahranagat Valley, Muddy River, and Meadow Valley Wash to estimate abundance and determine nest success and location of territories.

14.3 STATUS OF CRITICAL HABITAT

14.3.1 *Regulatory Status*

On July 22, 1997, we published a final critical habitat designation for the flycatcher along 964 river kilometers (km) (599 river miles) in Arizona, California, and New Mexico

(USFWS 1997a). We published a correction notice on August 20, 1997, on the lateral extent of critical habitat (USFWS 1997b).

As a result of a 1998 lawsuit from the New Mexico Cattlegrowers Association, we published a revised final flycatcher critical habitat rule on October 19, 2005, for portions of Arizona, California, New Mexico, Nevada, and Utah, totaling approximately 1,186 km (737 miles) (USFWS 2005). River segments were designated as critical habitat in 15 of the 32 management units described in the Recovery Plan for the flycatcher (USFWS 2002).

As a result of a 2010 lawsuit from the Center for Biological Diversity, we agreed to revise the 2005 critical habitat designation for the flycatcher. On August 15, 2011, we published a proposed rule for the revised designation of critical habitat that included 3,364 km (2,090 miles) of stream in Arizona, California, New Mexico, Nevada, and Utah (USFWS 2011). This proposed rule identified 180.9 km (112.3 miles) of stream in Nevada for revised critical habitat designation. A final designation of critical habitat is scheduled to be published in the Federal Register before the end of calendar year 2012.

14.3.2 *Primary Constituent Elements of Critical Habitat*

For inclusion in the designation of critical habitat for the southwestern willow flycatcher, the Service included those areas that contain the physical or biological features essential to the conservation of the species. These areas contribute to the conservation of the flycatcher by supporting metapopulation stability, population connectivity, and gene flow and protecting against catastrophic loss of populations. Using our current knowledge of the life history, biology, and ecology of the subspecies and the requirements of the habitat to sustain the essential life history functions, we determined the following to be the primary constituent elements (PCEs) of southwestern willow flycatcher habitat:

14.3.2.1 Primary Constituent Element (PCE) 1—Riparian vegetation

Riparian habitat in a dynamic river or lakeside, natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (such as Goodding’s willow, coyote willow, Geyer willow, arroyo willow, red willow, yewleaf willow, Pacific willow, boxelder, saltcedar, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash [*Fraxinus velutina*], poison hemlock, blackberry, seep willow, oak, rose, sycamore, false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut) and some combination of the following:

- Dense riparian vegetation with thickets of trees and shrubs ranging in height from 2 to 30 meters (m) (about 6–98 feet). Lower-stature thickets (2–4 m or 6–13 feet tall) are found in higher-elevation riparian forests, and tall-stature thickets are found in middle- and lower-elevation riparian forests.
- Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 feet) above ground; or dense foliage only at the shrub level, or as a low, dense tree canopy.
- Sites for nesting that contain a dense (about 50%–100%) tree or shrub canopy (or both) (canopy is the amount of cover provided by tree and shrub branches measured from the ground).

- Dense patches of riparian forests that are interspersed with small openings of open water or marsh, or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 hectare (ha) (0.25 acre) or as large as 70 ha (175 acres).

14.3.2.2 Primary Constituent Element (PCE) 2 – Insect prey populations

A variety of insect prey populations occur within or adjacent to riparian floodplains or moist environments, including flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies/moths and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

14.4 ENVIRONMENTAL BASELINE

14.4.1 Status of the Species in the Analysis Area

14.4.1.1 Pahranagat Valley

Two main breeding sites for flycatchers occur in Pahranagat Valley and are located at the federally managed Pahranagat NWR and the state-managed Key Pittman Wildlife Management Area (WMA). Detailed information regarding the habitat at these sites is described below under *Status of Critical Habitat in the Analysis Area*. The River Ranch, located between Pahranagat NWR and Key Pittman WMA, is privately owned and consists of 3 small (<0.5-ha [1.2-acre]), isolated patches of coyote willow (SWCA 2012). Water at these patches is variable depending on irrigation needs of the private landowner.

Pahranagat National Wildlife Refuge and Key Pittman Wildlife Management Area

The majority of flycatcher nests in Pahranagat Valley are concentrated at the northern end of Upper Lake at Pahranagat NWR and along the western edge of Nesbitt Lake at Key Pittman WMA. Ash, Crystal, and Hiko springs provide a source of water to flycatcher breeding areas in the Pahranagat Valley. Ash Spring is the principal headwater for Pahranagat Creek and Upper Lake in Pahranagat NWR, while Crystal Spring provides outflow to these sites outside of the summer irrigation season. Hiko Spring is a major source of water for Key Pittman WMA.

The number of breeding pairs and nests at these sites has been fairly stable over the last 5 years (Table 14-2). Access to conduct surveys at the River Ranch has been limited, but flycatcher nesting was documented there in 2011 (Table 14-2). The number of nests at Pahranagat NWR and Key Pittman WMA accounted for 56% and 49% of all the nesting pairs and 59% and 53% of all nests in Nevada in 2010 and 2011, respectively (SWCA 2011; SWCA 2012).

Meadow Valley Wash

Vegetation succession in Meadow Valley Wash has been set back several times due to large flood events in 2005 and 2010. Although coyote willow and cottonwood patches in Meadow Valley Wash are relatively small, the future potential of these sites to support breeding southwestern willow flycatchers is considered high (NDOW 2010). Thus, flycatcher surveys are conducted annually at sites in Meadow Valley Wash. Suitable flycatcher breeding habitat has not been quantified during these surveys. Surveys documented 2 nesting attempts in 1 site by a pair of flycatchers in 1998 (McKernan and Braden 1999). Although migratory willow flycatchers of undetermined species have been detected in subsequent years, no resident flycatchers have been documented since 1998 (NDOW 2010).

Warm Springs Natural Area

Limited habitat for breeding flycatchers exists at the Warm Springs Natural Area (WSNA); suitable habitat was more extensive prior to wildfires at WSNA in 2010. Before the 2010 fire, nesting flycatchers used 2 sites, consisting of considerable water and a dense mix of tamarisk, mesquite, willow, ash, cottonwood, arroweed (*Pluchea sericea*), and palms (*Washingtonia* spp.). After the 2010 fire, the northern site was heavily damaged, and only the southern site has suitable habitat remaining, which is characterized by a 0.7-ha (1.7-acre) patch of dense velvet ash with a flowing stream at the southern edge of the site. Low numbers of flycatcher pairs and nests have been documented at WSNA (Table 14-2) (SWCA 2012). Depending on future vegetation succession and restoration projects, habitat may improve and increase to support additional flycatcher nesting.

Table 14-2. Number of nests and pairs at breeding sites located in Pahranagat Valley, 2007–2011[a]

Year	Site	Number of Pairs	Number of Nests
2007[b]	Pahranagat NWR	10	12
2008[b]	Pahranagat NWR	9	12
2009[b]	Pahranagat NWR	10	18
2010[b]	Pahranagat NWR	10	20
2011[b]	Pahranagat NWR	6	7
2010[b]	Key Pittman WMA	17	31
2011[b]	Key Pittman WMA	18	33
2011[b]	River Ranch	3	4
2007[c]	Warm Springs Natural Area	0	0
2008[c]	Warm Springs Natural Area	0	0
2009[c]	Warm Springs Natural Area	≥1[d]	≥1[d]
2010[b]	Warm Springs Natural Area	3	3
2011[b]	Warm Springs Natural Area	1	1

[a] Not all sites were surveyed in all years.
[b] Surveys conducted and reported by SWCA Environmental Consultants.
[c] Surveys conducted and reported by Nevada Department of Wildlife (NDOW).
[d] Flycatcher fledglings were documented, so we assumed at least 1 pair of adult flycatchers produced the fledglings from at least 1 nest in the area; but number of pairs was not determined, and no nest was actually located.
Note: Survey data for some sites is limited due to variability in survey effort or gaps during years when surveys were not conducted or sites were inaccessible.

14.4.2 *Status of Critical Habitat in the Analysis Area*

Although no designated critical habitat for the southwestern willow flycatcher currently exists within the analysis area (USFWS 2005), several areas in the Pahranagat Valley have been proposed for listing through the revision of flycatcher critical habitat (USFWS 2011). In general, the areas proposed for designation of critical habitat are designed to provide sufficient riparian habitat for breeding, nonbreeding, territorial, dispersing, and migrating flycatchers in order to reach the geographic, distribution, abundance, and habitat-related recovery goals (USFWS 2011) described in the Recovery Plan (USFWS 2002). The Pahranagat Valley is included in 1 of 7 management units within the Lower Colorado Recovery Unit for the flycatcher. It includes specific river reaches or riparian areas where recovery efforts should be focused to help achieve recovery for the flycatcher (USFWS 2002). Proposed critical habitat within the Pahranagat Management Unit is anticipated to provide habitat for metapopulation stability, gene connectivity through this portion of the flycatcher's range, protection against catastrophic population loss, and population growth and colonization potential (USFWS 2011). At Key Pittman WMA, 6.3 km (3.9 miles) of water segments were proposed in the revision of flycatcher critical habitat, and 17.3 km (10.8 miles) were proposed at Pahranagat NWR (Figure 14-1).

The physical and biological features essential to the conservation of the southwestern willow flycatcher (described in the Primary Constituent Elements of Critical Habitat section, above) are present in areas of the Key Pittman WMA and Pahranagat NWR. These features result from water and vegetation management that encourages the germination, development, maintenance, and regeneration of riparian forest and provides food for breeding, nonbreeding, dispersing, territorial, and migrating flycatchers. The specific quality of riparian habitat for nesting (PCE 1), migration (PCE 1), foraging (PCE 1 and 2), and shelter (PCE 1) may not remain constant in their condition or location without active management over time, due to succession (i.e., plant germination and growth) or changes in water distribution.

Proposed critical habitat at Pahranagat NWR includes areas suitable for breeding, foraging, and migrating flycatchers. Breeding habitat occurs mainly on the north side of Upper Pahranagat Lake and consists of a 4.6-ha (11.4-acre) patch of large-diameter Goodding's willows and Fremont cottonwoods. Canopy height is around 20 m (65 feet), and canopy closure is approximately 80%. Standing water and saturated soils are present at this site at the beginning of the flycatcher breeding season due to overflow water from a channel running along the northern side of the habitat that drains into the lakebed at the patch's southeastern corner. Stringers of cottonwood and willow extend around the edges of Upper Pahranagat Lake and provide foraging and migrating habitat for flycatchers. Although the insect prey base has not been quantified, we assume it is present in sufficient amount to sustain the flycatchers nesting at this site.

Proposed critical habitat at Key Pittman WMA includes areas suitable for breeding, foraging, and migrating flycatchers. Breeding habitat is located at the south end of Key Pittman WMA in 15 small stands of coyote willow that occur between bulrush marsh along the western edge of Nesbitt Lake and dry, upland scrub. The combined area of these stands is 1.4 ha (3.5 acres). Canopy height varies from 4 to 8 m (13–26 feet) at these stands, and canopy closure is 70%–90%. Although the majority of these stands are not inundated with water, surface water from the lake is present on the eastern edges of the stands at the beginning of the nesting season. Soils typically remain damp throughout the summer. No specific surveys for insect prey densities have been completed at Key Pittman WMA. Although the insect prey base has not been quantified, we assume it is present in sufficient amount to sustain the flycatchers nesting at this site.

14.4.3 *Factors Affecting the Species and Proposed Critical Habitat in the Analysis Area*

In April 2005, the Nevada Department of Wildlife (NDOW) completed a management plan for Key Pittman WMA, which included strategies for managing flycatcher habitat, to provide a framework for implementing management actions for the next 10 years. Specific strategies identified in the plan to maintain and enhance riparian systems to benefit the flycatcher include 1) fencing of willow habitat patches along Nesbitt Lake; 2) maintenance of high water levels at Nesbitt Lake from April 15 through August 1 to inundate the flycatcher habitat and to encourage the establishment of willows; 3) commitment to monitor the population status of the flycatcher at Key Pittman WMA; and 4) planting of cottonwood, coyote willow, and ash throughout Key Pittman WMA. This management plan has been effectively implemented to improve flycatcher habitat at Key Pittman WMA. The NDOW annually regulates water levels to fulfill strategy 2 and has coordinated monitoring of breeding flycatchers to fulfill strategy 3. In 2008, NDOW completed fencing to exclude livestock grazing from the coyote willow patches along the west side of Nesbitt Lake and currently maintains the fence annually. Since the fencing was completed, monitoring of the willows has shown an increase in health, vigor, and expansion of the patches.

Pahranagat NWR is managed for the conservation of the southwestern willow flycatcher through efforts to protect, restore, and improve its habitat. Specific conservation efforts include 1) improving and maintaining existing occupied riparian habitat for breeding flycatchers and other migratory birds; 2) creating additional riparian habitat to provide more breeding and foraging habitat for the flycatcher; 3) continuing to coordinate with other agencies in their surveys and research for the flycatcher; and 4) seeking funding support for conservation and restoration efforts. Although survey effort has varied and not all sites have been surveyed in all years, flycatcher surveys have been conducted in southern Nevada since 1996, and in Pahranagat NWR since 1997; these surveys support the rangewide monitoring effort. In addition, Pahranagat NWR finalized a Habitat Management Plan for the southwestern willow flycatcher in 2010 (USFWS 2010).

In 2011, the Service began a habitat restoration project in the flycatcher breeding area at Pahranagat NWR to remove undesirable understory species (e.g., dogbane [*Apocynum cannabinum*]) and to plant native riparian species (e.g., Goodding’s willow, Fremont cottonwood). This project is expected to improve and increase suitable habitat for breeding flycatchers.

Other restoration work has occurred within the Meadow Valley Wash, such as tamarisk removal and willow plantings. In 2012, under the purview of the Southeastern Lincoln County HCP, approximately 650 willows were planted within a 2-acre site along the Meadow Valley Wash. The main goal of the restoration project is to create habitat that could be used in the future by the flycatcher.

14.4.4 *Recent Section 7 Consultations*

On September 26, 2008, the Service issued a biological opinion for the issuance of a section 10(a)(1)(A) enhancement of survival (i.e., Safe Harbor Agreement) permit to NDOW. On September 26, 2008, the Service issued the permit (TE-195202) for a Safe Harbor Agreement to the NDOW to promote conservation of multiple listed species and enhance their survival and recovery through a cooperative government-private partnership. The permit authorized incidental take of southwestern willow flycatcher for otherwise lawful activities on enrolled lands (the permit also authorized take of White River springfish [*Crenichthys baileyi baileyi*], Hiko White River springfish [*C. b. grandis*], and Pahranagat roundtail chub [*Gila robusta jordani*]). At the time the permit was issued, no critical habitat for the covered species was designated or proposed for the area covered by the permit; therefore, no effects to critical habitat were documented at that time. To date, no private landowners have enrolled to be covered under the Safe Harbor Agreement.

On April 23, 2010, the Service issued a biological opinion for the issuance of a section 10(a)(1)(B) incidental take permit to Lincoln County, Nevada. On May 5, 2010, the Service issued the incidental take permit (TE-09163) for the Southeastern Lincoln County Habitat Conservation Plan (SLCHP) to Lincoln County, Nevada, including the City of Caliente and Union Pacific Railroad (UPRR) (permittees). The incidental take permit allows incidental take of southwestern willow flycatchers (and Mojave desert tortoises [*Gopherus agassizii*]) for a period of 30 years on a total of 30,673.5 acres of nonfederal land in Lincoln County, and within UPRR rights-of-way (ROWs). Many development and construction activities covered under the SLCHP may result in the loss or disturbance of up to 84.3 acres of suitable flycatcher habitat. The final SLCHP and Environmental Impact Statement (ENTRIX 2010) serve as the permittees' HCP and detail their proposed measures to minimize, mitigate, and monitor the effects of covered activities.

On July 10, 2008, the Service issued a programmatic biological opinion to the Bureau of Land Management's (BLM's) Ely District for future proposed projects that may result in adverse effects to the southwestern willow flycatcher and 4 other listed species, 3 of which have critical habitat (File No. 84320-2008-F0078). During the 10-year term of the biological opinion, the Service exempted incidental take of one nesting pair of flycatchers every 5 years. In addition, up to 246 ha (609 acres) of flycatcher habitat could be disturbed as a result of the proposed program activities: 161 ha (400 acres) in vegetation and weed management; 16 ha (40 acres) for lands and realty; 36 ha (89 acres) for travel, off-highway vehicles, and recreation; 12 ha (30 acres) for minerals extraction; and 20 ha (50 acres) for fire management. To date, no southwestern willow flycatchers have been reported killed or injured, and no acres of breeding flycatcher habitat have been reported disturbed.

14.5 EFFECTS OF THE PROPOSED ACTION

Regulations define effects of the action as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR § 402.02). Direct effects are defined as the direct or immediate effects of the action on the species or its habitat. Indirect effects are defined as those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur.

For our effects analysis, we have examined the potential for southwestern willow flycatcher and its proposed critical habitat to be directly or indirectly affected by implementation of the proposed action; we have also examined the likely nature of any potential effects. As described in Chapter 1 (Introduction), our analysis includes a site-specific assessment of the effects of BLM's issuance of a ROW for the main and lateral pipelines and associated facilities (Tier 1 ROW) and a programmatic (conceptual) assessment of the effects associated with BLM's issuance of ROWs for future groundwater development facilities (Subsequent Tier ROWs). Our analysis includes an assessment of the long-term (indirect) effects of groundwater pumping, which are analyzed programmatically herein. The Service is not exempting take of endangered or threatened species incidental to the programmatic portions of this Opinion. Site-specific actions that are analyzed broadly under the programmatic portions of this Opinion and that might result in the incidental take of endangered or threatened species will undergo separate formal consultation before any take would occur.

We have also evaluated the ability of applicant committed measures (ACMs) and BLM mitigation measures to avoid, minimize, or mitigate effects to the southwestern willow flycatcher and its proposed critical habitat. These measures are presented below, in some cases in summary form; we refer readers to the Final Environmental Impact Statement (FEIS) for the entire text of the measures (Chapter 3.20 and Appendix E; BLM 2012b). As described in Chapter 5 (Analytical Approach), some measures are very specific while others set up a process for monitoring, managing, and mitigating impacts from future activities, such as groundwater pumping. Any mitigation measure that is specific in terms of how and when it will be applied was considered in our effects analysis. We also recognized and considered those programmatic measures that are more process-oriented (i.e., establishing a framework for developing plans), especially if the intent behind the measure is (at least in part) to protect threatened and endangered species and their habitats. However, because development of specific mitigation measures for programmatic activities (and an analysis of the effectiveness of such measures) has been deferred to future National Environmental Policy Act/Endangered Species Act (NEPA/ESA) consultations, we are uncertain of the likelihood or magnitude of adverse effects or the extent to which they would be lessened by implementation of such measures. Therefore, for our programmatic analyses, we begin by assessing potential impacts of the proposed action absent these measures, recognizing that if impacts occur, they may (or likely will) be minimized due to implementation of these programmatic measures. However, absent site-specific project information, we do not assume that effects from programmatic activities will or can be completely avoided (see Chapter 5 for more information on our analytical approach).

As described in Chapter 1 (Introduction), future site-specific actions that are analyzed programmatically herein will go through further review once project details are identified, including consultation pursuant to section 7 of the Act as appropriate. These additional reviews create opportunities to modify an action before that action might result in the take of endangered or threatened species.

14.5.1 *Applicant Committed Measures Relevant to the Flycatcher*

The project applicant, Southern Nevada Water Authority (SNWA), has identified a suite of potential environmental protection measures that may be considered in future site-specific analyses and implemented (as needed) to avoid, minimize, or mitigate potential effects to water resources associated with proposed groundwater pumping (SNWA 2012; BLM 2012b). These measures are described in Section B (Programmatic Measures – Future ROWs) and Section C (Regional Water-Related Effects) of SNWA's ACMs, which are located at the end of SNWA's Conceptual Plan of Development (BLM 2012b, Appendix E); measures specific to the flycatcher are presented or summarized below.

ACM B.1.1 Groundwater production well sites will be selected after considering 1) suitable hydrogeologic conditions, including well yield, groundwater drawdown, and groundwater chemistry, based upon exploratory drilling; 2) avoidance of springs, streams, and riparian/wetland areas; and 3) the presence of special-status species and their habitat. [This represents a partial list of those elements of the measure that are relevant to the flycatcher.]

Commitments by SNWA under the Delamar, Dry Lake, and Cave Valleys (DDC) Stipulation are addressed in ACM C.1.31 – C.1.42. The delineated Area of Interest for the DDC Stipulation covers the entirety of Pahranagat Valley. Ash and Crystal springs are identified in the DDC Stipulation as sites at which spring discharge is currently being monitored (continuously) through a funding agreement between SNWA, U.S. Geological Survey (USGS), and the Nevada Division of Water Resources (NDWR). If this funding agreement changes, terminates, or expires, SNWA will continue discharge monitoring at Ash and Crystal springs if agreed upon by the stipulation parties and if access can be gained to private land. Hiko Spring is identified in the DDC Stipulation as a site where spring discharge may potentially be monitored, pending further evaluation and granting of access. The DDC Stipulation also recognizes all 3 of these springs, Pahranagat NWR, and Key Pittman WMA as potential biological monitoring sites, if selected by the Stipulation's Biological Review Team (BRT) for monitoring and if access can be obtained. Hydrologic and biological monitoring plans have been developed by the Stipulation hydrology and biology technical work groups (Technical Review Panel [TRP] and BRT), and these plans have been accepted by the Stipulation Executive Committee (EC) and the Nevada State Engineer (NSE). Initial committed measures can be found in the 2009 DDC Hydrologic Monitoring and Mitigation Plan (SNWA 2009) and the 2011 DDC Biological Monitoring Plan (BRT 2011), which includes 1) continuous discharge monitoring at Ash, Crystal, and Hiko springs; and 2) two new monitoring wells, the first to be located on the east side of the Hiko Range in Sixmile Flat in Pahranagat Valley and the second to be located near the southern boundary of Delamar Valley within a structural feature of the Pahranagat Shear Zone (SNWA 2012). Currently, the biological and hydrologic monitoring plans do not include monitoring of the flycatcher and its habitat at the 2 main breeding sites in Pahranagat Valley.

The DDC Stipulation requires a minimum of 2 years of hydrologic monitoring, and the NSE requires a minimum of 2 years of baseline (biology and hydrology) data collection. SNWA has committed to 3 years of biological baseline monitoring (an initial site characterization followed by 2 years of monitoring according to established protocols), and will continue monitoring during ground water withdrawal. Portions of the hydrologic monitoring plan (SNWA 2009) have already been implemented.

Additionally, SNWA has developed a new Cave Valley ACM (Appendix C). In this ACM, SNWA has committed to develop groundwater in Cave Valley in a staged (phased) approach. Staged development will be accompanied by hydrologic monitoring and the setting of decision-making triggers, which will be approved by BLM and FWS and included in future consultations and NEPA analyses prior to initiation of groundwater pumping in Cave Valley.

The SNWA has prepared a Conceptual Adaptive Management (AM) Framework for consideration at the programmatic level (SNWA 2012). The AM Framework sets out a potential process for implementing AM measures to address adverse environmental impacts associated with SNWA groundwater withdrawals for the GWD Project. Examples of AM measures that may be considered and implemented and that are relevant to the flycatcher include but are not limited to the following:

ACM C.2.1 In accordance with the Spring Valley and DDC Stipulations and any future water right rulings, the following actions may be implemented to mitigate injury to federal water rights and unreasonable adverse effects to federal resources and special-status species: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) augmentation of water supply for federal and existing water rights and federal resources using surface and groundwater sources; and 4) acquisition of real property and/or water rights dedicated to the recovery of special-status species within their current and historic habitat range. [This represents a partial list of those elements of the measure that are relevant to the flycatcher.]

ACM C.2.11 Work with NDOW to improve and/or expand southwestern willow flycatcher habitat on Key Pittman WMA.

ACM C.2.12 Work with the Service to improve and/or expand southwestern willow flycatcher habitat on Pahranagat NWR.

ACM C.2.14 Assist the BLM with habitat enhancement projects in Rainbow Canyon of Lower Meadow Valley Wash to improve conditions for southwestern willow flycatchers, yellow-billed cuckoo, and speckled dace.

ACM C.2.21 Conduct facilitated recharge projects to offset local groundwater drawdown, to benefit water right holders or sensitive biological areas (e.g., routing excess surface water to subirrigate wet meadows, or creating containment ponds to store floodwaters for use in recharging the aquifer).

14.5.2 *Bureau of Land Management Mitigation Measures Relevant to the Flycatcher*

The BLM has identified additional mitigation measures through the NEPA process, which are presented in detail in Chapter 3.20 (Monitoring and Mitigation Summary) in the FEIS (BLM 2012b). Mitigation measures for future groundwater development and pumping are general in nature because they are based on the programmatic-level NEPA analysis. These general measures apply to future GWD Project activities but will be replaced by more specific measures resulting from future tiered NEPA analyses (BLM 2012b). Below, we summarize those components of the BLM mitigation measures that are (or may be) relevant to the flycatcher and within BLM's jurisdiction:

ROW-WR-3: ***Construction Water Supply Plan.*** A construction water supply plan will be provided to the BLM for approval prior to construction. The plan will identify the specific locations of water supply wells (whether existing or new) that will be used to supply water for construction of the water pipeline and ancillary facilities; identify specific groundwater aquifers that would be used; estimate effects to surface water and groundwater resources from the groundwater withdrawal; define the methods of transport and delivery of the water to the construction areas; identify reasonable measures to reuse or conserve water; and identify any additional approvals that may be required. The BLM will review and approve the plan and, if necessary, include any monitoring or mitigation requirements required to minimize impacts prior to construction approval. The SNWA will provide the drilling logs and water chemistry reports on water wells drilled for pipeline construction. The BLM, in consultation with State agencies and the grazing permittee, will review the location of any newly constructed water wells and determine if any will be needed for multiple use management goals. If specific wells slated to be plugged and abandoned are determined to benefit the BLM for multiple use management, the BLM will work with the SNWA to procure the rights to the wells and obtain appropriate water rights for the beneficial use(s). The BLM will not approve a plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. At locations of potential habitat, but where species occurrence has not yet been determined, surveys will be conducted in accordance with appropriate protocol prior to approving the plan. The construction water supply plan will be a component of the SNWA Plan of Development (POD). Prior to approval of the POD, the BLM will coordinate with the Service regarding portions of the POD relating to their regulatory role under the ESA. This process will be used to determine if there would be adverse impacts to listed species or adverse effects to critical habitat, as well as to identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary.

GW-WR-3a: ***Comprehensive Water Resources Monitoring Plan*****.** This mitigation measure requires that SNWA develop a comprehensive Water Resources Monitoring Plan (WRMP) prior to project pumping that specifies hydrologic monitoring requirements to facilitate the creation of an early warning system designed to distinguish between the effects of project pumping, natural variation, and other nonproject-related groundwater pumping activities. Monitoring would include 1) water sources essential to federally listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or State lands; 2) wells sited on the northern boundary between Delamar and Pahranagat valleys, and in northern Pahranagat Valley, to monitor groundwater elevations between the project pumping in Dry Lake and Delamar valleys and the regional spring discharge in northern Pahranagat Valley (i.e., Hiko, Crystal, and Ash springs); and 3) well(s) sited in the Pahranagat Shear Zone at the boundary between southern Delamar and southern Pahranagat valleys, to monitor groundwater elevations between the groundwater production wellfield in Delamar Valley and the perennial water resources in southern Pahranagat Valley (i.e., Pahranagat National Wildlife Refuge). The WRMP would be implemented such that critical baseline data necessary to determine pumping effects would be collected for at least 5 years prior to initiation of pumping.

GW-WR-3b: ***Numerical Groundwater Flow Modeling Requirements*****.** This mitigation measure requires that SNWA update and recalibrate the regional groundwater flow model at least every 5 years after pumping is initiated, and that SNWA develop basin-specific models to be approved by BLM prior to tiered NEPA for specific groundwater development activities. BLM would use the basin-specific models to critically evaluate the effects of pumping and the effectiveness of the proposed mitigation measures, ACMs, and other measures proposed through the AM process. BLM would establish a Technical Review Team to review the model on a periodic basis.

GW-WR-7: ***Groundwater Development and Drawdown Effects to Federal Resources and Federal Water Rights.*** This mitigation measure addresses BLM action in the event that monitoring or modeling information provided in accordance with GW-WR-3a indicates that impacts to federal resources from groundwater withdrawal are occurring or are likely to occur, and that the GWD Project is the likely cause or a contributor to the impacts. The BLM would evaluate available information and determine if emergency action and/or a site-specific mitigation plan is required. If BLM determines that emergency action is required, BLM could serve a "Cease and Desist" order identifying actions to be taken to avoid, minimize, or offset impacts. If a site-specific mitigation plan is needed, BLM could require that specific measures be implemented per the schedule specified in the plan to avoid, minimize, or offset impacts to federal resources or federal water rights. Such measures might include but not be limited to the following: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation in groundwater withdrawals; 3) flow augmentation to maintain flow in specific water sources; 4) recharge projects to offset local groundwater drawdown; and 5) other on-site or off-site improvements.

GW-AB-3: ***Flow Change Mitigation.*** This measure specifies that BLM will identify detailed mitigation measures during subsequent NEPA for those springs and streams with special-status aquatic species where flow or water level changes are identified during modeling or monitoring. Mitigation ideas are identified at the programmatic level in the ACMs, BLM's comprehensive monitoring, management, and mitigation plan (COM Plan), and mitigation measure GW-WR-7.

GW-VEG-3: ***Wetlands Monitoring.*** This measure requires SNWA to develop a wetlands monitoring plan prior to any project pumping in Cave, Dry Lake, Delamar, or Spring valleys. The plan would include specific monitoring requirements and metrics for vegetation, soils, and hydrology and would be conducted in all wetlands (those under U.S. Army Corps of Engineers jurisdiction and otherwise) in areas that may be affected by groundwater pumping. Specific monitoring locations would be identified in the COM Plans associated with subsequent NEPA tiers.

GW-MN-AB-2: ***Spring and Aquatic Biological Monitoring.*** This measure requires SNWA to monitor flows in moderate- and high-risk springs (as defined by BLM) with special-status species where potential pumping effects could occur (as determined by BLM).

Because BLM does not identify sites in Pahranagat Valley as being at moderate or high risk from GWD Project pumping, we assume that it is unlikely that BLM will require monitoring or studies as specified in GW-MN-AB-2 and GW-MN-AB-3 for flycatcher habitat at this time. However, we also assume that if BLM's risk assessment for flycatcher sites were to change at future tiers (i.e., move from low risk to moderate or high risk), then these measures would apply to the flycatcher and its habitat in Pahranagat Valley. Additionally, GW-WR-3a requires monitoring of water sources essential to federally listed species that are determined by BLM to be at risk from the GWD Project and that are on public and/or State lands; currently, none of the flycatcher sites meet these criteria, but this could change at future tiered consultation stages.

The BLM is also developing its own comprehensive monitoring, management, and mitigation program (COM Plan) that addresses all hydrographic areas and all facilities associated with the GWD Project (BLM 2012b). The intent of the COM Plan is to protect federal resources and federal water rights that may be impacted by the GWD Project, including avoiding adverse impacts that could cause jeopardy to listed species or destruction or adverse modification of designated critical habitat. The BLM will base this plan on SNWA's final Plan of Development and develop it in coordination with other agencies; Notices to Proceed will not be issued until the COM Plan has been completed (BLM 2012b). The COM Plan for Tier 1 will outline a process for developing additional mitigation, monitoring, and management requirements for future ROW grants and will identify baseline and data gap information needs to better inform subsequent NEPA analysis for groundwater development. COM Plans that specifically address groundwater development may be developed for subsequent tiers of the GWD Project, or the COM Plan for Tier 1 may be amended. The COM Plan(s) will also include development of triggers for management action and AM thresholds (BLM 2012b).

14.5.3 *Approach to Analysis*

Please refer to Chapter 5 (Analytical Approach) for a detailed discussion of our approach for analyzing effects related to Tier 1 ROWs, Subsequent Tier ROWs, and groundwater pumping. The hydrologic analysis forms the backbone of the effects analysis for all federally listed species that rely on groundwater-dependent ecosystems. The hydrologic analysis can be found in Chapter 7 and is referenced in this chapter as appropriate. Below, we focus primarily on describing potential project effects to the flycatcher and its proposed critical habitat and potential cumulative effects. Lastly, we present our determination as to whether the proposed action is likely to jeopardize the continued existence of the flycatcher and/or result in the destruction or adverse modification of its proposed critical habitat.

As explained in Chapter 5 and Chapter 7, considerable uncertainty surrounds the Central Carbonate-Rock Province (CCRP) modeling results, especially the predictions of spring and stream flow discharge. Therefore, we used the CCRP Model as a starting point for our analysis of potential groundwater drawdown impacts. We then assessed whether the model may over- or underpredict drawdown in the carbonate aquifer at Ash, Crystal, and Hiko springs and in the vicinity of springs, wetlands, and riparian habitat of the Pahranagat Creek.

14.5.4 *Potential Effects to the Southwestern Willow Flycatcher*

14.5.4.1 *Tier 1 ROWs (Main Pipeline and Associated Facilities)*

We do not anticipate any direct or indirect construction-related effects to southwestern willow flycatcher associated with Tier 1 ROWs. Flycatcher breeding sites in Pahranagat Valley, Lower Meadow Valley Wash, and Muddy River Springs Area occur approximately 9–48 km (6–30 miles) away from the nearest construction support area and Tier 1 ROW (BLM 2012a) (Figure 14-1). At these distances, the flycatcher would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Indirect effects from groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) are examined separately in the paragraphs that follow.

We do not anticipate that pumping of groundwater in Delamar, Dry Lake, or Cave valleys for construction purposes will adversely affect southwestern willow flycatchers that occur in Pahranagat Valley, Lower Meadow Valley Wash, and Muddy River Springs Area. The SNWA anticipates that, at most, 27 acre-feet, and approximately 37 km (23 miles) of pipeline in Delamar Valley, so we estimate that 621 acre-feet of water will be needed for construction purposes in this valley. There are approximately 106 km (66 miles) in Dry Lake Valley, so we estimate that 1,782 acre-feet of water will be needed for construction purposes in this valley. The specific locations of the construction water supply wells and the specific groundwater aquifer that will be used are not yet known, but SNWA assumes that this water will be obtained from existing wells or exploratory wells that are available at the time of construction and that a construction water supply well will be needed approximately every 16 km (10 miles) along the pipeline alignment (BLM 2012a).

Pumping will be temporary, and the amount of water pumped will be relatively small. Pumping locations will likely be a considerable distance from flycatcher sites in Lower Meadow Valley Wash and the Muddy River Springs Area. Temporary pumping for construction will likely be situated closest to flycatcher sites in Pahranagat Valley, though still a distance away. Regardless, BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will review and approve prior to construction (ROW-WR-3). If necessary, BLM will include monitoring or mitigation requirements in order to minimize impacts prior to construction approval. In correspondence with the Service (dated September 27, 2012 and October 4, 2012), BLM indicated that they will not approve a Construction Water Supply Plan that has the potential to affect perennial springs, streams, wetlands, or artesian well flow. Considering all of these factors, we do not anticipate that pumping for GWD Project construction in Delamar and Dry Lake valleys or even more distant locations (Cave Valley) will affect the flycatcher. If later determinations indicate that adverse effects not considered in this consultation could occur to the flycatcher, then BLM should request reinitiation of section 7 consultation.

14.5.4.2 Subsequent Tier Rights of Way (Groundwater Development Areas)

We do not anticipate any direct effects to the southwestern willow flycatcher from construction, operation, and maintenance activities associated with future groundwater development facilities (Subsequent Tier ROWs). We also do not anticipate any indirect construction-related effects associated with future groundwater development facilities. Southwestern willow flycatcher breeding sites in Pahranagat Valley, Lower Meadow Valley Wash, and Muddy River Springs Area occur approximately 9–96.5 km (6–60 miles) away from the nearest groundwater development area in Delamar Valley (BLM 2012a) (Figure 14-1). At these distances, the flycatcher would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) is examined separately in the paragraphs that follow.

The length of future collector pipelines is not known, but SNWA has made estimates based on assumptions regarding number of future groundwater production wells and known geologic and hydrologic conditions. The SNWA estimates that up to 96.5 km (60 miles) of collector pipeline could be built in Delamar Valley in order to develop and transport groundwater at quantities granted by the NSE in 2012 (BLM 2012a). Considering the assumptions discussed above regarding water needs for construction purposes, we anticipate that SNWA will need up to 1,620 acre-feet of water for construction purposes in Delamar Valley.

Construction water supply well sites, the source aquifer (basin-fill, volcanic, or carbonate), pumping rates, and the exact quantities of water needed are not yet known. However, we do not anticipate impacts to the flycatcher from temporary groundwater pumping in Delamar Valley for construction purposes, because of the following factors: 1) the temporary nature of this pumping; 2) the large intervening distance between the identified groundwater development areas and flycatcher sites; and 3) BLM's commitment to not approve a Construction Water Supply Plan with potential impacts to perennial springs, streams, wetlands, or artesian well flow. Similarly, we do not anticipate that temporary pumping for construction purposes in even more distant locations (i.e., Dry Lake Valley or Cave Valley) will affect the flyctacher. We will reevaluate this conclusion for any tiered consultation involving ROWs in Delamar, Dry Lake, and Cave valleys, using updated project information provided at that time.

14.5.4.3 Groundwater Pumping

As described in Chapter 7, we believe that measurable hydrologic impacts that could result in significant effects on flycatcher breeding sites in the Lower Meadow Valley Wash and Muddy River Springs Area from GWD Project pumping are not likely to occur. Therefore, we believe that GWD Project pumping will not contribute appreciably to impacts at these 2 areas within the timeframe of our analysis.

On the other hand, we anticipate that measurable hydrologic impacts could occur in riparian areas that flycatchers use within the Pahranagat Valley, but we are unsure of the likelihood or magnitude of such effects. Chapter 7 explains in detail our assertion that the potential exists for measurable impacts to the discharge of the Pahranagat warm springs and the springs, wetlands, and riparian habitat of Pahranagat Wash, due to the proposed pumping in Dry Lake and Delamar valleys (and potentially Cave Valley). Given the uncertainty associated with the likelihood or magnitude of drawdown effects, we cannot rule out the possibility that GWD Project pumping could result in significant (as applied under the Act) impacts to the southwestern willow flycatcher within the timeframe of our analysis. Therefore, we do not concur with BLM's "may affect, not likely to adversely affect" determination for the flycatcher.

As described above, Ash, Crystal, and Hiko springs are the source of water for numerous water rights in Pahranagat Valley. Water is used for irrigation, wildlife, stock watering, and quasi-municipal uses all along the central axis of Pahranagat Valley from Hiko Spring in the north to Lower Pahranagat Lake in the south. Included in these rights is the Service's decreed wildlife water right of 1,514 acre feet per year (6.6 csf) via the Pahranagat Lake Decree. With this water right, water can be used for irrigation on Pahranagat NWR from March 14 to June 22 (or October 1), and for Pahranagat NWR reservoir storage from October 1 to March 14 each year, As such, this water is used year-round to support wildlife and maintain wildlife habitat on the Pahranagat NWR where southwestern willow flycatchers breed. NDOW also has permitted groundwater rights at a well on Key Pittman WMA, which contributes water to the Nesbitt/Frechy Lake area where southwestern willow flycatchers breed. These existing water rights are protected under the Pahranagat Lake Decree and Nevada water law (NRS 533.370 and 533.482). NRS 533.482 provides the NSE with the authority to seek injunctive relief to prevent any action that would violate Nevada water law's protection of existing rights or any order or regulation of the NSE. The NSE may even request an injunction before any injury to a water right occurs. The fact that both federal district courts and Nevada state courts have consistently ruled in favor of protecting senior existing water rights from injury underscores the fact that spring flows from Ash, Crystal and Hiko springs that support these existing water rights are insulated from adverse effects from the GWD Project.

Declines in discharge from Ash, Crystal, and Hiko springs as a result of GWD Project pumping in Dry Lake and Delamar valleys may adversely impact flycatchers that use spring and wetland systems within the Pahranagat Valley. Ash, Crystal, and Hiko springs provide a source of water to flycatcher breeding areas in the Pahranagat Valley. Ash Spring is the principal headwater for Pahranagat Creek and Upper Lake in Pahranagat NWR, while Crystal Spring provides outflow to these sites outside of the summer irrigation season. Hiko Spring is a major source of water for Key Pittman WMA. The main breeding areas for southwestern willow flycatchers at Key Pittman WMA and Pahranagat NWR are altered, controlled, and have experienced large water fluctuations due to management. These areas are primarily managed to support migratory waterfowl and have targeted conservation specifically for southwestern willow flycatcher.

Maintaining groundwater levels is important for maintaining riparian vegetation, used by flycatchers for breeding and sheltering. Particularly in arid regions, shallow groundwater, seeps, and springs provide a more constant source of water to riparian vegetation than occasional flooding can (Goodwin et al. 1997). Groundwater pumping can lower water tables and reduce spring outflow, and if water tables are lowered sufficiently, riparian plants that require access to subsurface water may be negatively impacted (Brand et al. 2010). Horton et al. (2001) found that common riparian species, such as cottonwood and willows, had more dead branches and experienced greater mortality with decreasing groundwater levels. Water availability can influence the growth and survival of mature cottonwoods and willows, and seasonal availability in the spring affects the germination and establishment of these trees (Stromberg 1993). Thus, over the timeframe of our analysis, potential decreases in spring outflow from groundwater pumping could result in lowered water tables and potential decreases in the recruitment and survivorship of riparian plant species that provide migratory and breeding sites for flycatchers.

We are not able to predict specifically how potential groundwater drawdown or diminished spring flow would affect the riparian plant community within the Pahranagat Valley over time. Plant composition may change dramatically over a gradient of groundwater depth: plants that can only survive in wetland conditions can be replaced by plants that are tolerant of drier conditions as groundwater levels are reduced, causing habitat community shifts and in some cases complete loss of riparian species (Stromberg et al. 1996). Decreases in groundwater levels may favor the establishment of invasive plant species or monoculture of species that would not be beneficial to riparian stand structure. Declines in spring discharge and flow would alter not only the composition, but likely the cover and distribution of riparian plant communities that provide shade, cover, and food (i.e., insects) input into wetlands and streams that are used by foraging, breeding, and migrating flycatchers.

Southwestern willow flycatchers require slow-moving or standing water or saturated soils in or adjacent to nesting sites in order to successfully breed (Johnson et al. 1999, USFWS 2002). Without this water component, the habitat cannot be considered suitable and will not be occupied by breeding flycatchers. Nest microclimate, including humidity, daily temperature range, and soil moisture, is important for flycatcher nest site selection and is influenced by water levels. McLeod et al. (2008) found that nest microclimate is important for nest selection and success, and female flycatchers select nest sites that are cooler, wetter, and more thermally moderate than unused sites. We do not know the likelihood or magnitude of the decline in spring discharge and flow into riparian habitat that may result from GWD Project pumping. However, if surface water is appreciably reduced within existing flycatcher breeding areas, we would anticipate alteration of nest microclimates within these areas and a decrease in quality and quantity of nesting habitat for flycatchers in Pahranagat Valley.

14.5.5 *Potential Effects to Designated Critical Habitat*

No designated critical habitat for the southwestern willow flycatcher exists within the action area.

14.5.6 *Potential Effects to Proposed Critical Habitat*

The BLM has requested to conference on the potential effects to proposed southwestern willow flycatcher critical habitat. Critical habitat has been recently proposed in the analysis area along segments of the Pahranagat Creek that runs through Pahranagat NWR and Key Pittman WMA (USFWS 2011a).

14.5.6.1 *Tier 1 ROWs (Main Pipeline and Associated Facilities)*

We do not anticipate any direct or indirect effects to proposed southwestern willow flycatcher critical habitat from construction, operation, or maintenance of the main pipeline and associated facilities. Proposed critical habitat at Pahranagat Valley is located approximately 1.3 km (0.83 mile) away from the nearest Tier 1 ROW. At this distance, the proposed critical habitat would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance.

Additionally, we do not anticipate that pumping of groundwater in Delamar Valley for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) will adversely affect proposed critical habitat in Pahranagat Valley. The SNWA anticipates that at most about 27 acre-feet (8.7 million gallons) of water will be needed for every mile of pipeline. Approximately 37 km (23 miles) of pipeline occur in Delamar Valley, so we estimate that 621 acre-feet of water will be needed for construction purposes in this valley. The specific locations of the construction water supply wells and the specific groundwater aquifer that will be used are not yet known, but SNWA assumes that this water will be obtained from existing wells or exploratory wells that are available at the time of construction and that a construction water supply well will be needed approximately every 10 miles along the pipeline alignment (BLM 2012a).

This pumping will be temporary, and the amount of water to be pumped is relatively small; however, pumping sites could be located fairly close to proposed critical habitat given that the closest Tier 1 ROW is less than a mile away. However, BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will review and approve prior to construction (ROW-WR-3). And BLM committed it will not approve a plan would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Considering all of these factors, we do not anticipate that pumping for GWD Project construction in Delamar Valley or more distant locations (e.g., Dry Lake and Cave valleys) will affect proposed critical habitat for the flycatcher in Pahranagat Valley. If later determinations indicate that adverse effects not considered in this consultation could occur to the proposed critical habitat, then BLM should request reinitiation of this conference opinion.

14.5.6.2 Subsequent Tier ROWs (Groundwater Development Areas)

We do not anticipate any direct or indirect effects to proposed critical habitat from construction, operation, or maintenance of facilities associated with groundwater production in the groundwater development areas. Proposed critical habitat at Pahranagat Valley is located approximately 10.2 km (6.38 miles) away from the nearest groundwater development area. At this distance, proposed critical habitat would not experience direct effects such as loss of habitat or indirect effects from dust, noise, traffic, or hazardous or toxic material spills associated with construction, operation, and maintenance. Groundwater pumping for construction purposes (dust control, pipe bedding, trench backfill compaction, and hydrostatic testing) is examined separately in the paragraphs that follow.

The length of future collector pipelines is not known, but SNWA has made estimates based on assumptions regarding number of future groundwater production wells and known geologic and hydrologic conditions. The SNWA estimates that up to 96.5 km (60 miles) of collector pipeline could be built in Delamar Valley in order to develop and transport groundwater at quantities granted by the NSE in 2012 (BLM 2012a). Considering the assumptions discussed above regarding water needs for construction purposes, we anticipate that SNWA will need up to 1,620 acre-feet of water for construction purposes in Delamar Valley.

Construction water supply well sites, the source aquifer (basin-fill, volcanic, or carbonate), pumping rates, and the exact quantities of water needed are not yet known. However, we do not anticipate impacts to proposed critical habitat for the flycatcher in Pahranagat Valley from this activity, because of the following factors: 1) the temporary nature of this pumping; 2) the large intervening distance between the identified groundwater development areas and proposed critical habitat in Pahranagat Valley; and 3) BLM's commitment to not approve a Construction Water Supply Plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. Similarly, we do not anticipate that temporary pumping for construction purposes in even more distant locations, (i.e., Dry Lake or Cave valleys) will affect proposed critical habitat for the flycatcher. We will reevaluate this conclusion for any tiered consultation involving ROWs in Delamar, Dry Lake, and Cave valleys, using updated project information provided at that time.

14.5.6.3 Groundwater Pumping

We anticipate that proposed southwestern willow flycatcher critical habitat at Pahranagat Valley could be adversely affected by declining groundwater levels and decreased spring flow from GWD Project pumping (see Chapter 7), but we are uncertain of the likelihood or magnitude of such effects. Groundwater pumping of 6,042 afy in Delamar Valley and 11,584 afy in Dry Lake Valley could result in adverse impacts to proposed critical habitat and its PCEs (described above) for flycatchers.

As described in detail in Chapter 7, because of inherent uncertainties associated with the model predictions and because of the uncertain hydrogeologic conditions between the proposed well fields and Pahranagat Wash and the locations of Ash, Crystal, Hiko springs, we conclude that measurable groundwater declines could occur in the vicinity of these water sources within the timeframe of our analysis. If groundwater declines occurred, they could result in decreases in water quantity (discharge) from these 3 regional springs. Above, we have described how declining groundwater levels at these locations and decreases in discharge of Ash, Crystal, and Hiko springs could affect the southwestern willow flycatcher habitat, including riparian vegetation (PCE 1). Although it is difficult to predict specifically how groundwater drawdown or diminished spring flow would affect the riparian plant community within the Pahranagat Valley, we anticipate the quality of riparian habitat for nesting (PCE 1), migration (PCE 1), foraging (PCE 1 and 2), and shelter (PCE 1) could be reduced. In addition, potential changes in riparian vegetation and in the extent and quantity of surface water may have negative consequences for insects (flycatcher food) (PCE 2). These changes could result in significant impacts to the PCEs but depend largely on the magnitude of the flow reduction, which is still uncertain.

14.5.7 *Analysis of Effects to Southwestern Willow Flycatcher with Implementation of Applicant-committed and Bureau of Land Management-committed Mitigation Measures*

The Service anticipates that the ACMs and BLM mitigation measures described in this chapter would reduce the potential or magnitude of effects to the flycatcher and its proposed critical habitat by requiring development and implementation of a broad monitoring, management, and mitigation plan (COM Plan) designed to 1) provide early warning of potential adverse impacts; 2) establish decision-making triggers; 3) avoid, minimize, or mitigate adverse impacts to groundwater-dependent ecosystems and biological communities; 4) monitor the effectiveness of mitigation measures in achieving expected outcomes and reducing impacts; and 5) allow for adaptability and flexibility in management of the GWD Project (a more detailed list of COM Plan goals and objectives can be found in Chapter 3.20 of the FEIS; BLM 2012b). However, in the absence of a developed 3M Plan and site-specific project information/mitigation measures to further evaluate the potential effects of groundwater withdrawal, the Service anticipates that adverse effects may still occur as a result of GWD Project pumping. The BLM and Service will evaluate site-specific effects when project details related to groundwater development are known and proposed by the project applicant, at which time we will again determine if adverse effects to listed species and their critical habitats are likely to occur, and follow the appropriate consultation procedures.

14.5.8 *Cumulative Effects*

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Act.

We are not aware of future actions that may affect southwestern willow flycatchers that occur at River Ranch and Key Pittman WMA.

We believe that future groundwater uses are reasonably certain to occur in the action area. The BLM considered these future groundwater uses as part of their baseline assessment, so we account for them in the conclusion section under aggregate effects. See Chapter 5 (Analytical Approach, Cumulative Effects).

14.6 CONCLUSION

We have evaluated the environmental baseline, project effects, and cumulative effects for the species. Another source of uncertainty with respect to effects on the species is climate change. Climate change has the potential to exacerbate the effects of decreased discharge from GWD Project pumping on flycatchers and their habitat. Potential climate change impacts are discussed in detail in Chapter 8 of this Opinion. In summary, higher air temperatures, more winter precipitation in the form of rain rather than snow, and earlier snowmelt could result in increased evapotranspiration and shifts in the timing and/or amount of groundwater recharge and runoff (USEPA 1998), potentially resulting in decreased water availability for supporting riparian habitat. These changes could result in reduced soil moisture (Sada and Herbst 2008), which in turn could affect riparian vegetation. However, predicting local climate change impacts is difficult due to substantial uncertainty in trends of hydrologic variables (e.g., natural variability can mask long-term climate trends), limitations in spatial and temporal coverage of monitoring networks, and differences in the spatial scales of global climate models and hydrologic models (Bates et al. 2008). Thus, while climate change may affect flycatcher habitat in Pahranagat Valley, the attributes that will be affected and/or the timing, magnitude, and rate of change are uncertain. Future tiered analyses for groundwater development and pumping will provide us with opportunities to update the cumulative effects analysis, using current climate change information and/or local-scale model predictions for climate change.

After reviewing the current status of the southwestern willow flycatcher and its proposed critical habitat, the environmental baseline for the analysis area, the effects of the proposed action, and the cumulative effects, we conclude that the action, as proposed, could adversely affect the flycatcher and its proposed critical habitat. We have determined that the proposed action is not likely to jeopardize the continued existence of the flycatcher, and that the proposed action is not likely to adversely modify proposed critical habitat. While adverse impacts to proposed critical habitat could occur, we do not anticipate that such alterations will appreciably diminish the value of proposed critical habitat for both the survival and recovery of the flycatcher. We have reached these conclusions for the following reasons:

- Our hydrologic analyses (see Chapter 7) suggest that potential exists for reductions to the discharge of Ash, Crystal, and Hiko springs and springs, wetlands, and riparian habitat of the Pahranagat Wash due to the proposed pumping in Dry Lake and Delamar valleys within the timeframe of our analysis.
- Given the potential for reduced discharge noted above, we cannot rule out the possibility of significant effects (as applied under the ESA) to the flycatcher and its proposed critical habitat in Pahranagat Valley.
- Pumping-induced drawdown in the vicinity of Pahranagat Wash and reduced spring discharge from the Pahranagat Valley regional springs could adversely affect riparian plant communities that provide shade, cover, appropriate microclimate, and food (i.e., insects) for breeding and migrating flycatchers. The extent to which these effects occur will depend primarily on the magnitude and duration of reductions in spring discharge, for which considerable uncertainty exists.
- We anticipate that impacts to the flycatcher and its proposed critical habitat can be minimized by implementation of the ACMs and BLM mitigation measures, but the actual effectiveness of such measures is unknowable at this time.

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Chapter 15
CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act (Act or ESA) directs federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to implement recovery plans, or to develop information. To be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species or their habitats, the U.S. Fish and Wildlife Service (Service or USFWS) requests notification of the implementation of any conservation recommendations. The Service recognizes that these recommendations may be improved upon or refined as additional information becomes available and additional analyses are completed.

We submit the following conservation recommendations, which are designed to: 1) obtain data and information necessary for conducting subsequent tiered analyses and determining incidental take, including understanding how threatened and endangered species and their habitats will respond to reductions in spring flow that may result from the proposed federal action; 2) assist with the development of rigorous monitoring plans to meet the goal of avoiding and minimizing adverse effects to threatened and endangered species and their habitats; 3) meet other monitoring, research, and/or management needs for assessing and mitigating potential future impacts of the federal action; 4) develop a clear process for the setting of biological and hydrologic decision-making triggers; and 5) assist with recovery of federally listed species that are the subject of this consultation through activities that could, through their implementation, make the species more resilient to future habitat changes that result from the proposed action. We believe that assisting with recovery efforts applies to this project because the proposed federal action is predicted to result in substantial impacts to land and water resources, including sites with listed species, critical habitat, and/or potential habitat.

15.1 RECOMMENDATIONS COMMON TO MULTIPLE SPECIES

COMM-1—We recommend that Bureau of Land Management (BLM) involve statisticians early in the development and review of biological monitoring sampling designs and protocols to ensure that all data collected as part of the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) biological monitoring program (i.e., species and habitat monitoring) are designed in a rigorous manner and consistent with meeting the goals and objectives of the monitoring program (i.e., providing early warning, detecting change, and determining causal relationships). We recommend that BLM select statisticians in consultation with the Service, the project applicant, and other appropriate parties, and that these parties work together with the statisticians to ensure a rigorous sampling design. Lastly, we recommend that BLM obtain the services of qualified statisticians to assist with the analysis and interpretation of data collected as part of the GWD Project monitoring program.

COMM-2—We recommend that BLM ensure that if pumping is terminated, the comprehensive monitoring, management, and mitigation plans (COM Plans) remain in effect for as long as effects continue to propagate and until recovery of any affected groundwater-dependent ecosystems (GDEs), to the extent that recovery occurs.

COMM-3—Consistent with portions of BLM Monitoring and Mitigation Measure GW-MN-AB-3 and the COM Plan process, including monitoring needs for subsequent National Environemtal Policy Act (NEPA) tiers to fill data gaps and provide baseline data, we recommend that the BLM 1) coordinate with the Service, the project applicant, and other parties as appropriate (e.g., with Nevada Department of Wildlife [NDOW]), to collect information needed to define ecological water requirements for federally listed species and their groundwater-dependent habitats that are at risk of being adversely affected by GWD Project pumping); and 2) consult with the Service to determine and set initial triggers for management action ("decision-making triggers") that will avoid or minimize impacts to these at-risk listed species and their critical habitat. By "trigger," we mean a commitment within an adaptive Monitoring, Management, and Mitigation Plan that stipulates what actions will be taken if monitoring results reveal particular resource outcomes (*sensu* Nie and Schultz 2012). These initial commitments should be adaptable so that negotiated changes can be made as new information is obtained during the life of the GWD Project. However, we recommend that BLM and the Service develop an explicit process for adjusting triggers to ensure transparency and accountability (Nie and Schultz 2012). Additionally, we recommend that these studies be initiated in order to facilitate sufficient data collection prior to initiation of future ESA consultations for groundwater development.

The Service should make the final selection of hydrologic and biological decision-making triggers for the cessation and/or reduction of project pumping at various locations in consultation with BLM, in order to provide as much assurance as possible that the federal action will not reduce appreciably the likelihood of both the survival and recovery of federally listed species.

The decision-making triggers should include a specific commitment by the project applicant to stop or reduce pumping if particular outcomes are revealed through monitoring. If monitoring reveals new information about GWD Project impacts to federally listed species and/or critical habitat that was not considered in this Opinion or any future consultations for groundwater development, then BLM should reinitiate consultation with the Service, as described in Chapter 1 (Introduction, Reinitiation Notice).

Setting triggers will assist the BLM, Service, and project applicant with assessing potential impacts to federally listed species and/or refining the impact analysis when future environmental compliance is required. Determining triggers will also assist all parties with developing and managing the groundwater development aspect of the action.

To support this process, we recommend the following:

- Solicit outside expertise (e.g., U.S. Geological Survey [USGS], academia), as appropriate, to assist in developing recommendations for 1) ecological water requirements for federally listed species and their groundwater-dependent habitats, including groundwater levels or flow regime needed for survival and recovery; 2) potential approaches for the development of decision-making triggers (both hydrologic and biological); and 3) research needs for those species where response to potential adverse impacts from GWD Project pumping is not sufficiently known [consistent with the Federal Advisory Committee Act].

- Develop a peer-reviewed report describing ecological water requirements for GDEs and associated flora and fauna; recommended decision-making triggers and their likely effectiveness at reducing or eliminating risk to these systems and species; and knowledge gaps that require further study;
- Solicit input from the Delamar, Dry Lake, and Cave (DDC) and Spring Valley Technical Review Panels (TRPs) on a voluntary basis regarding the selection of specific hydrologic decision-making triggers for project pumping (given the unique detailed working knowledge of TRP members concerning the hydrogeology of the area, existing hydrologic monitoring, hydrologic trends, and existing predictive tools) with the goal of detecting the development of any hydrologic conditions that may affect habitat for federally listed species. BLM and Service TRP members should make final recommendations concerning the selection of specific hydrologic decision-making triggers for project pumping given the aim of the triggers.
- Solicit input from the DDC Biological Review Team (BRT) and Spring Valley Biological Work Group (BWG) on a voluntary basis regarding the selection of specific biological decision-making triggers for project pumping with the goal of detecting the development of any biological conditions which may affect the survival and/or recovery of federaly listed species. BLM and Service BRT/BWG members should make final recommendations concerning the selection of specific biological decision-making triggers given the aim of the triggers.

The results of the above efforts along with other available information as appropriate, should be used to set triggers (e.g., the level of impact) at monitoring sites, so that those triggers, when reached, will result in specific management or mitigation actions (e.g., reduction or cessation of pumping) to avoid or minimize the probability of undesired impacts to federally listed species and their habitats and ensure that risk to these species remains at an acceptable level.

The parties should consider the following in selecting the triggers: 1) the potential for a time lag (which could be considerable at some sites) between pumping and reduced water availability at sites of concern; 2) the delay in the development of maximum impacts at some sites until sometime following any cessation of pumping (potentially decades or longer); 3) the potential for a significant time lag between cessation or reduction in pumping and increased water availability at sites of concern (also potentially on the order of decades); 4) the time it could take groundwater-dependent habitat and federally listed species to respond to changes in water availability; and 5) the potential for climate change to also affect long-term water availability, thus resulting in a larger combined impact (e.g., reductions in spring flow, reductions in aquatic area) to federally listed species and their habitats.

COMM-4—Consistent with portions of BLM Monitoring and Mitigation Measures GW-MN-AB-3 and the COM Plan process, we recommend that BLM coordinate with the Service and other parties (e.g., NDOW) as appropriate to develop and implement scientific investigations that would evaluate the flow regime (spring discharge/stream flow/water levels) needed for survival, maintenance, and recovery of federally listed species and their habitats. We recommend that these studies be initiated to facilitate sufficient data collection *prior to initiation of* *tiered section 7 consultations for groundwater development* *and* *prior to pumping in those valleys* to use this information for future environmental compliance. Specifically, we recommend BLM consider the following:

- Collect data on federally listed species' demography and habitat use during different flow conditions (i.e., wet and dry years)
- Collect data on changes to listed species' habitats during different flow conditions (i.e., wet and dry years)
- Implement studies on habitat use and preference to improve understanding of federally listed species' response to pumping-induced changes in habitat
- Implement targeted research on federally listed species (or surrogates, as appropriate) to investigate species-specific responses to incremental decreases in spring/stream flow
- Develop ecological models that can be used to help predict potential responses of species to reduced spring/stream flow and consequent changes to habitat. Work with the Service to identify the species for which ecological models would be most useful (e.g., White River spinedace) and to set guidelines for construction and maintenance of the model(s), including potential contractors

We recommend that BLM coordinate with the Service and other parties as appropriate to select principal investigators for those studies related to federally listed species and their habitats.

COMM-5—Consistent with portions of BLM Monitoring and Mitigation Measures GW-WR-3a, GW-MN-AB-2, and other relevant measures (e.g., GW-VEG-3), we recommend that BLM require at least five years (preferably 10 years) of baseline hydrologic and biological data collection *prior to initiation of tiered section 7 consultations for groundwater development* at sites with federally listed species (or critical habitat) that may be adversely affected by groundwater pumping, if access can be obtained. Data collected prior to tiered section 7 consultations will inform the tiered environmental compliance effects analysis (e.g., help BLM and the Service better understand natural variability, trends, and potential responses of GDEs to changing flow conditions).

COMM-6—Once groundwater pumping is initiated, we recommend that BLM and the Service meet at least annually (outside of the NEPA cooperating agency process) to 1) review and discuss interpretations of monitoring data that is relevant to federally listed species and critical habitat; 2) evaluate potential impacts and their likely cause(s); 3) determine whether early warning triggers have been reached or may be reached, using predictive modeling, monitoring data, and other analyses; 4) evaluate whether new information suggests that revisions to decision-making triggers are needed; 5) evaluate the results and effectiveness of actions taken to avoid, minimize, or mitigate adverse impacts to federally listed species and/or critical habitat; 6) evaluate options for additional adaptive monitoring and management measures; and 7) determine if any of the criteria for reinitiation of section 7 consultation, as outlined in the programmatic biological opinion, have been met. The frequency of these meetings can be adjusted depending on perceived risk to threatened and endangered species.

COMM-7—We recommend that BLM review and approve the qualifications of those responsible for field collection of monitoring data under the COM Plan, with input from the Service related to surveys for federally listed species and their habitats. Additionally, we recommend that BLM review the qualifications of those responsible for collecting information that will be used by BLM in the decision-making process and to inform the COM Plan process. Since the BLM and Service will be relying on these data to make decisions that could have consequences for persistence of federally listed species, it is important that all parties feel comfortable with data quality.

COMM-8—We recommend that BLM provide for Service participation in BLM's hydrologic oversight team responsible for reviewing and providing input on future improvements to the Central Carbonate-Rock Province (CCRP) model and the development of any "child" models.

COMM-9—Consistent with portions of the COM Plan framework presented in the Final Environmental Impact Statement (EIS) (BLM 2012), we recommend that monitoring data, information, and reports that are collected, compiled, or created as part of the COM Plan process and relevant to federally listed species and critical habitat be provided to the Service on a regular basis via a data-exchange website, the U.S. Geological Survey National Water Resources Information System (NWIS), the Utah Geological Survey (UGS) Snake Valley Groundwater Monitoring Project Web site, or other appropriate tools. We feel it is important to stress that the Service requests timely review of data and information collected or compiled for the proposed federal action, as the interagency input process is somewhat vague on this point ("The agencies would periodically review monitoring reports and data made available by the Southern Nevada Water Authority (SNWA) and BLM," [BLM 2012, p. 3.20-23]).

COMM-10 (*Indirect effects of reduced water on landscape*)—To supplement BLM Monitoring and Mitigation Measure GW-WH-1 (*Water Source Maintenance*) and GW-WR-1 (*Spring Inventories*), we recommend that BLM require SNWA to 1) conduct an inventory of all water sources within the project footprint before and during the life of the project (ephemeral, intermittent, and perennial waters); 2) implement a biological monitoring study of wild horse space use of these water resources before and throughout the life of the project; and 3) design the GWD Project biological monitoring program in a manner that will allow for an assessment of the potential indirect/cascading effects of the use of remaining water resources by wild horses on threatened and endangered species. We believe that this is important because it is expected that pumping-induced impacts to water sources may affect the distribution and space use of wild horses and other animals (i.e., cause concentrations of animals at remaining water holes), which will result in impacts to and/orlisted species dependent on the remaining aquatic environments, wetland vegetation, and surrounding upland habitats. To accomplish this, the project proponent should deploy the use of GPS collar technology on wild horses and "trail cameras" at water sources. Information collected on wild horse use of water sources within the project footprint will assist BLM with identifying where artificial water sources could be maintained to supply herds with adequate water supplies, identified in GW-WH-1. This activity should be coordinated with BLM's National Wild Horse and Burro Research Advisory Team Leader.

COMM-H11 ***(Adequate hydrologic monitoring of habitat for federally listed aquatic species)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the establishment and implementation of adequate hydrologic monitoring of habitat for federally listed species. Prior to future ESA consultations for project pumping in Cave, Dry Lake, Delamar, or Spring valleys, develop and implement a plan that leads to the collection of adequate hydrologic baseline data to distinguish the effects of pumping from natural variation and other influences on habitat for federally listed species once project pumping begins, these data will also improve the quality of future ESA analyses for groundwater pumping (including the development of improved predictive tools), as a part of the development of BLM's COM Plan or otherwise. Input should be solicited from the Spring Valley and DDC Technical Review Panels (TRPs) on a voluntary basis regarding the nature, siting, installation, and frequency of any additional monitoring (given the unique detailed working knowledge of TRP members concerning the area hydrogeology, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), with the BLM and Service TRP members making final recommendations given the aim of the monitoring. Additional monitoring should be installed, performed, and reported by SNWA on a timely basis via a data-exchange Web site. Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in advance of project pumping. Once initiated, monitoring should continue through the start of project pumping, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record and interpretation of the data), for the duration of project pumping, and in the case project pumping is terminated in the applicable valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves).

COMM-H12 ***(Maintenance of hydrologic monitoring networks)*****—**Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service makes specific recommendations with respect to the maintenance of adequate hydrologic monitoring networks. In order ensure adequate collection of baseline groundwater-level data, constrain the calibration (and recalibration) of flow models in advance of future ESA analyses, and provide adequate hydrologic early warning of the propagation of project-induced drawdown to habitat for federally listed species, we recommend that groundwater-level monitoring be continued at the indicated frequencies in the following wells:

- Spring Valley Network—Continue continuous water-level monitoring in the following monitoring wells: 184 N09 E68 30AAAB 1 USGS-MX, 184 N10 E68 31CD 1 USGS-MX, 184 N11 E66 23AB 1 USGS-MX, 184 N11 E68 19DCDC 1 USGS-MX, 184 N14 E66 24BDDD 1 USGS-MX, 184 N15

E67 26CA 1 USGS-MX, 184 N19 E66 11B 1, 196 N08 E69 35DC 2, 184 N09 E68 11 BD 2, 184 N11 E66 34 DD 2, 184 N12 E66 26 BA 2, 184 N09 E67 11 DB 1, 184 N11 E68 05 BC 2, 184 N14 E66 09 AB 2, and 184 N15 E67 26 CD 2.

Accompanied by an increase in the frequency of monitoring from quarterly to continuous in the following wells: 184 N08 E68 14A 1 USBLM (basin-fill well, south Spring Valley), 196 N08 E69 15B 1 (basin-fill well, northern Hamlin Valley), 196 N08 E70 06B 1 USBLM–Monument Well (basin-fill well, northern Hamlin Valley), the Cleveland Ranch nested monitoring well located 3.2 kilometer (km) (2 miles) north of Unnamed 5 Spring, and 184 N12 E66 21CD1 (carbonate-rock well, west side of Spring Valley), the latter as a complement to groundwater-level monitoring on the eastern side of Steptoe Valley.

- DDC Network—Continue continuous water-level monitoring in the following monitoring wells: 181 N03 E63 27CAA 1 USGS-MX (carbonate-rock well, west Dry Lake Valley), 181M-1 (carbonate-rock well, west Dry Lake Valley), 209M-1 (carbonate-rock well, north Delamar Valley / north Pahranagat Valley), and 182M-1 (volcanic well, south Delamar Valley).

Accompanied by an increase in the frequency of monitoring from quarterly to continuous in the following wells: 209 S04 E61 28CD1 (basin-fill / volcanic well, north Pahranagat Valley), 182W906M (volcanic well, South Delamar Valley), and 209 S07 E62 20AA1 / Dean Turley Well (volcanic well, south Pahranagat Valley).

[See recommendations for White River spinedace for additional recommendations concerning the continuation of adequate hydrologic monitoring.]

We recommend that baseline data be collected at the above wells for a minimum of 5 years, and preferably 10 years, in advance of future ESA analyses for project pumping to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on area groundwater levels once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Groundwater-level monitoring should continue at the above locations and frequencies through the initiation of project pumping in the applicable project basins, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record), for the duration of project pumping in the basins, and in the case project pumping is terminated in the basins, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). The groundwater-level data should be made available on a timely basis via data-exchange or other accessible Web sites.

COMM-H13 ***(Planned monitoring wells, DDC network)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service makes the following specific recommendations with respect to the installation and monitoring of monitoring wells in the area of Cave, Dry Lake, and Delamar valleys. Prior to future ESA consultations for project pumping in Cave, Dry Lake, or Delamar valleys, the following monitoring wells should be installed and monitored continuously to collect adequate baseline groundwater-level data, facilitate aquifer testing (independent estimates of aquifer parameters), and constrain the calibration (and recalibration) of flow models in advance of future ESA analyses for groundwater pumping and to provide adequate early warning of the propagation of project pumping impacts to habitat for federally listed species:

- PAH1010M, sited in the regional carbonate-rock aquifer in northern Pahranagat Valley, several miles east of Hiko Spring in the vicinity of Six-Mile Pass (a complement to carbonate-rock monitoring well 209M-1 on the northern boundary between Delamar and Pahranagat valleys)
- DEL4003X, sited in volcanic rocks of the Pahranagat Shear Zone at a key location on the boundary between southern Delamar and southern Pahranagat valleys

[See recommendations for White River spinedace for additional recommendations concerning the installation and monitoring of planned monitoring wells.]

We recommend that the wells be installed with multiple monitored intervals (multiple completions) to maximize the utility of monitoring (monitoring of both lateral and vertical hydraulic gradients) and the estimation of aquifer parameters, with the aim of improving predictive tools needed for future tiered analyses and providing effective warning of the propagation of project-induced drawdown to habitat for federally listed species. Input should be solicited from the DDC TRP (voluntarily) regarding the completion of the wells (given the unique detailed working knowledge of TRP members concerning the area hydrogeology, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), with the BLM and Service TRP members making final recommendations given the aim of the monitoring, as a part of the development of BLM’s COM Plan or otherwise. Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in advance of project pumping in order to gather sufficient data to distinguish between the effects of project pumping, natural variation, and other influences on area groundwater levels once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, groundwater-level monitoring should continue through the initiation of project pumping, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record and interpretation of the data), for the duration of project pumping in Cave, Dry Lake, or Delamar valleys, and in the case project pumping is terminated in the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Well completion and groundwater-level data should be made available on a timely basis via a data-exchange Web site.

COMM-H14 ***(Minimum additional monitoring wells in the area of potential project impacts)—***Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the expansion of existing groundwater-level monitoring networks. GW-WR-3a describes the development of the WRMP (a comprehensive water resources monitoring plan). Prior to future ESA consultations for project pumping in Cave, Dry Lake, Delamar, or Spring valleys, the WRMP should address the collection of continuous groundwater-level measurements needed to characterize baseline conditions, facilitate aquifer testing (independent estimates of aquifer parameters and the properties of key structures), and constrain the calibration (and recalibration) of flow models required for future ESA analyses. We recommend that the plan include, but not be limited to, the siting, installation, and monitoring of additional wells meeting the description (general criteria) provided below (prior to future ESA consultations for project pumping in the applicable project basins):

- Three wells sited in the vicinity of southern Pahranagat Valley to monitor for the propagation of drawdown from project pumping in Dry Lake and Delamar valleys to the area of Pahranagat Wash / Pahranagat National Wildlife Refuge through the lower (regional) carbonate-rock aquifer and overlying volcanic rocks:
    - A well sited in the vicinity of prospective DDC Stipulation “alternative site” PAH1011M in southern Pahranagat Valley (a complement to monitoring well DEL4003X) in order to detect pumping-induced changes in gradient within the Pahranagat Shear Zone (southern Delamar to southern Pahranagat valleys)
    - A well sited in the southern portion of Pahranagat National Wildlife Refuge (NWR) between the Buckhorn and Maynard Faults of the Pahranagat Shear Zone, wherein the bottommost monitored interval is completed in the lower (regional) carbonate-rock aquifer and the uppermost monitored interval is completed in overlying volcanic rocks or other fill across the water table, with the aim of detecting any upward propagation of project-induced drawdown to the surface waters of the NWR
    - A well sited in the northern portion of the NWR between the Arrowhead and Buckhorn Faults of the Pahranagat Shear Zone, wherein the bottommost monitored interval is completed in the lower (regional) carbonate-rock aquifer and the uppermost monitored interval is completed in overlying volcanic rocks or other fill across the water table, with the aim of detecting any upward propagation of project-induced drawdown to the surface waters of the NWR
- Three wells sited in the vicinity of Shoshone Ponds to monitor for the propagation of project-induced drawdown from prospective production sites in Spring Valley to the area of the Shoshone Ponds flowing artesian wells (based on the locations of successful exploration / test wells drilled to date):

    - A well sited approximately midway between Shoshone Ponds and SNWA exploratory well SPR7007X in the alluvial fan near Swallow Springs (approximately 4.8 km [3 miles] south-southeast of the Ponds)
    - A well sited approximately midway between the Ponds and SNWA exploratory well 184W105 in Ely Limestone of the upper carbonate-rock aquifer (approximately 4.8 km [3 miles] southwest of the Ponds)
    - A well sited approximately 4.8 km (3 miles) north-northwest of the Ponds in the direction of SNWA exploratory well SPR7005X in the damaged zone of the range-bounding fault on the west side of Spring Valley

- Two or more wells sited in Steptoe Valley to monitor for the westward propagation of drawdown from project pumping in Spring Valley into southern Steptoe Valley beneath the Schell Creek Range (as predicted by the CCRP model) toward habitat for federally listed aquatic species in White River Valley:
    - Well(s) completed in the lower (regional) carbonate-rock aquifer along the eastern margin of southern Steptoe Valley, east of the range-bounding fault, to monitor for the westward propagation of drawdown from project pumping in Spring Valley into Steptoe Valley, and as a criterion for siting and installing of one or more additional monitoring wells in the lower (regional) carbonate-rock aquifer along the western margin of southern Steptoe Valley, west of the range-bounding fault, in order to monitor for the propagation of project-induced drawdown toward habitat for federally listed species in White River Valley
    - In the event that project-induced drawdown is detected in the monitoring well(s) along the western margin of southern Steptoe Valley, one or more additional monitoring wells sited and installed in the lower (regional) carbonate-rock aquifer along the eastern margin of central White River valley, east of the range-bounding fault, to monitor and characterize the propagation of project-induced drawdown in the vicinity of or toward habitat (or potential habitat) for the federally listed White River spinedace at Lund Spring, Preston Big Spring, and Ellison Creek in White River Valley.
- Contingent on the documented occurrence or high potential for the occurrence of Ute ladies'-tresses in northern Snake Valley (e.g., the area of Gandy Warm Spring, Gandy Salt Marsh Complex, Bishop Spring Complex, Leland-Harris Spring Complex, or Twin Springs), 2 wells completed in the pass between the northern Snake Range and Kern Mountains to monitor for the propagation of drawdown from project pumping in Spring Valley to the above locations (as predicted by the CCRP model):
    - A water table well sited in the pass at the approximate location of the boundary between Spring and Snake valleys, and a second water

  table well on the east side of the pass (west side of Snake Valley), east of the range-bounding fault and west of Gandy Warm Springs

  - In the event that project-induced drawdown is detected in the monitoring wells in the pass, plan and complete hydrologic field studies leading to the hydrologic characterization of range-bounding and other faults that are mapped in the vicinity of Gandy Warm Spring, Gandy Salt Marsh Complex, Bishop Spring Complex, Leland-Harris Spring Complex, and Twin Springs and that may affect the propagation of project-induced drawdown into northern Snake Valley sites (contingent on the documented occurrence or high potential for the occurrence of Ute ladies'-tresses at any of the above locations).

- One or more wells sited in Panaca Valley to monitor for the eastward propagation of drawdown from project pumping in Dry Lake Valley into Panaca Valley (as predicted by the CCRP model) toward habitat for federally listed species at Panaca Spring (in Panaca Valley) and Delmue Springs and Condor Canyon (in Dry Valley):

  - A well completed in the lower (regional) carbonate-rock aquifer along the western margin of Panaca Valley to monitor for the eastward propagation of drawdown from project pumping in Dry Lake Valley into Panaca Valley at a location judged to be most vulnerable to the eastward propagation of project-induced drawdown

  - In the event that project-induced drawdown is detected in the well(s) along the western margin of Panaca Valley, plan and complete additional hydrologic field studies leading to the hydrologic characterization of faults and hydrogeologic units located immediately west of Panaca Spring, which are simulated as lower-conductivity structures in the CCRP Model and may affect the propagation of project-induced drawdown into the area of Panaca Spring, Delmue Springs, and Condor Canyon.

- One or more wells sited in Lower Meadow Valley Wash to monitor for the southeasterly or easterly propagation of drawdown from project pumping in Dry Lake and/or Delamar valleys into northern Lower Meadow Valley Wash within the Caliente Caldera Complex (as predicted by the CCRP model) toward habitat for the federally listed southwestern willow flycatcher:

  - A well completed in volcanic rocks of the caldera complex at a location judged to be most vulnerable to the southeasterly or easterly propagation of project-induced drawdown

  - In the event that project-induced drawdown is detected in volcanic rocks of northern Lower Meadow Valley Wash, plan and complete additional hydrologic field studies leading to the hydrologic characterization of north-northeast trending faults located west of southwestern willow flycatcher habitat in northern Lower Meadow Valley Wash, which are simulated as lower-conductivity structures in the CCRP Model and may affect the propagation of project-induced drawdown to southwestern willow flycatcher habitat in the Wash.

[See recommendations for White River spinedace for additional recommendations concerning the expansion of existing groundwater-level monitoring networks.]

We recommend that the wells be installed with multiple monitored intervals (multiple completions) to maximize the utility of monitoring (monitoring of both lateral and vertical hydraulic gradients) and the estimation of aquifer parameters, with the aim of improving predictive tools needed for future ESA analyses and providing effective warning of the propagation of project-induced drawdown to habitat or potential habitat for federally listed aquatic species. Input should be solicited from the DDC TRP (voluntarily) regarding the final siting and completion of the wells (given the unique detailed working knowledge of TRP members concerning the area hydrogeology, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), given the aim of the monitoring, the BLM and Service TRP members should make final recommendations as a part of the development of BLM's COM Plan or otherwise. The wells should be installed and monitored continuously by SNWA to minimize ambiguity in the records and the interpretation of the data. Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in advance of project pumping in order to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on area groundwater levels once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, groundwater-level monitoring should continue in the wells through the initiation of project pumping, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record), for the duration of project pumping in Cave, Dry Lake, Delamar, or Spring valleys (as applicable), and in the case project pumping is terminated in any of the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Well completion and groundwater-level data should be made available on a timely basis via a data-exchange Web site.

COMM-H15 ***(Minimum additional aquifer testing in the area of potential project impacts)*****—** Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to additional aquifer testing. Aquifer (pumping) tests performed to date by the project proponent were largely designed to estimate specific capacity (production potential), as opposed to aquifer parameters needed to improve groundwater flow models (predictive tools) and other forms of hydrologic analyses that will be required for future ESA analyses for project pumping. Prior to the update of the CCRP regional flow model, construction of any "child" models based on the CCRP model, or future ESA consultations for project pumping, we recommend that the SNWA perform additional aquifer tests that meet the criteria provided below, as a part of the development and implementation of BLM's COM Plan or otherwise:

- Southern Dry Lake Valley, northern Delamar Valley, and the Regional Warm Springs of Pahranagat Valley—A pumping test should be performed in carbonate-rock monitoring well 209M-1 in northeastern Pahranagat Valley utilizing a minimum of the following observation wells: new carbonate-rock monitoring well PAH101M (northern Pahranagat Valley); 209 S04 E61 01AACB1 (basin-fill well, northern Pahranagat Valley); and 209 S04 E61 28CD1 (basin-fill / volcanic well, northern Pahranagat Valley). Hiko and Crystal Springs should be monitored continuously throughout the test, including a significant recovery period. A stopping criterion should be identified at carbonate-rock monitoring well PAH101M (4.8–6.4 km [3–4 miles] east of Hiko Spring) for the pumping portion of the test to ensure the test poses no risk to Hiko or Crystal springs. The rate of pumping, duration of pumping, and duration of monitored recovery should be planned and adjusted as necessary to maximize the estimation of transmissivities and storage coefficients for the lower (regional) carbonate-rock aquifer underlying Dry Lake, Delamar, and Pahranagat valleys and, if possible, other units such as upper valley fill and overlying volcanic rocks.

- Pahranagat Shear Zone and southern Delamar and Pahranagat Valleys—A pumping test should be performed in prospective monitoring well DEL4003X (volcanic rocks of the Pahranagat Shear Zone, southern Delamar Valley), utilizing a minimum of the following observation wells: new volcanic-rock monitoring well PAH1011M (Pahranagat Shear Zone, southern Pahranagat Valley); 209 S07 E62 20AA1 / Dean Turley Well (basin-fill / volcanic well, southern Pahranagat Valley); piezometers at Maynard and Cottonwood springs (in southern Pahranagat Valley within the shear zone); 182M-1 (volcanic well, southwestern Delamar Valley); and 182W906M (volcanic well, southern Delamar Valley). The rate of pumping, duration of pumping, and duration of monitored recovery should be planned and adjusted as necessary to maximize the estimation of transmissivities and storage coefficients for volcanic rocks within the Pahranagat Shear Zone and vicinity (southern Delamar and Pahranagat valleys).

- Volcanic rocks, western Delamar Valley—A pumping test should be performed in monitoring well 182M-1 (volcanic rocks, southwestern Delamar Valley), utilizing a minimum of the following observation wells: 209 S07 E62 20AA1 / Dean Turley Well (basin-fill / volcanic well, south Pahranagat Valley); the new volcanic-rock monitoring well DEL4003X (southern Delamar Valley); new volcanic-rock monitoring well PAH1011M (southern Pahranagat Valley); and volcanic-rock monitoring well 182W906M (southern Delamar Valley). The rate of pumping, duration of pumping, and duration of monitored recovery should be planned and adjusted as necessary to maximize the estimation of transmissivities and storage coefficients for volcanic rocks of the South Pahroc Range (between Delamar Valley and southern Pahranagat Valley).

- Characterization of the regional carbonate-rock aquifer, west Dry Lake Valley—A pumping test should be performed in carbonate-rock monitoring well 181 N03 E63 27CAA 1 USGS-MX (western Dry Lake Valley), utilizing a minimum of the following observation wells: 181M-1 (carbonate-rock well, south-central Dry Lake Valley); 181 N03 E64 20BD 1 USBLM - Coyote Well (basin-fill well, northern Dry Lake Valley), and 181 N02 E64 03B 1 USBLM (basin-fill well, northern Dry Lake Valley). The rate of pumping, duration of pumping, and duration of monitored recovery should be planned and adjusted as necessary to maximize the estimation of transmissivities and storage coefficients for volcanic rocks of the North Pahroc Range separating Dry Lake and Pahroc valleys (the latter of which flows into Pahranagat Valley) and, if possible, upper valley fill of northern Dry Lake Valley (the CCRP Model-simulated production unit).

- Aquifer test(s) should be planned and conducted to estimate transmissivities and storage coefficients for upper valley fill and the upper and lower (regional) carbonate-rock aquifers in the area of the Shoshone Ponds flowing artesian wells and locations between the Ponds and prospective production targets, as well as the hydrologic character of significant fault zones and potential for leakage through lower valley fill (in the case project production wells are ultimately installed in one or both of the carbonate-rock aquifers or the damaged zones of the range-bounding faults in Spring Valley.

- Aquifer test(s) utilizing the new and existing Zone wells and other available wells in the vicinity of southern Spring and southern Snake valleys (including the Big Springs SW well) should be planned and conducted to estimate the transmissivity and storativity of carbonate rocks comprising the Limestone Hills, degree of hydraulic connection with overlying basin-fill deposits, and hydraulic characteristics of the range-bounding faults (east side of Spring Valley and west side of Snake valley) in advance of future ESA analyses for project pumping with the aim of improving predictive tools and evaluations of the potential for project impacts to potential Ute ladies'-tresses habitat in southern Snake Valley.

[See recommendations for White River spinedace for additional recommendations concerning aquifer testing.]

We recommend that the tests be planned and carried out with the objective of maximizing the characterization of key hydrogeologic units and constraining the calibration (and recalibration) of groundwater flow models required for future ESA analyses for project pumping, particularly in the vicinity of potential production targets (e.g., successful SNWA exploratory / test wells) and areas between those targets and habitat for federally listed species. The tests, including the selection of observation wells, monitored intervals, duration and rate of pumping, and duration of recovery monitoring should, to the extent practicable, be planned to provide estimates of transmissivity and storage coefficients for upper valley fill, the upper and lower (regional) carbonate-rock aquifers, and volcanic rocks at relevant locations, and determine the hydrologic character of significant fault zones and potential for leakage through lower valley fill and the upper aquitard unit (i.e., where relevant and feasible). Input should be solicited from the DDC and Spring Valley TRPs (voluntarily) regarding the final specifications of the tests (given the unique detailed working knowledge of TRP members concerning the area hydrogeology, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), with the BLM and Service TRP members making final recommendations given the aim of the tests. The tests should be interpreted by SNWA, with review and interpretations solicited from the TRPs (voluntarily). Aquifer test data should be made available by SNWA on a timely basis via a data-exchange Web site. Where feasible, observation intervals at multiple depths should be utilized during the tests.

COMM-H16 ***(SNWA exploratory/test wells)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the monitoring of SNWA exploratory and test wells. Prior to future ESA consultations for project pumping, groundwater levels in SNWA exploratory/test wells should be monitored continuously, preferably for a minimum of 5 years, to gather sufficient data to distinguish between the effects of project pumping, natural variation, and other influences on area groundwater levels near project wellfields once project pumping begins, and to improve the quality of future ESA analyses for groundwater pumping (including the development of improved predictive tools). Once initiated, groundwater-level monitoring should continue in the exploratory/test wells through the initiation of project pumping in the applicable project basin(s), even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record), for the duration of the project pumping, and in the case the project pumping is terminated, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Well completion and groundwater-level data should be made available on a timely basis via a data-exchange Web site.

COMM-H17 ***(SNWA production wells)—***Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to groundwater-level monitoring in and production monitoring of SNWA production wells. Beginning with well development and pumping for aquifer tests in prospective production wells, groundwater levels in SNWA production wells should be continuously monitored, and daily production from the individual wells recorded, to facilitate the interpretation of other hydrologic monitoring data, anticipate potential pumping impacts, and improve the quality of groundwater flow models (predictive tools). The collection of groundwater level and production data from the production wells should continue for the duration of project pumping. In the case that production is permanently terminated at a well, groundwater-level monitoring should continue through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Well completion, groundwater-level data, and the results of any aquifer tests performed by SNWA using the production wells should be made available on a timely basis via a data-exchange Web site.

COMM-H18 ***(CCRP Model refinements and development of "child" models)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3b, the Service specifically recommends the following with respect to CCRP Model refinements and the development of "child" models. After the recommended aquifer (pumping) tests have been completed and the hydrologic monitoring data utilized to the maximum extent, we recommend that the CCRP regional groundwater flow model be updated by SNWA before preparing "child" models and before future ESA consultations for project pumping. The DDC and Spring Valley TRPs should participate on BLM's internal model review team for model refinement / development on a voluntary basis (given the unique detailed working knowledge of TRP members concerning the hydrogeology of the area, existing hydrologic monitoring, hydrologic trends, and existing predictive models), in conjunction with other subject area experts selected by BLM.

COMM-H19 ***(Formal USGS peer review of CCRP Model improvements and "child" models)*** —We recommend that a complete formal peer review of the revised CCRP regional flow model and any "child" models based on the revised CCRP Model be conducted by the U.S. Geological Survey (USGS) Water Resources Division (WRD) prior to future ESA consultations for project pumping. Changes/improvements to the model(s) that are suggested by USGS as part of the formal peer review should be addressed (responses documented) prior to utilizing the model(s) for future ESA analyses, including Biological Assessments, or providing the results of the model simulations to the Service for future ESA consultations.

COMM-H20 ***(Hydrologic predictive tools)***—We recommend that a full range of available groundwater flow models be utilized in future ESA analyses, as well as other hydrologic analyses undertaken in advance of consultations (e.g., the interpretation of monitoring data, anticipation of adverse impacts to habitat for federally listed species, and formulation of recommendations concerning monitoring and avoidance, minimization, and mitigation measures based on model simulations).

COMM-H21 ***(Input from USGS WRD on development of hydrologic decision-making triggers)***—We recommend that input be formally solicited from the USGS Water Resources Division (WRD) concerning options (potential approaches) for the development of hydrologic decision-making triggers for the initiation of avoidance, minimization, and mitigation measures to protect habitat for federally listed species from the impacts of the proposed project pumping.

COMM-H22 ***(Development of specific hydrologic decision-making triggers)***—We recommend that hydrologic decision-making triggers for the initiation of avoidance, minimization, and mitigation measures to protect habitat for federally listed species from project pumping impacts be developed prior to future ESA consultations for groundwater development, as a part of the development and implementation of BLM's COM Plan or otherwise. Following input from the USGS WRD concerning options (potential approaches) for the development of hydrologic decision-making triggers, input should be solicited from the DDC and Spring Valley TRPs on a voluntary basis regarding the selection of specific hydrologic triggers for project pumping impacts (given the unique detailed working knowledge of TRP members concerning the area hydrogeology, existing hydrologic monitoring, hydrologic trends, and existing predictive tools) with the goal of detecting the development of any hydrologic conditions that may affect habitat for federally listed species.

COMM-H23 ***(Analysis of the combined impacts of climate change and pumping)*****—**Prior to future ESA consultations for groundwater pumping in Cave, Dry Lake, Delamar, or Spring valleys, consideration should be given to the feasibility of utilizing the downscaled projections of available climate models (range of possible changes in air temperature and precipitation) to estimate groundwater evapotranspiration and recharge under the indicated climate change scenarios as input to available groundwater flow models with the aim of evaluating the potential cumulative impacts of the proposed pumping and possible long-term climatic change over the timeframe of potential project impacts. Specifically, CCRP Model simulations provided to the Service in support of this consultation suggest that maximum project-induced drawdown would occur 50 or more years after any cessation of project pumping at many of the locations examined in this Opinion, with the effects of that pumping persisting for a significant period beyond the time of maximum impacts. Input should be solicited from the USGS WRD concerning options (approaches) for estimating potential changes in groundwater evapotranspiration and groundwater recharge from downscaled projections of changes in air temperature and precipitation (climate model output) for the area of potential project impacts. Utilizing the recommended approach, estimates of groundwater evapotranspiration and recharge for the area of potential project impacts should be prepared from available downscaled predictions of air temperature and precipitation and utilized, to the extent feasible, as input to available flow models with the aim of using the flow models in a scenario-testing capacity to quantify, to the extent practicable, the potential cumulative impacts of the proposed pumping and possible long-term climate change over relevant timeframes.

15.2 SPECIES-SPECIFIC RECOMMENDATIONS

15.2.1 *White River Spinedace*

WRS-1 ***(Habitat and fish monitoring)*****—**Consistent with portions of BLM Monitoring and Mitigation Measures, GW-MN-AB-2 and GW-MN-AB-3, we recommend that spinedace habitat monitoring accompany fish population monitoring for at least 5 years (preferably 10 years) prior to initiation of future ESA consultations for Cave Valley groundwater development. Data collected prior to tiered section 7 consultations will inform the effects analysis for future environmental compliance for groundwater development in Cave Valley (e.g., help BLM and the Service better understand natural variability, trends, and potential responses of groundwater-dependent habitats to changing flow conditions). Following this, we recommend that habitat and fish monitoring should occur for at least 5 years (preferably 10 years) immediately prior to pumping and for at least 10 years prior to propagation of impacts to Flag Springs, as predicted by hydrologic monitoring, groundwater flow modeling, and other available information/tools. Monitoring should then continue for the duration of project pumping and for a recovery period to be determined and reassessed throughout the project.

We recommend that spinedace habitat monitoring at Flag Springs include but not be limited to the following components:

- Water temperature and quality (dissolved oxygen, pH, conductivity, and other standard water quality measurements), to be monitored at regular spatial and temporal intervals (or continuously, if feasible)
- Extent/area of aquatic habitat (e.g., pools, riffles, etc.), water depth, channel width, and velocity at regular spatial and temporal intervals
- Riparian and aquatic vegetation monitoring
- Macroinvertebrate sampling

Sampling design and protocols should be developed in coordination with the Service, NDOW, and other partners, as appropriate.

WRS-2 ***(Ecological Studies)*****—**Consistent with portions of BLM Monitoring and Mitigation Measure GW-MN-AB-3, we recommend that BLM coordinate with the Service and NDOW to determine what ecological studies are needed for the White River spinedace at Flag Springs in order to 1) better understand how this species will respond to changes in habitat that could occur from decreased spring flow and 2) develop a flow-ecological response relationship for this species at Flag Springs. We further recommend that BLM coordinate with the Service, NDOW, and species experts to minimize disturbance to the species and ensure that studies fill in data gaps and do not overlap with other planned studies. Potential study topics include, but are not limited to the following:

- White River spinedace demography (reproductive rates, age structure, population growth rates)
- Habitat requirements for spawning and each life stage of the species
- Identification of limiting factors at Flag Springs
- Food preferences and feeding habits
- Native fish community structure (interspecific interactions with other native fish)
- Response of species and its habitat to changes in spring discharge at Flag Springs
- Flow regime needed to maintain and maximize habitat for the species

We recommend that BLM coordinate with the Service, NDOW, and others parties as appropriate to design and implement recommended studies. We also request that the BLM coordinate with the Service regarding selection of the principal investigators for such studies. Lastly, we recommend that these studies be initiated in order to facilitate sufficient data collection prior to initiation of future ESA consultations for groundwater development and pumping in Cave Valley.

WRS-3 ***(Ecological Model)*****—**We recommend that BLM coordinate with the Service and other appropriate parties to develop an ecological model designed to understand and anticipate the effects of decreased discharge and habitat change on White River spinedace. We further recommend that BLM consult with the Service on the person(s) hired to prepare the model, and work together on specifications for model development.

WRS-4 ***(Recovery Implementation)*****—**We recommend that BLM assist with implementation of recovery activities identified in the White River Spinedace Recovery Plan (and any subsequent revisions) and by the White River Spinedace RIT that are within BLM's authorities. Assistance may include, but is not limited to, any of the following:

- Assist with efforts to re-establish White River spinedace into historically occupied habitats, including rehabilitation of these habitats (e.g., restoration, lengthening spring outflows, extirpation of nonnative fishes) prior to re-establishment efforts
- Assist with efforts to improve habitat for White River spinedace at Flag Springs Complex
- Assist with efforts to eliminate or reduce nonnative vegetation and/or aquatics at Flag Springs
- Support research on White River spinedace ecology, behavior, life history (reproductive rates, age structure, population growth rates) and habitat use/preference
- Assist with efforts to establish White River spinedace refuge population(s) in areas that were not historically occupied by the species

WRS-H5 ***(Phased pumping, Cave Valley)*****—**The Cave Valley Applicant-Committed Measures (ACM), as documented in SNWA's letter of September 12, 2012 and further clarified in a letter dated November 4, 2012, commits to project pumping in Cave Valley that will be phased-in over a significant period of time in order to facilitate the collection of hydrologic data which has not been available to date. and/or

WRS-H6 ***(Planned monitoring well, DDC network)*****—**Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the installation and monitoring of a monitoring well in the area of CaveValley / Flag Springs. Prior to future ESA consultations for project pumping in Cave or Dry Lake valleys, the following monitoring wellshould be installed and monitored continuously to collect adequate baseline groundwater-level data, facilitate needed aquifer testing (independent estimates of aquifer parameters), and constrain the calibration (and recalibration) of flow models in advance of future ESA analyses and provide adequate early warning of the propagation of project pumping impacts to habitat for White River spinedace at Flag Springs:

- WRV1012M, sited in the regional carbonate-rock aquifer at the base of Shingle Pass in southern White River Valley, approximately 3.2 km (2 miles) north of Flag Springs on the east side of the range-bounding fault (a complement to carbonate-rock monitoring well 180W501M at the top of the Shingle Pass fault zone in Cave Valley).

We recommend that the well be installed with multiple monitored intervals (multiple completions) to maximize the utility of monitoring (monitoring of both lateral and vertical hydraulic gradients) and the estimation of aquifer parameters with the aim of improving predictive tools needed for future ESA analyses and providing effective warning of the propagation of project-induced drawdown to habitat for White River spinedace at Flag Springs. Input should be solicited from the DDC TRP (on a voluntary basis) regarding the completion of the well (given the unique detailed working knowledge of TRP members concerning the hydrogeology of the area, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), with the BLM and Service TRP members making final recommendations given the aim of the monitoring. Baseline groundwater-level data should be collected from the well for a minimum of 5 years, and preferably 10 years, in advance of project pumping in Cave Valley to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on area groundwater levels once project pumping begins, as well as to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, groundwater-level monitoring in well WRV1012M should continue through the initiation of project pumping in Cave and Dry Lake valleys, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record and interpretation of the data), for the duration of project pumping in the basins, and in the case project pumping is terminated in the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Well completion and groundwater-level data should be made available on a timely basis via a data-exchange Web site.

WRS-H7 ***(Minimum additional monitoring wells, area of Cave Valley and Flag Springs)—*** Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the expansion of the existing groundwater-level monitoring network in the vicinity of Cave Valley / Flag Springs. Prior to future ESA consultations for project pumping in Cave or Dry Lake valleys, we recommend that additional monitoring wells meeting the description (general criteria) provided below are sited, installed, and monitored continuously to collect adequate baseline groundwater-level data, facilitate aquifer testing (independent estimates of aquifer parameters), constrain the calibration (and recalibration) of flow models in advance of future ESA analyses, and provide adequate early warning of the propagation of project pumping impacts to habitat for White River spinedace at Flag Springs:

- Two wells sited on the margins of the southern Egan Range to monitor for the propagation of drawdown from southern Cave Valley to the area of Flag Springs through the Range by way of the lower (regional) carbonate-rock aquifer (as predicted by the CCRP Model), to facilitate the estimation of aquifer parameters for the intervening carbonate rocks, and (in the case of the second well) to improve the current estimate of the driving head on Flag Springs (as discussed in Chapter 7, Flag Springs):

- A well sited on the western margin of southern Cave Valley, east side of the Egan Range (e.g., within or immediately north of Trough Spring Canyon [or another equally likely high-permeability pathway for the propagation of drawdown]), completed in the lower (regional) carbonate-rock aquifer, and preferably in a combination of the upper carbonate-rock aquifer, upper aquitard (Chainman Shale), and lower (regional) carbonate-rock aquifer (multiple completions), to facilitate the estimation of aquifer parameters for key hydrogeologic units in the vicinity of the proposed pumping in Cave Valley and monitor for changes in both lateral and vertical hydraulic gradients due to project pumping (i.e., the propagation of drawdown from project pumping in Cave Valley to Flag Springs)
- A complementary well sited on the eastern margin of southern White River Valley, on the east side of the range-bounding fault (e.g., roughly 3.2 km [2 miles] south of Flag Springs on the north side of Trough Spring Canyon [or another equally likely high-permeability pathway for the propagation of drawdown from southern Cave Valley to the area of the springs]), completed in the lower (regional) carbonate-rock aquifer; this well together with planned monitoring well WRV1012M, which is sited approximately 3.2 km (2 miles) north of Flag Springs, will facilitate improved estimates of the driving head on the springs

We recommend that the above wells be installed with multiple monitored intervals (multiple completions) to maximize the utility of monitoring (monitoring of both lateral and vertical hydraulic gradients) and the estimation of aquifer parameters, with the aim of improving predictive tools needed for future ESA analyses and providing effective warning of the propagation of project-induced drawdown to habitat for White River spinedace at Flag Springs. Input should be solicited from the DDC Stipulation TRP (on a voluntary basis) regarding the final siting and completion of the wells (given the unique detailed working knowledge of TRP members concerning the hydrogeology of the area, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), with the BLM and Service TRP members making final recommendations given the aim of the monitoring. The wells should be installed by SNWA. Baseline groundwater-level data should be collected from the wells for a minimum of 5 years, and preferably 10 years, in advance of project pumping in Cave Valley to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on area groundwater levels once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, groundwater-level monitoring in the wells should continue through the initiation of project pumping in Cave and Dry Lake valleys, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record and interpretation of the data), for the duration of project pumping in the basins, and in the case project pumping is terminated in the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Well completion and groundwater-level data should be made available on a timely basis via a data-exchange Web site.

WRS-H8 ***(Maintenance of hydrologic monitoring networks, area of Cave Valley/ Flag Springs)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the maintenance of adequate hydrologic monitoring in the area of Cave Valley / Flag Springs. In order to ensure adequate collection of baseline groundwater-level data, constrain the calibration (and recalibration) of flow models in advance of future ESA analyses for groundwater pumping in Cave or Dry Lake valleys, and provide adequate hydrologic early warning of the propagation of project-induced drawdown to White River spinedace habitat at Flag Springs, we recommend that continuous water-level monitoring be continued in monitoring wells 180W501M (carbonate-rock well, north Cave Valley) and 180W902M (carbonate-rock well, south Cave Valley). We also recommend that monitoring be continued at monitoring wells 180 N08 E64 15BCBC1 USBLM (basin-fill well, south Cave Valley) and 180 N07 E63 14BADD1 USGS-MX (carbonate-rock well, south Cave Valley), and that the frequency of monitoring be increased from quarterly to continuous.

Baseline data should be collected at the above wells for a minimum of 5 years, and preferably 10 years, in advance of future ESA analyses for groundwater pumping in Cave or Dry Lake valleys to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on area groundwater levels once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Groundwater-level monitoring should continue at the above locations and frequencies through the initiation of project pumping in Cave and Dry Lake valleys, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record), for the duration of project pumping in the basins, and in the case project pumping is terminated in the basins, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). The groundwater-level data should be made available on a timely basis via data-exchange or other accessible Web sites.

WRS-H9 ***(Hydrologic monitoring at North, Middle, and South Flag springs)—***Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the establishment and implementation of adequate hydrologic monitoring of habitat for White River spinedace at Flag Springs. Prior to future ESA consultations for project pumping in Cave or Dry Lake valleys, discharge data should be collected continuously by USGS, funded by SNWA, at North, Middle, and South Flag springs, respectively, for a minimum of 5 years, and preferably 10 years (if access can be obtained /

maintained from NDOW), in order to gather sufficient baseline data to accomplish the following:

- Distinguish between the effects of project pumping, natural variation and other influences on the discharge of the springs once project pumping begins
- Support the development of empirical relationships between hydraulic head (and drawdown) in the carbonate-rock aquifer at the source of the springs and the discharge of each spring, which can be used to estimate the effects of various amounts of pumping-induced drawdown (as predicted by groundwater flow models) on the discharge of the individual springs, including the extinction head for the individual spring discharges
- Improve the quality of future ESA analyses for project pumping (including the development of improved predictive tools and triggers for the cessation and/or reduction of project pumping in Cave Valley)

Specifically, discharge data should be collected continuously at Middle Flag Spring by the USGS, funded by SNWA, for a minimum of 5 years, and preferably 10 years (if access can be maintained from NDOW), prior to future ESA consultations for project pumping in Cave or Dry Lake valleys. Additionally, the feasibility of installing continuous discharge monitoring at North and South Flag springs without adversely affecting habitat for White River spinedace or otherwise adversely affecting White River spinedace should be assessed. This determination should be made in consultation with and contingent on the findings of the Service. If continuous discharge monitoring is found to be feasible at North and South Flag springs, continuous discharge monitoring should be performed at the spring(s) by the USGS, funded by the SNWA, for a minimum of 5 years, and preferably 10 years (if access can be obtained/maintained from NDOW), prior to future ESA consultations for project pumping in Cave or Dry Lake valleys. If the Service determines that continuous discharge monitoring cannot be installed at North and/or South Flag springs without a potential adverse affect on White River spinedace, or if the installation of continuous discharge monitoring is prohibited by the physical attributes of the site(s), then a piezometer should be installed by SNWA at a location and depth that is representative of conditions at the spring orifice(s) and in the immediate vicinity of the orifice(s) and water level should be monitored continuously in the piezometer(s) in lieu of discharge for a minimum of 5 years, and preferably 10 years (if access can be obtained/maintained from NDOW), prior to future ESA consultations for project pumping in Cave or Dry Lake valleys. In the latter case, continuous piezometer water-level data should be collected by the USGS, funded by SNWA.

Additionally, continuous discharge (or surrogate piezometer water-level) monitoring at North, Middle, and South Flag springs should be conducted for the duration of project pumping in Cave or Dry Lake valleys, and in the case project pumping is terminated in the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). The SNWA should ensure that continuous discharge (or surrogate piezometer water-level) monitoring at North, Middle, and South Flag springs continues through the initiation of project pumping in Cave and Dry Lake valleys, even if this results in the collection of more than 10 years of baseline data, to maximize the information content of the baseline records (and avoid creating significant breaks and ambiguities in the records). Monitoring data whould be reported in real time on NWIS.

WRS-10 ***(Establishment of decision-making triggers for project pumping in Cave Valley)—*** Prior to initiation of future ESA consultations for groundwater development, BLM and the project applicant should consult with the Service to establish triggers for management action ("decision-making triggers") that will ensure that the risk to White River spinedace and its critical habitat at Flag Springs remains at an acceptable level. By "decision-making trigger," we mean a pre-negotiated commitment within an adaptive Monitoring, Management, and Mitigation Plan that stipulates what specific actions will be taken if monitoring results reveal particular resource outcomes (*sensu* Nie and Schultz 2012). These initial commitments should be adaptable so that negotiated changes can be made as new information is obtained during the life of the GWD Project. However, the BLM and the Service should develop an explicit process for adjusting triggers to ensure transparency and accountability (Nie and Schultz 2012).

The decision-making triggers will include a specific commitment by the project applicant to reduce or stop pumping if particular outcomes are revealed through monitoring. Triggers may also be set that require reinitiation of section 7 consultation before proceeding or continuing with the action. Additionally, if monitoring reveals new information about GWD Project impacts to White River spinedace and/or its critical habitat at Flag Springs that was not considered in this Opinion or any future consultations for groundwater development, then BLM will need to reinitiate consultation with the Service, as described in Chapter 1 (Introduction, Reinitiation Notice).

Specifically, the parties should establish hydrologic triggers for the cessation and/or reduction of project pumping in Cave Valley with the goal of detecting the development of any hydrologic conditions that may affect the discharge of Flag Springs. The parties should consider the following in selecting the triggers: 1) the potential for a time lag (which could be considerable in the case of Flag Spring) between pumping and reduced water availability at the springs; 2) the delay in the development of maximum impacts at Flag Springs until sometime following any cessation of pumping (potentially decades); 3) the potential for a significant time lag between cessation or reduction in pumping and increased water availability at Flag Springs (also potentially on the order of decades); 4) the time it could take groundwater-dependent habitat and the spinedace population at Flag Springs to respond to changes in water availability; and 5) the potential for climate change to also affect long-term water availability, thus resulting in a larger combined impact (e.g., reductions in spring flow, reductions in aquatic area) to White River spinedace and its habitat at Flag Springs.

WRS-H11 ***(Input from USGS Water Resources Division on development of hydrologic triggers)—***Input should be formally solicited from the USGS Water Resources Division concerning options (potential approaches) for the development of hydrologic decision-making triggers for the cessation and/or reduction of project pumping in Cave Valley, which will ensure that any hydrologic condition which arises in connection with the pumping can be responded to adaptively to maintain the risk to Flag Springs at an acceptable level.

WRS-12 ***(Input on development of biological triggers)—***We recommend that input be formally solicited from outside experts (e.g., USGS, academia) concerning approaches for the development of biological decision-making triggers for the cessation and/or reduction of project pumping in Cave Valley which will ensure that any biological condition which arises in connection with the pumping can be responded to adaptively to maintain the risk to spinedace at an acceptable level.

WRS-H13 ***(Development of hydrologic decision-making triggers for project pumping in Cave Valley)—***Hydrologic decision-making triggers for the cessation and/or reduction of project pumping in Cave Valley should be developed prior to initiation of future ESA consultations for groundwater development in Cave Valley (and prior to the initiation of phased-in pumping in the basin) meeting the objectives of WRS-10. After soliciting input from the USGS Water Resources Division (WRD) concerning options (potential approaches) for the development of hydrologic decision-making triggers, input should be solicited from the DDC TRP on a voluntary basis regarding the selection of specific triggers for project pumping in Cave Valley (given the unique detailed working knowledge of TRP members concerning the hydrogeology of the area, existing hydrologic monitoring, hydrologic trends, and existing predictive tools) with the goal of detecting the development of any hydrologic conditions which may affect the discharge of Flag Springs. The parties should consider the following in selecting the triggers: 1) the potential for a time lag (which could be considerable in the case of Flag Spring) between pumping and reduced water availability at the springs; 2) the delay in the development of maximum impacts at Flag Springs until sometime following any cessation of pumping (potentially decades); and 3) the potential for a significant time lag between cessation or reduction in pumping and increased water availability at Flag Springs (also potentially on the order of decades). BLM and Service TRP members should make final recommendations concerning the selection of specific hydrologic decision-making triggers for project pumping in Cave Valley given the aim of the triggers. The Service should make the final selection of hydrologic decision-making triggers for the cessation and/or reduction of project pumping in Cave Valley in consultation with BLM, subject to amendment / update by the Service based on new information (i.e., on an ongoing basis as indicated) in consultation with BLM.

WRS-14 ***(Development of biological decision-making triggers for project pumping in Cave Valley)—***Biological decision-making triggers for the cessation and/or reduction of project pumping in Cave Valley should be developed prior to initiation of future ESA consultations for groundwater development in Cave Valley (and prior to the initiation of phased-in pumping in the basin) meeting the objectives of WRS-10. After soliciting input from outside experts (e.g., USGS, academia) concerning approaches for the development of biological decision-making triggers, input should be solicited from the DDC BRT on a voluntary basis regarding the selection of the specific triggers for project pumping in Cave Valley, with the goal of detecting the development of any biological conditions that may affect the survival and/or recovery of White River spinedace at Flag Springs. BLM and Service BRT members should make final recommendations concerning the selection of specific biological decision-making triggers for project pumping in Cave Valley given the aim of the triggers. These recommendations should be used to inform the setting of the hydrologic decision-making triggers (above). The parties should consider the following in selecting the triggers: 1) the potential for a time lag (which could be considerable in the case of Flag Springs) between pumping and reduced water availability at the springs; 2) the delay in the development of maximum impacts at Flag Springs until sometime following any cessation of pumping (potentially decades); 3) the potential for a significant time lag between cessation or reduction in pumping and increased water availability at Flag Springs (also potentially on the order of decades); 4) the time it could take groundwater-dependent habitat and the spinedace population at Flag Springs to respond to changes in water availability; and 5) the potential for climate change to also affect long-term water availability, thus resulting in a larger combined impact (e.g., reductions in spring flow, reductions in aquatic area) to White River spinedace and its habitat at Flag Springs. The Service should make the final selection of hydrologic and biological decision-making triggers for the cessation and/or reduction of project pumping in Cave Valley in consultation with BLM, subject to amendment / update by the Service based on new information (i.e., on an ongoing basis as indicated) in consultation with BLM.

WRS-H15 ***(Minimum additional aquifer testing, area of Cave Valley)—***Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to additional aquifer testing in the area of Cave Valley / Flag Springs. Aquifer (pumping) tests performed to date by the project proponent were largely designed to estimate specific capacity (production potential), as opposed to aquifer parameters needed to improve groundwater flow models (predictive tools) and other forms of hydrologic analyses that will be required for future ESA consultations for project pumping. Prior to the update of the regional CCRP flow model, construction of any “child” models for the area of Cave Valley or Flag Springs (based on the CCRP or other regional flow models), or future ESA consultations for groundwater pumping in Cave Valley, we recommend that SNWA perform additional aquifer tests that meet the general criteria provided below:

- Southern Cave Valley / Flag Springs—A pumping test should be performed in CAV6002X on the southeast side of southern Cave Valley near Sidehill Pass and the boundary with Dry Lake Valley (i.e., a longer-duration test than conducted for exploration purposes) utilizing a minimum of the following observation wells in southern Cave Valley: carbonate-rock wells 180W902M, CAV6002M2, and 180 N07 E63 14BADD1 and the new carbonate-rock well (including any multiple completions) on the east side of the Egan Range in southern Cave Valley; basin-fill well 180 N06 E64 18CC 1 Sidehill Pass Well, with additional basin-fill wells selected as observation wells in southern Cave Valley following a review of the completion, construction, and condition of the available wells. Flag Springs should be carefully monitored throughout the pumping portion of the test and a significant recovery period. We recommend that the rate of pumping, duration of pumping, and duration of monitored recovery be planned and adjusted as necessary to maximize the estimation of transmissivities and storage coefficients for the lower (regional) carbonate-rock aquifer underlying southern Cave Valley and, if possible, other units such as upper valley fill and the upper aquitard.

- Southern Cave Valley / Flag Springs—A pumping test should be performed in the new carbonate-rock monitoring well installed on the east side of the Egan Range in southern Cave Valley, utilizing a minimum of the following observation wells in southern Cave Valley: carbonate-rock wells 180W902M, CAV6002X, CAV6002M2, and 180 N07 E63 14BADD1 and basin-fill well 180 N06 E64 18CC 1 Sidehill Pass Well, with additional basin-fill wells selected as observation wells in southern Cave Valley following a review of the completion, construction, and condition of the available wells. The test should additionally utilize the new carbonate-rock monitoring well located on the west side of the Egan Range approximately 3.2 km (2 miles) south of Flag Springs (immediately north of Trough Spring Canyon) and carbonate-rock monitoring well WRV1012M (which is planned but not yet installed under the current DDC Stipulation hydrologic monitoring program), both on the west side of the Egan Range approximately 3.2 km (2 miles) north of Flag Springs, with the aim of characterizing the transmissivity and storativity of carbonate rocks separating southern Cave Valley from the springs. Stopping criteria should be identified at the latter carbonate-rock wells (west side of the Egan Range) for the pumping portion of the test with the aim of ensuring that the test poses no risk to Flag Springs. All 3 springs (North, Middle, and South Flag springs) should be carefully monitored throughout the pumping portion of the test and a significant recovery period. We recommend that the rate of pumping, duration of pumping, and duration of monitored recovery be planned and adjusted as necessary to maximize the estimation of transmissivities and storage coefficients for the lower (regional) carbonate-rock aquifer underlying southern Cave Valley, carbonate rocks of the southern Egan Range (separating southern Cave Valley from Flag Springs), and (if possible) other units such as upper valley fill and the upper aquitard of southern Cave Valley. Additionally, if multiple completions are available in the pumped well (on the east side of the Egan Range), they should be monitored to facilitate estimates of the conductivity of the upper aquitard unit.

- Shingle Pass, Cave Valley—A pumping test should be performed in carbonate-rock monitoring well 180W501M in the Shingle Pass fault zone, utilizing a minimum of the following observation wells: carbonate-rock well 180 N07 E63 14BADD1 located south of the horst block comprising the Shingle Pass fault zone in the floor of southern Cave Valley; and basin-fill well 180 N08 E64 15BCBC1 USBLM in the floor of southern Cave Valley; with additional basin-fill wells selected in southern Cave Valley near the horst block comprising the fault zone, and within northern Cave Valley, following a review of the completion, construction, and condition of the available wells. A stopping criterion should be identified at carbonate-rock well WRV1012M located at the base of the Pass approximately 3.2 km (2 miles) north of Flag Springs (on the west side of White River Valley) for the pumping portion of the test to ensure that the test poses no risk to Flag or Butterfield springs. Both springs should be carefully monitored throughout the pumping portion of the test and a significant recovery period. The rate of pumping, duration of pumping, and duration of monitored recovery should be planned and adjusted as necessary to maximize the estimation of aquifer parameters for carbonate rocks of the Shingle Pass fault zone and the collection of faults on the southeastern margin of the horst block.

We recommend that the tests be planned and carried out with the objective of maximizing the characterization of key hydrogeologic units and constraining the calibration (and recalibration) of groundwater flow models required for future ESA analyses for groundwater pumping in Cave and/or Dry Lake valleys, particularly in the vicinity of production targets (successful SNWA exploratory / test wells) in Cave Valley (e.g., CAV6002X) and areas between those targets and habitat for White River spinedace at Flag Springs. The tests—including the selection of observation wells, monitored intervals, duration and rate of pumping, and duration of recovery monitoring—should be planned to provide estimates of transmissivity and storage coefficients for upper valley fill, the upper and lower (regional) carbonate-rock aquifers, and volcanic rocks at relevant locations, and to determine the hydrologic character of significant fault zones and potential for leakage through lower valley fill and the upper aquitard unit (wherever and to the extent feasible). Input should be solicited from the DDC TRP (voluntarily) regarding the final specifications of the tests (given the unique detailed working knowledge of TRP members concerning the hydrogeology of the area, existing hydrologic monitoring, hydrologic trends, and existing predictive tools), with the BLM and Service TRP members making final recommendations given the aim of the testing. The tests should be interpreted by SNWA, with review and interpretations solicited from the TRPs (on a voluntary basis). Aquifer test data should be made available by SNWA on a timely basis via a data-exchange Web site. Where feasible, observation intervals at multiple depths should be utilized during the tests. Test data should be made available by SNWA on a timely basis via a data-exchange Web site.

15.3 PAHRUMP POOLFISH

PP-1 (*clarification of GW-WR-5*)—The stock pond consistently has the highest number of poolfish and appears to be the most stable of the populations in this area; therefore, it is important that flow and water quality be maintained at Shoshone Well No. 4 as well as the other two wells that supply water to poolfish habitat (or any water sources for additional habitat created in the future).

PP-2 (*Coordination with the Service on monitoring plans*)—We recommend that BLM submit the Shoshone Ponds surface water and groundwater monitoring plan required of SNWA under GW-WR-5 to the Service for review, and that approval of the Plan by BLM should be made in consultation with the Service.

PP-3 (*Water quality monitoring*)—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3, we recommend that BLM require water quality monitoring (temperature, dissolved oxygen, pH, conductivity, and other standard water quality measurements) at regular and frequent intervals (or continuously, if feasible) for at least 5 years (and preferably 10 years) prior to pumping in order to understand baseline levels and the natural range of variation. We also recommend continuation of 24-hour water quality surveys (if continuous monitoring is not done) and vertical water quality profiling, such as performed by SNWA in 2012. Additionally, we recommend that baseline monitoring occur during and after years with extreme climate conditions (wet years, drought years) to document responses to extreme wet and dry conditions. Water quality monitoring should continue for the duration of project pumping and a recovery period to be determined and reassessed throughout the project. Specifics (e.g., sampling design, frequency, protocols) should be developed in coordination with the Service, NDOW, and the project applicant. We also recommend that BLM coordinate with the Service and NDOW to install water quality monitoring equipment with minimal disturbance to the Pahrump poolfish. This recommendation should supplement any on-going water quality measurements, and is not meant to replace and/or replicate other monitoring efforts.

We recommend that data be collected for 5–10 years prior to initiation of Subsequent Tier consultations so that the data can inform future Opinions and assist with determining the extent of incidental take that could occur.

PP-4 (*Aquatic habitat monitoring*)—Consistent with portions of BLM Monitoring and Mitigation Measure GW-MN-AB-2, we recommend that BLM require monitoring of poolfish habitat within Shoshone Ponds Natural Area, including but not limited to the following: extent of aquatic and marshy habitat; depth of ponds; and aquatic vegetation and algae. Monitoring should continue for at least 5 years (and preferably 10 years) prior to future ESA section 7 consultations for groundwater development in Spring Valley *and* for at least 5 years (preferably 10 years) prior to the start of pumping in Spring Valley in order to understand baseline levels and the natural range of variation. This monitoring should continue for the duration of project pumping and a recovery period to be determined and reassessed throughout the project. We further recommend that this monitoring be developed in coordination with the Service, NDOW, and the project applicant; and that this aspect of the project be designed so as to cause minimal disturbance to the Pahrump poolfish.

We recommend that data be collected for 5–10 years prior to initiation of Subsequent Tier consultations so that they can inform future Opinions and assist with determining the extent of incidental take that could occur.

PP-5 (*Ecological studies*)—Consistent with portions of BLM Monitoring and Mitigation Measure GW-MN-AB-3, , we recommend that the BLM coordinate with the Service and NDOW to determine what ecological studies (e.g., life history, habitat use and preference) are needed for the Pahrump poolfish at Shoshone Ponds in order to 1) better understand how this species will respond to changes in habitat that could occur from decreased well flow; and 2) assist with management of this species at Shoshone Ponds. We further recommend that BLM coordinate with the Service, NDOW, and project applicant to design and implement recommended studies. Additionally, we recommend that these studies be initiated in order to facilitate sufficient data collection prior to initiation of future ESA consultations for groundwater development and pumping in Spring Valley.

We note that GW-MN-AB-3 states that flow or water level–habitat relationships will be studied in *selected* streams and springs to determine minimum flow or water levels needed to support critical life stages of aquatic species (emphasis added). This measure does not specifically state that studies will occur on Pahrump poolfish to better understand how this species may respond to habitat changes that could result from groundwater pumping, including changes to water quality.

PP-6 (*Evaluating baseline conditions*)—We recommend that the BLM ensure (to the extent feasible) that maintenance and habitat improvement projects at Shoshone Ponds (e.g., creation of additional pools; fencing; changes in livestock management) are completed as far in advance of biological baseline data collection as possible. Changes in management during the baseline data collection period could make determining baseline conditions difficult; the baseline conditions are the basis for assessing effects of the proposed federal action. Therefore, this measure is relevant to the proposed action for this reason. Additionally, we recommend that BLM choose specific springs on BLM land in Spring Valley that will serve primarily as monitoring sites for the GWD project, and would not be subject to a multitude of other uses (e.g., livestock grazing). These spring sites could be strategically chosen to provide early warning of pumping-induced impacts to sites with sensitive species, such as the Pahrump poolfish. By doing this, BLM could help limit “noise” that would confound interpretation of data and potentially obscure cause-effect relationships for this project. This recommendation was proffered by Dr. D. Sada (Desert Research Institute, Reno, Nevada) in regard to monitoring biological effects of groundwater extraction in Spring Valley.

PP-H7 ***(Shoshone Ponds flowing artesian wells)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-5, the Service specifically recommends the following with respect to the establishment of adequate hydrologic monitoring of the Shoshone Ponds flowing artesian wells. Prior to future ESA consultations for project pumping in Spring Valley, we recommend that a flow meter/logger with appropriate range, accuracy, and precision be installed and monitored continuously on Shoshone Pond Well #4 which supplies the stock pond at Shoshone Ponds to collect and record discharge data for as long as there are Pahrump poolfish at the Shoshone Ponds site as a whole. Likewise, a flow meter / logger (with appropriate range, accuracy, and precision) should be installed on any additional Shoshone Ponds flowing artesian wells which supply water to a pond or stream in which Pahrump poolfish occur to collect and record discharge data continuously. Also, a pressure gage (with appropriate range, accuracy, and precision) should be permanently installed on the wellhead of any Shoshone Ponds flowing artesian well which is restricted by a Nevada State Engineer (NSE) water right permit; pressure measurements (with the well restricted to reproduce the NSE-awarded discharge rate) should be manually recorded on a monthly basis at such wells in lieu of monitoring shut-in artesian pressure (i.e., as a cost-effective alternative to the installation of replacement shut-in artesian wells in which artesian pressure can be continuously monitored). The above activities should be coordinated with Service Ecological Services staff to determine exact needs. In the case that any of the above (historic) flowing artesian wells fail, the well(s) should be replaced with shut-in artesian well(s) and artesian pressure should be monitored in the well(s) continuously. Baseline data should be collected at each of the above sites for a minimum of 5 years, and preferably 10 years, in advance of project pumping in Spring Valley to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on the Shoshone Ponds flowing artesian wells once project pumping begins, as well as to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, discharge and pressure measurements should continue through the start of project pumping, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record), for the duration of project pumping, and in the case project pumping is terminated in Spring Valley, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Continuous discharge and manual pressure measurements should be made available on a timely basis via a data-exchange Web site.

15.4 PAHRANAGAT VALLEY FISHES

PV-PRC-1 (*Ecological studies*)—We recommend that BLM coordinate with the Service and NDOW to develop and implement scientific investigations on life history characteristics and spawning and habitat requirements of Pahranagat roundtail chub to better understand how this species will respond to habitat changes resulting from decreased spring flow, reduced water volume, and other habitat changes that may occur as the result of pumping-induced groundwater drawdown.

We assume that this recommendation is not covered by BLM Monitoring and Mitigation Measure GW-MN-AB-3 because BLM concluded that areas occupied by the chub were not at moderate or high risk of being affected by the proposed federal action.

PV-PRC-2 (*Assisting with recovery activities*)—We recommend that BLM coordinate with the Service and NDOW to help with identifying potential refuge sites for the chub in Pahranagat Valley and establishing additional refuge populations. Activities could include, but are not limited to the following: 1) assist with studies to characterize potential refuge sites, including establishing temperature loggers, measuring dissolved oxygen (DO) levels, and measuring flow rates; 2) assist with studies to determine why Cottonwood Springs on Pahranagat NWR failed as a chub refuge; and 3) assist with habitat improvement projects at springs that may serve as future refuge sites for the chub.

PV-PRC-3 (*Chub habitat improvement projects*)—We recommend that BLM assist the Service, NDOW, and private landowners as opportunities arise to implement Pahranagat roundtail chub and springfish habitat improvement projects in the Ash Springs system, including non-native species control and/or eradication, developing deeper pooled habitat within Pahranagat Creek to benefit chub, and creating a more diverse thermal environment for native fish of the system. We also recommend that BLM coordinate with the Service and NDOW to develop and implement habitat improvement projects on BLM land at Ash Springs.

PV-PRC-4 (*Chub habitat on Key Pittman WMA*)—If impacts to the well-fed pond on Key Pittman Wildlife Management Area are anticipated as a result of future tiered consultations, we recommend that BLM require hydrologic monitoring for at least 5 years (and preferably 10 years) in advance of the propagation of impacts, and work with NDOW to maintain flow to the pond.

PRC, WRSF, SWF-H5 *(Ash Springs, Pahranagat Valley)*—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the maintenance of adequate hydrologic monitoring of Ash Springs in Pahranagat Valley. Prior to future ESA analyses for project pumping in Dry Lake or Delamar valleys, we recommend that discharge data be collected continuously at the primary Ash Spring gage and Ash Spring Irrigation Diversion gage by USGS, funded by SNWA, i.e., continued, to estimate and monitor the discharge of Ash Springs (if access can be obtained / maintained). Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in advance of project pumping in Dry Lake or Delamar valleys to gather sufficient data to distinguish between the effects of project pumping, natural variation and other influences on the springs once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Continuous discharge monitoring at Ash Springs should continue for the duration of project pumping in Dry Lake or Delamar valleys and, in the case project pumping in these valleys is terminated, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Moreover, continuous discharge monitoring that is being performed by the USGS at Ash Springs, with funding from SNWA, should be continued through the initiation of project pumping in Dry Lake and Delamar valleys, even if this results in the collection of more than 10 years of baseline data, to maximize the information content of the baseline record (and avoid creating significant breaks and ambiguities in the record) at these important sites. Monitoring data should continue to be reported in real time on NWIS.

15.5 SOUTHWESTERN WILLOW FLYCATCHER

SWFL-1 (*Flycatcher habitat improvement*)—We recommend that BLM work with the Service, NDOW, and private landowners, as appropriate, to implement the following conservation management actions: 1) improving and maintaining existing occupied riparian habitat; 2) creating and maintaining additional riparian habitat; and 3) reducing parasitism and predation rates.

SWFL-2 (*Clarification of GW-VEG-4*)—We recommend that BLM clarify that mitigation measure GW-VEG-4 applies to the monitoring of riparian and other phreatophytic vegetation communities in areas that may be affected by groundwater pumping and that are *outside* of the GW Development Areas. The current title of this measure (Phreatophytic Vegetation Monitoring in GW Development Areas) suggests otherwise.

SWFL-H3 *(Hydrologic monitoring, Pahranagat NWR, North Marsh)*—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the establishment of adequate shallow groundwater-level monitoring in the area of southwestern willow flycatcher habitat in the North Marsh of Pahranagat National Wildlife Refuge. Prior to future ESA consultations for project pumping in Dry Lake or Delamar valleys, we recommend that a pair of nested piezometers be sited, installed, and monitored continuously by SNWA near the north marsh willow stand on Pahranagat NWR, which harbors southwestern willow flycatcher. This activity should be coordinated with Service Ecological Services and Pahranagat NWR staff to determine exact needs. Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in advance of project pumping in Dry Lake or Delamar valleys to gather sufficient data to distinguish between the effects of project pumping, natural variation, and other influences on surficial water levels in the area of this habitat once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, piezometer water-level measurements should continue through the initiation of project pumping, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record and interpretation of the data), for the duration of project pumping, and in the case project pumping is terminated in any of the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Monitoring data should be made available on a timely basis via a data-exchange Web site.

SWFL-H4 ***(Hydrologic monitoring, Key Pittman Wildlife Management Area, Pahranagat Valley)*****—**Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the establishment of adequate shallow groundwater-level monitoring in the area of southwestern willow flycatcher habitat at Key Pittman Wildlife Management Area in Pahranagat Valley. Prior to future ESA consultations for project pumping in Dry Lake or Delamar valleys, we recommend that a nested piezometer be sited, installed, and monitored continuously by SNWA near southwestern willow flycatcher habitat on Key Pittman Wildlife Management Area (if access can be obtained / maintained from NDOW). This activity should be coordinated with Service Ecological Services and NDOW staff to determine exact needs. Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in advance of project pumping in Dry Lake or Delamar valleys to gather sufficient data to distinguish between the effects of project pumping, natural variation, and other influences on surficial water levels in the area of this habitat once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Once initiated, piezometer water-level measurements should continue through the initiation of project pumping, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record and interpretation of the data), for the duration of project pumping, and in the case project pumping is terminated in any of the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Monitoring data should be made available on a timely basis via a data-exchange Web site.

SWFL-H5 ***(Hydrologic monitoring, southwestern willow flycatcher habitat, northern Lower Meadow Valley Wash)*****—**Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the establishment of adequate shallow groundwater-level monitoring in the area of southwestern willow flycatcher habitat in northern Lower Meadow Valley Wash. If propagation of project-induced drawdown into northern Lower Meadow Valley Wash is documented, a piezometer should be sited, installed, and monitored by SNWA near southwestern willow flycatcher habitat in the Wash. This activity should be coordinated with Service Ecological Services and Pahranagat NWR staff to determine exact needs. Once initiated, piezometer water-level measurements should continue for the duration of project pumping in Dry Lake and Delamar valleys, and in the case project pumping is terminated in the valleys, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Monitoring data should be made available on a timely basis via a data-exchange Web site.

SWFL, MD-H6 ***(Hydrologic monitoring, Muddy River Springs Area)*****—**Monitoring established in Coyote Spring Valley and the Muddy River Springs Area for the Nevada State Engineer Order 1169 Pumping Study (including monitoring frequencies and daily production records) should be continued to constrain the calibration/recalibration of flow models (predictive tools) needed for future ESA analyses, specifically the capacity to assess and anticipate any impacts to habitat for the federally listed Moapa dace and southwestern willow flycatcher at the Muddy River Springs that may occur in response to project pumping in Cave, Dry Lake, or Delamar valleys. Monitoring on this portion of the network should continue for the duration of project pumping in Cave, Dry Lake, or Delamar Valleys and, in the case project pumping in these valleys is terminated, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). The monitoring data should be made available on a timely basis via a data-exchange Web site.

15.6 UTE LADIES'-TRESSES

ULT-1 (*Ute ladies'-tresses surveys, construction pumping*)—Two years prior to initiation of Tier 1 construction the following should occur: 1) identify potentially suitable habitat for Ute ladies'-tresses that may exist outside the Tier 1 ROW in Spring Valley and that may be affected by groundwater pumping for construction purposes and 2) conduct follow-up surveys of all habitats identified as having a "moderate" or "high" potential to support Ute ladies'-tresses to confirm presence/absence of the species. Determinations of “low”, “moderate”, and “high” potential habitat should follow the assessment protocol developed by BIO-WEST (2007) in its Ute ladies'-tresses reconnaissance surveys for SNWA (see Chapter 11). These species-specific surveys should be conducted in accordance with the most current Ute ladies'-tresses survey protocol developed by the Service's Utah Field Office, particularly with regard to ensuring that surveys are timed to maximize the likelihood of observing flowering individuals. The results of these species-specific surveys (positive or negative) should also be mapped in a GIS, with the following attribute data provided for each spatially discrete location mapped: the actual date(s) of surveys, the hours of survey effort, whether the species was observed, the number of individuals present (actual or estimated), the spatial extent of the population, and the spatial extent of seemingly suitable habitat (if different).

ULT-2 (*Ute ladies'-tresses surveys, Subsequent Tier ROWs*)—Two years prior to initiation of tiered section 7 consultations, surveys of habitats likely to be affected by future components of this project should be conducted. The geographic area to be surveyed for Ute ladies'-tresses will be determined based on updated groundwater pumping simulation models in coordination with the Nevada Fish and Wildlife Office (NFWO) and Utah Fish and Wildlife Office (UFWO). The purpose of these surveys should be to evaluate the potential for surveyed locations to contain Ute ladies'-tresses, with explicit deference to the habitat criteria described in the most current Ute ladies'-tresses survey protocol developed by the Service's Utah

Field Office. As with the habitat surveys conducted in support of this programmatic section 7 consultation, all locations surveyed for potentially suitable habitat (for Ute ladies'-tresses) should be categorized in terms of their potential to support the species, using a ranking of "low", "moderate", and "high". Determinations of "low", "moderate", and "high" potential habitat should follow the assessment protocol developed by BIO-WEST in its 2007 Ute ladies'-tresses reconnaissance surveys for SNWA (see Chapter 11). Results of these habitat surveys should be mapped in a GIS, with the location and extent of all sites surveyed clearly delineated, with attribute data (specific to each survey location) indicating the potential for each survey location to support the species.

ULT-3 (*Ute ladies'-tresses surveys, follow-up surveys of moderate- and high-potential habitat*)—Two years prior to initiation of section 7 consultation, follow-up surveys of all habitats identified as having a "moderate" or "high" potential to support Ute ladies'-tresses should be conducted to confirm presence/absence of the species. Determinations of "low", "moderate", and "high" potential habitat should follow the assessment protocol developed by BIO-WEST (2007) in its Ute ladies'-tresses reconnaissance surveys for SNWA (see Chapter 11). These species-specific surveys should be conducted in accordance with the most current Ute ladies'-tresses survey protocol developed by the Service's Utah Field Office, particularly with regard to ensuring that surveys are timed to maximize the likelihood of observing flowering individuals. The results of these species-specific surveys (positive or negative) should be mapped in a GIS, with the following attribute data provided for each spatially discrete location mapped: the actual date(s) of surveys, the hours of survey effort, whether the species was observed, the number of individuals present (actual or estimated), the spatial extent of the population, and the spatial extent of seemingly suitable habitat (if different).

ULT-4 (*Survey guidelines*)—All botanical surveys conducted for Ute ladies'-tresses (whether to identify potentially suitable habitat or the presence/absence of the species) should be consistent with the Service's Utah Field Office Guidelines for Conducting and Reporting Botanical Inventories and Monitoring of Federally Listed, Proposed, and Candidate Plants (version date: August 31, 2011, or most current).

ULT-5 (*Changes to Tier 1 ROW corridor*)—If the Tier 1 ROW corridor and/or associated facilities are relocated outside the footprint depicted in Figures 2-3 through 2-6 of BLM (2012a), an appropriate review should be conducted for potentially suitable Ute ladies'-tresses habitat.

ULT-6 (*Reporting of Ute ladies'-tresses occurrences*)—If Ute ladies'-tresses is found to occur within the action area in future surveys, these known locations should be reported to the Service as well as the appropriate State natural heritage program (Nevada or Utah).

ULT-7 (*Future Ute ladies'-tresses monitoring associated with groundwater pumping*)—If Ute ladies'-tresses is subsequently found to occur within Spring Valley, the species should be adopted as a species of concern and identified as a monitoring target.

ULT-H8 *(Groundwater-level monitoring, northern Hamlin Valley)*—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the installation and monitoring of planned monitoring wells in the area of the 'Zone' between southern Spring and southern Snake valley. Prior to future ESA consultations for project pumping in Spring Valley, we recommend that the following interbasin 'Zone' monitoring wells (or their equivalent) be installed and monitored continuously by SNWA to collect adequate baseline groundwater-level data, characterize aquifer parameters for the Limestone Hills, and constrain the calibration (and recalibration) of flow models that are needed for future ESA analyses: SPR7009M (a carbonate-rock well, southern Spring Valley), HAM1007M (a carbonate-rock well, northern Hamlin Valley), SPR7010M (a carbonate-rock well at the boundary between southern Spring and northern Hamlin valleys), HAM1005M (a basin-fill well, northern Hamlin Valley), and HAM 1006M (a basin-fill well, northern Hamlin Valley near Big Springs). Baseline data should be collected for a minimum of 5 years, and preferably 10 years, in order to gather sufficient data to distinguish between the effects of project pumping, natural variation, and other influences on area groundwater levels once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Continuous groundwater-level monitoring in the new and existing Zone wells should continue for the duration of project pumping in Spring Valley and, in the case that project pumping in Spring Valley is terminated, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Once initiated, SNWA should ensure that continuous groundwater-level monitoring in the Zone wells continues through the initiation of project pumping in Spring Valley, even if this results in the collection of more than 10 years of baseline data, in order to maximize the information content of the baseline record (and avoid creating significant breaks and ambiguities in the record). Well completion and groundwater-level data should be made available on a timely basis via a data-exchange Web site.

ULT-H9 *(Hydrologic monitoring, northern Hamlin Valley)*—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the continuation of adequate groundwater-level monitoring in northern Hamlin Valley. We recommend that the Big Springs SW well be continuously monitored by SNWA beginning immediately. Continuous monitoring of the Big Springs SW well is needed to gather sufficient baseline data to distinguish between the effects of project pumping, natural variation and other influences on groundwater levels in the regional carbonate-rock aquifer of northern Hamlin and southern Snake valleys once project pumping begins, and to improve the quality of future ESA analyses (including the development of improved predictive tools). Continuous groundwater-level monitoring in the Big Springs SW well should continue for the duration of project pumping in Spring Valley, and in the case that project pumping in Spring Valley is terminated, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). SNWA should ensure that continuous groundwater-level monitoring in the Big Springs SW well continues through the initiation of project pumping in Spring Valley, even if this results in the collection of more than 10 years of baseline data, in order to maximize the information content of the baseline record (and avoid creating significant breaks and ambiguities in the record) at this important location. Groundwater-level data should be made available on a timely basis via a data-exchange Web site.

ULT-H10 ***(Groundwater-level monitoring, southern Snake Valley)—***Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the continuation of adequate groundwater-level monitoring in southern Snake Valley contingent on the documented occurrence or high potential for the occurrence of Ute ladies'-tresses in the area. Contingent on the latter and in the event that the State of Utah ceases to fund operation of the current Utah Geological Survey (UGS) network of monitoring wells/piezometers, we recommend that SNWA ensure continued operation of the network, <u>or an equivalent groundwater-level monitoring network</u>, which utilizes a combination of basin fill, carbonate-rock, and volcanic wells / piezometers, including monitoring at multiple depths (multiple completions), from Garrison, Utah, to the area of volcanic rocks south of South Little Spring (south of Big Spring), with monitoring at the frequencies utilized in the UGS network and timely reporting of the data on a data-exchange Web site, in order to provide: adequate baseline data collection (should Utah cease to fund the UGS network before Spring Valley pumping begins), information for improvements to predictive tools (groundwater flow models) and future ESA analyses, and monitoring and anticipation of potential impacts to any identified habitat for Ute ladies'-tresses in southern Snake Valley. Continuous groundwater-level monitoring should continue on the network through the initiation of project pumping in Spring Valley, even if this results in the collection of more than 10 years of baseline data (to avoid significant breaks and ambiguities in the record), for the duration of project pumping in Spring Valley, and in the case that project pumping in Spring Valley is terminated, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves).

ULT-H11 ***(Groundwater-level monitoring, northern Snake Valley)***—Consistent with portions of BLM Monitoring and Mitigation Measure GW-WR-3a, the Service specifically recommends the following with respect to the continuation of adequate groundwater-level monitoring in northern Snake Valley contingent on the documented occurrence or high potential for the occurrence of Ute ladies'-tresses in the area. In the event that drawdown due to project pumping in Spring Valley is detected in UGS monitoring wells (or their equivalent) at Garrison, Utah, e.g., AG13BC, PW01ABC, and/or PW03AB, or in the recommended wells in the pass between the northern Snake Range and Kern Mountains, we recommend that SNWA ensure continued operation of the UGS network of monitoring wells / piezometers, <u>or an equivalent network</u>, from UGS site #25 (the Leland-Harris Spring sites) to the southern end of the network (e.g., PW04AB), including any multiple completion intervals, maintaining monitoring frequencies established under the current UGS Snake Valley Groundwater Monitoring Project, in case the State of Utah ceases to fund operation of the network. Groundwater-level monitoring should continue on the network for the duration of project pumping in Spring Valley, and in the case project pumping is terminated in the valley, through a recovery period to be determined and reassessed throughout the project (i.e., as the capacity to anticipate the duration of significant post-pumping impacts improves). Monitoring data should be made available on a timely basis via a data-exchange Web site.

15.7 LITERATURE CITED

[BLM] Bureau of Land Management. 2012a. Revised Biological Assessment for the Clark, Lincoln, and White Pine Counties Groundwater Development Project. May 11, 2012.

[BLM] Bureau of Land Management. 2012b. Final environmental impact statement for the Clark, Lincoln, and White Pine Counties Groundwater Development Project. U.S. Department of the Interior, BLM. August 2012.

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Nie, M., and C. Schultz. 2011. Decision making triggers an adaptive management. University of Montana, College of Forestry and Conservation, Missoula, MT.

[SNWA] Southern Nevada Water Authority. 2011a. Hydrologic data analysis report for test well CAV6002X in Cave Valley, Hydrographic Area 180. Southern Nevada Water Authority, Las Vegas, Nevada, Doc. No. DAR-ED-0008. June 2011.

[SNWA] Southern Nevada Water Authority. 2011b. 2010 Delamar, Dry Lake, and Cave valleys hydrologic monitoring and mitigation plan status and data report. Southern Nevada Water Authority, Las Vegas, Nevada. March 2011.

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Appendix A

U.S. Army Corps of Engineers Letter Designating Lead Agency

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO CA 95814-2922

REPLY TO
ATTENTION OF

RECEIVED MAR 12 2012

February 27, 2012

Regulatory Division SPK-2009-00594

Penny Woods
Bureau of Land Management
PO Box 12000
Reno, Nevada 89520-0006

Dear Ms. Woods:

This letter concerns the designation of lead Federal agency for the proposed Clark, Lincoln and White Pine Counties Groundwater Development project. The project is located in Clark, Lincoln and White Pine Counties, as shown on the Attachment 1 – Map of the proposed project.

We hereby designate Bureau of Land Management as the lead Federal agency to act on our behalf for purposes of compliance with the Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA) for Department of the Army (DA) authorization required for the Clark, Lincoln and White Pine Counties Groundwater Development project.

When you initiate consultation under Section 7 of the ESA or Section 106 of the NHPA, please include a statement indicating that we have designated Bureau of Land Management as the lead Federal agency for the project, along with a copy of this letter.

Please refer to identification number SPK-2009-00594 in any correspondence concerning this project. If you have any questions, please contact Patricia Mcqueary at 196 E Tabernacle Street Room 30, St. George, Utah 84770, email *Patricia.L.McQueary@usace.army.mil*, or telephone 435-986-3979. For more information regarding our program, please visit our website at *www.spk.usace.army.mil/regulatory.html.*

Sincerely,

Jason A. Gipson
Utah-Nevada Branch Chief
Sacramento District

Enclosure: Attachment 1: Map of project location

Cc: Lisa Luptowitz, SNWA, PO Box 99956, Las Vegas, NV 89193-9956

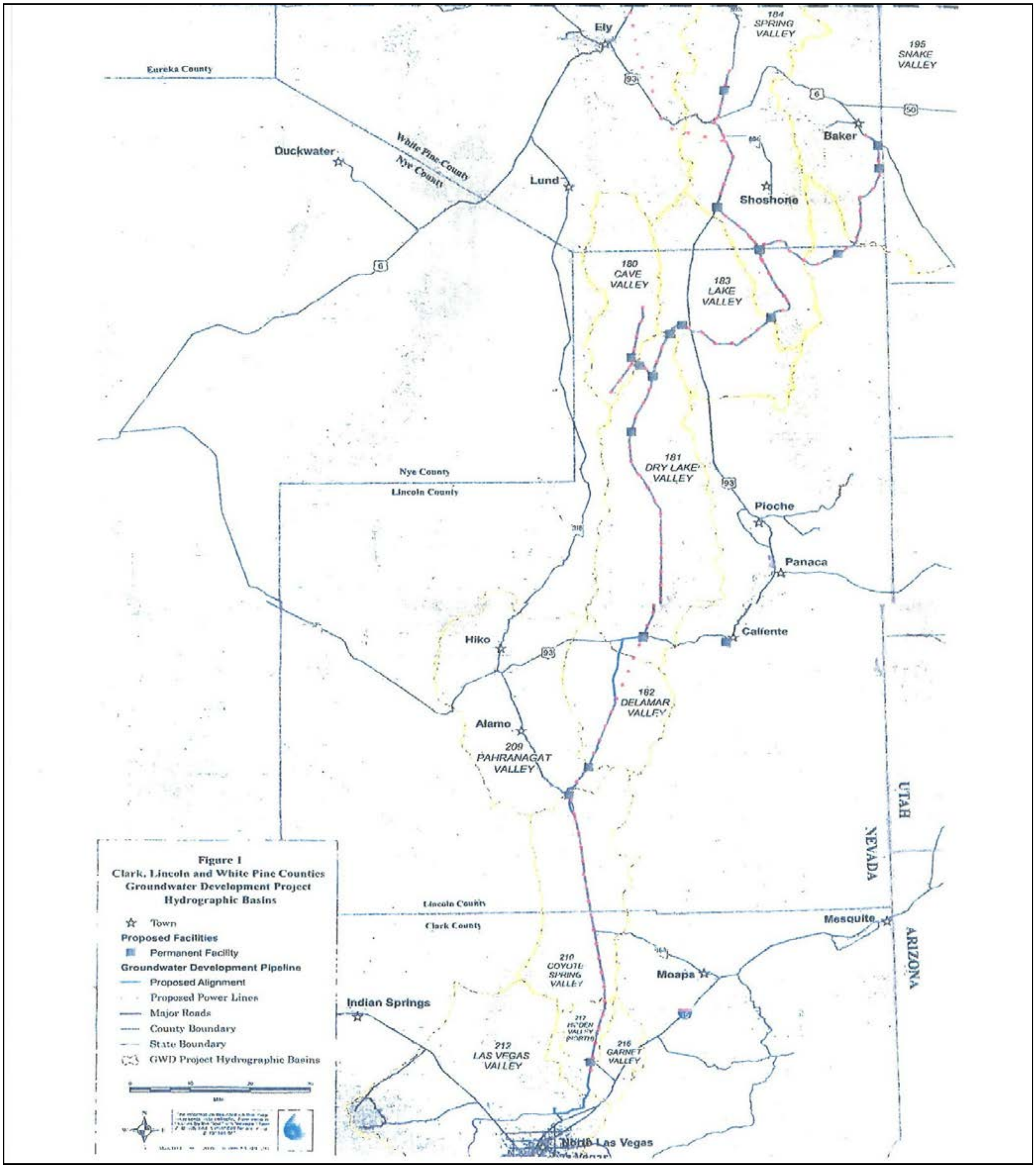

Figure 1
Clark, Lincoln and White Pine Counties
Groundwater Development Project
Hydrographic Basins

Appendix B

Informal Consultation

B–1 INFORMAL CONSULTATION

The Bureau of Land Management (BLM) has asked for our written concurrence with their determinations that implementation of the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project) may affect, but is not likely to adversely affect (MANLAA) 6 species listed as threatened or endangered under the Endangered Species Act (ESA or Act). As explained in Chapter 1 (Introduction) of this Biological and Conference Opinion, we do not concur with BLM's MANLAA determinations for 5 out of the 6 species (see Table 1-2 in Chapter 1). Therefore, this Opinion provides section 7(a)(2) analyses for these 5 species. On the other hand, we concur with BLM that the federal action MANLAA Moapa dace (*Moapa coriacea*), and our rationale is provided in this appendix.

The BLM also requested our written concurrence with their determinations that implementation of the GWD Project may affect, but is not likely to disturb or destroy designated or proposed critical habitat for 4 species. We do not concur with these determinations and have provided our analyses and rationale in the body of this Opinion.

Additionally, BLM provided us with their rationale for no effect determinations for the Yuma clapper rail (*Rallus longirostris yumanensis*), Big Spring spinedace (*Lepidomeda mollispinis pratensis*), and Big Spring spinedace critical habitat as an appendix to their final Biological Assessment (BLM 2012a). The BLM is not required to seek, nor are they seeking, our concurrence on no effect determinations. However, for completeness of record, we provide our effects determinations for these species in this Opinion. We are in agreement with BLM that the proposed action will not affect Yuma clapper rail; therefore, we are providing no additional analysis for this species. However, we are not in agreement with BLM's no effect determination for Big Spring spinedace and its critical habitat. We believe that the proposed action MANLAA Big Spring spinedace and its critical habitat for reasons explained below.

B-1.1 MOAPA DACE

B-1.1.1 *Background*

The Service listed the Moapa dace as endangered under the Endangered Species Preservation Act of 1966 on March 11, 1967 (USFWS 1967), and the Moapa dace has been protected under the ESA since its inception in 1973. The Service finalized and approved a recovery plan in 1996 (USFWS 1996). No critical habitat has been designated for this species.

The Moapa dace is a member of the Cyprinidae family and the only member of the genus *Moapa*. It is endemic to the Muddy River and associated thermal spring systems within the Warm Springs area of Clark County, Nevada. Moapa dace occupy a variety of habitats in this area, including spring pools, spring outflows, and the mainstem Muddy River (USFWS 1996). Historically, they may have inhabited as many as 25 individual springs and up to 16 km (10 mi) of stream habitat (Ono et al. 1983). Much of the Muddy River system is now unavailable to the dace due to the invasion of tilapia (*Oreochromis aurea*) and other habitat modifications. Moapa dace are therefore restricted to 3 spring complexes and their tributaries (Apcar, Pedersen, and Plummer), including their immediate confluence (upstream of the Muddy River) on the Moapa Valley National Wildlife Refuge (NWR) and Southern Nevada Water Authority (SNWA) Warm Springs Natural Area (Johnson, pers. comm., 2012).

The Moapa dace is thermophilic and typically occurs in waters ranging from 26 to 32 degrees Celsius (°C) (78.8 to 89.6 degrees Fahrenheit [°F]) (Hubbs and Miller 1948). Although Rinne and Minckley (1991) rarely observed the species below 30 °C (86 °F), Deacon and Bradley (1972) indicated that the species reaches its greatest abundance at temperatures between 28 and 30 °C (82.4 and 86.0 °F). Juveniles occur almost exclusively in the spring-fed tributaries, whereas adults occur in the mainstem of the Muddy River (Scoppettone et al. 1992). Adults show the greatest tolerance to cooler water temperatures, such as 26 °C (78.8 °F) (Scoppettone 1993). Given the species' temperature tolerances and the cooling pattern of the river (in a downstream direction), the species range is restricted to the warmer waters of the upper springs and tributaries of the Warm Springs area (Deacon and Bradley 1972; Cross 1976; Scoppettone et al. 1992). Reproduction occurs year-round and is confined to the upper, spring-fed tributaries where the water temperatures vary from 29 to 32.2 °C (84.2 to 89.9 °F) and dissolved oxygen concentrations vary between 4.1 and 6.2 parts per million (Scoppettone et al. 1992).

The Moapa Valley NWR was established in 1979 for protection of the Moapa dace. It is a 116-acre property, including stream channels supported by 6 thermal springs that provide habitat for the Moapa dace. In 2007, the SNWA purchased the Warm Springs Ranch, a 494-hectares (1,220-acre) property that encompasses several springs in the Muddy River headwaters area and 6.1 km (3.8 mi) of the mainstream Muddy River. The SNWA property is now called the Warm Springs Natural Area; it is managed for protection of the Moapa dace as well as numerous other sensitive species. The Warm Springs Natural Area and the Moapa Valley NWR are home to the majority of the Moapa dace population.

Moapa dace counts have fluctuated since surveys began in 2005 (2005–2012 count range: 459–1,296 [USFWS 2012]). Extensive surveys from 1984 to 1987 estimated the population of Moapa dace adult fish to be 2,600–2,800 (Scoppettone et al. 1992). However, between 2007 and 2008, the population declined by approximately 60%, from 1,172 to 459 fish. Surveys conducted since 2008 indicate an increasing population trend, with a count of 1,181 dace in August 2012 (USFWS 2012). Various age classes including larvae and juveniles were documented in the 2012 survey, demonstrating reproduction (Ambos 2012).

Threats to Moapa dace habitat include nonnative fishes (e.g., tilapia and mollies) and parasites; habitat loss from water diversions and impoundments; increased threat of fire due to encroachment of nonnative plant species such as palm trees; and reductions to surface spring-flows resulting from groundwater development, which reduces spawning, nursery habitats, and the food base for the species. These threats, in conjunction with the limited distribution of the Moapa dace, make the species vulnerable to catastrophic events. Recent conservation efforts via the Muddy River Memorandum of Agreement (MOA) on the Moapa Valley NWR and SNWA Warm Springs Natural Area include removal of woody plants and debris, construction of a fish barrier, removal of tilapia, and spring and stream habitat restoration.

B-1.1.2 *Effects of the Proposed Action and Conclusion*

We do not anticipate any direct or indirect construction-related effects to Moapa dace associated with Tier 1 rights-of-way (ROWs) or Subsequent Tier ROWs. Construction of Tier 1 facilities will occur approximately 17.7 km (11 mi) or more away from the Moapa dace population in the Muddy River Springs area (BLM 2012a); and the closest groundwater development area is located approximately 64.3 km (40 mi) from the Moapa dace (BLM 2012a). At this distance, we do not anticipate adverse effects from construction activities. The one construction-related activity that we explored in more depth is temporary groundwater pumping for dust control, pipe bedding, trench backfill compaction, and hydrostatic testing (see below).

The SNWA anticipates that it will need at most 8.7 million gallons (or about 27 acre-feet) of water for every mile of pipeline during construction, for dust control and other purposes. The specific locations of the construction water supply wells are still unknown, and the specific groundwater aquifer that will be used has not been identified. However, SNWA assumes that this water will be obtained from existing wells or exploratory wells that are available at the time of construction and that a construction water supply well will be needed approximately every 10 miles along the pipeline alignment (BLM 2012a). The Tier 1 ROW as it traverses Coyote Springs Valley comes within approximately 11 miles of Moapa dace habitat. Given that we do not know the location of supply wells for construction water, the aquifer that will be pumped (e.g., carbonate versus alluvial), or pumping rates, we cannot rule out the possibility of impacts. We would be concerned if construction pumping were to cause an increase (even if temporary) in total groundwater withdrawal from the carbonate aquifer in Coyote Springs Valley.

However, BLM is requiring SNWA to develop a Construction Water Supply Plan that BLM will review and approve prior to construction (ROW-WR-3). If necessary, BLM will include monitoring or mitigation requirements in order to minimize impacts prior to construction approval. The BLM has indicated that they will not approve a Construction Water Supply Plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. The BLM will also coordinate with the Service to determine if adverse impacts to listed species occured, and to identify mitigation (including conditions to avoid impacts to listed species) and monitoring requirements, if necessary. Considering all of these factors, we do not anticipate that pumping for GWD Project construction in Delamar, Dry Lake, or Cave valleys will affect the Moapa dace in the Muddy River Springs Area. If later determinations indicate that adverse effects not considered in this consultation could occur to the dace, then BLM should request reinitiation of section 7 consultation.

The Service completed a Programmatic Biological Opinion (BO) (1-5-05-FW-536) for groundwater withdrawal in Coyote Springs Valley and California Wash basins that included conservation measures associated with the Muddy River MOA for this project. Conservation measures in the MOA and Programmatic BO include triggers for minimum in-stream flow levels, nondiscretionary financial contributions for stream restoration, and establishment of the Muddy River Recovery Implementation Program. The minimum instream flow level commitments are nondiscretionary and do not have source attribution requirements; therefore, they could also be triggered by development of temporary construction or pumping in Delamar, Dry Lake, and Cave valleys for the GWD Project. Additionally, the Muddy River Springs Area is also a designated basin, which means the Nevada State Engineer (NSE) has the authority under N.R.S. § 534.120 to make additional rules, regulations, and orders to protect water resources of the basin.

I is our opinion here that long-term pumping in Dry Lake, Delamar, and Cave valleys under the proposed action (project pumping to 75 years after full project build-out [FBO]) could potentially affect the Moapa dace population in the Muddy River Springs Area, which is a major discharge area for the White River Groundwater Flow System. However, the best available information suggests that such effects are extremely unlikely to occur or that they would be insignificant (*note*: use of this term is as applied under the Act; i.e., a person would not be able to meaningfully measure, detect, or evaluate these effects). This conclusion is based on our hydrologic analyses of potential pumping-induced impacts to discharge of the Muddy River Springs, which are presented below under *Hydrologic Analyses- Muddy River Springs Area*, and the nondiscretionary minimum in-stream flow conservation measures required by the Muddy River MOA and Programmatic BO (1-5-05-FW-536) noted above.

It is our opinion that discharge of the Muddy River Springs may be affected, but available information does not support a conclusion that a significant effect would be likely.

B-1.2 BIG SPRING SPINEDACE AND ITS CRITICAL HABITAT

B-1.2.1 *Background*

The Service listed the Big Spring spinedace as threatened with critical habitat on April 29, 1985, due to the extirpation of 1 of the 2 known populations and threats to the remaining population, such as habitat alteration and the possible introduction of nonnative species (USFWS 1985). The listing included a special rule allowing take of the species for certain purposes in accordance with state laws and regulations. A recovery plan was approved on January 20, 1994 (USFWS 1994).

The Big Spring spinedace is a member of the Plagopterini tribe of Cyprinid fish encompassing the genera *Meda* (spikedace), *Plagopterus* (woundfin), and *Lepidomeda* (spinedace) (Miller and Hubbs 1960). The Big Spring spinedace historically occurred at Panaca (Big) Spring in Panaca, Lincoln County, Nevada, where it occupied the outflow stream, which flows into Meadow Valley Wash below Condor Canyon. This species was extirpated from Big Spring by 1959 due to the introduction of nonnative aquatic species and habitat modifications for agricultural purposes, including diversion of water and the occasional desiccation of both the original outflow and the diversion ditch (La Rivers 1994). The species is now only known to exist in a 0.8-km (0.5-mi) stretch of the Meadow Valley Wash that flows through private and public lands in Condor Canyon northeast of Panaca, Nevada. Big Spring spinedace were discovered in 1977 in the plunge pool beneath a 15-m (49-feet) waterfall (Delmue Falls) in Condor Canyon, approximately 6.1 km (3.8 mi) north of Panaca Spring (Allan 1983). In 1980, larval Big Spring spinedace were transplanted from the waterfall plunge pool to small, in-stream pools 1.4 km (0.9 mi) above the waterfall (R. C. Allen, NDOW, unpub. data, cited in Jezoreck et al. 2011). Adults were captured there the following year. Since spinedace may be able to mature in 1 year (Scoppettone et al. 2004), whether the Big Spring spinedace above the falls are the result of the transplant or if spinedace were present in the stream above the waterfall prior to the transplant is unknown (Jezoreck et al. 2011).

Big Spring spinedace have been described by Nevada Department of Wildlife (NDOW) as being relatively abundant in Condor Canyon, based on recent (2001–2008) reports on electroshocking surveys. More recent surveys, conducted by the U.S. Geological Survey (USGS), provide the best data to date concerning abundance and distribution of spinedace within Condor Canyon. These surveys found Big Spring spinedace to be more common above Delmue Falls than below (consistent with earlier surveys; see USFWS 1994). Population estimates for the survey area were calculated for 3 time periods (Fall 2008, Spring 2009, and Fall 2009) and ranged from a low of 3,378 fish in Spring 2009 to a high of 9,284 fish in Fall 2009, with high variability of populations at sample sites within and between stream reaches (Jezoreck et al. 2011).

Water flow in the perennial stream channel through Condor Canyon originates from a series of springs located in the Condor Canyon area, including Delmue Springs above the northern end of Condor Canyon. Aquatic habitat within the canyon has been altered from past conditions, likely due to historic mining and railroad development (USFWS 1994). In general, the channel is highly incised and filled with sediment. Aquatic habitat conditions are relatively turbid. Within the current known habitat, surveys conducted by NDOW from 2001 to 2008 show Big Spring spinedace occupying waters in the temperature range of 9.5–21.1 °C (Celcius) (49.1–70 °F[Fahrenheit]), with dissolved oxygen between 5.76 milligrams per liter (mg/L) and 9.8 mg/L, during the April and September survey times. During the USGS study mentioned above, recorded stream temperatures varied between 9.7 and 28.4 °C (49.4–83.1 °F) during July–September 2008 (Jezoreck et al. 2011). The substrate is predominantly sand/silt and gravel (NDOW 2007). Riparian vegetation consists primarily of box elder (*Acer negundo*), Goodding's willow (*Salix gooddingii*), sandbar or coyote willow (*Salix exigua*), and salt cedar (*Tamarix* spp.). Cottonwoods (*Populus* spp.) are also present. Common herbaceous riparian species include cattails (*Typha domingensis* and *T. latifolia*), redtop (*Agrostis stolonifera*), sedges (*Carex* spp.), and rushes (*Juncus* spp.). Watercress (*Nasturtium officinale*) occurs in patches within the stream channel.

At the time the spinedace was listed, nonnative species were not known to occur at Condor Canyon. Since then, surveys have detected the establishment of one crayfish species and limited numbers of largemouth bass (*Micropterus salmoides)*, rainbow trout (*Oncorhynchus mykiss*), and white crappie (*Poxomis annularis*) (Withers 1986; 1987a; 1987b; 1988). Specific impacts to Big Spring spinedace from these nonnative species are unknown. However, nonnative species are known to negatively affect other species by way of predation and competition for food resources (Deacon et al. 1964: Deacon 1979; Miller et al. 1989; Minckley and Deacon 1968); Big Spring spinedace are most likely similarly affected by the presence of nonnative species in their habitat.

Critical habitat encompasses 6.4 km (4 miles) of Meadow Valley Wash and an approximately 15-meters (50-feet) riparian zone along each side of the stream as it flows through Condor Canyon. Critical habitat begins at the north end of the canyon and continues downstream to the terminus of the canyon (USFWS 1985). Critical habitat does not include all stream habitat currently or historically occupied by Big Spring spinedace. The primary constituent elements of Big Spring spinedace critical habitat include 1) clean, permanent, flowing, spring-fed stream habitat with deep pool areas and shallow marshy areas along the shore and 2) the absence of nonnative fishes (USFWS 1985).

B-1.2.2 *Effects of the Proposed Action and Conclusion*

We do not anticipate direct or indirect construction-related effects to Big Spring spinedace and its critical habitat associated with Tier 1 ROWs or Subsequent Tier ROWs. Construction of Tier 1 facilities would occur approximately 34 km (21 mi) from Condor Canyon (BLM 2012a); and the closest groundwater development area is located approximately 30.5 km (19 mi) from Condor Canyon (BLM 2012a). At this distance, we do not anticipate adverse effects to the spinedace and its critical habitat from construction, including groundwater pumping for construction purposes (e.g., dust control, pipe bedding, trench backfill compaction, and hydrostatic testing). Additionally, the BLM has indicated that they will not approve a Construction Water Supply Plan that would result in adverse impacts to listed species or adverse effects to critical habitat associated with perennial springs, streams, wetlands, or artesian well flow. The BLM will also coordinate with the Service to determine if there are adverse impacts to listed species or adverse effects to critical habitat. In addition, the BLM and Service will identify mitigation (including conditions to avoid impacts to listed species and critical habitat) and monitoring requirements, if necessary. Considering all of these factors, we do not anticipate that pumping for GWD Project construction will affect the Big Spring spinedace in Condor Canyon. If later determinations indicate that adverse effects not considered in this consultation could occur to the spinedace, then BLM should request reinitiation of section 7 consultation.

It is our opinion that long-term pumping in Dry Lake Valley under the proposed action (project pumping to 75 years after FBO) may affect the Big Spring spinedace population and designated critical habitat within Condor Canyon. However, best available information suggests that while adverse impacts to the spinedace and its critical habitat from groundwater pumping in Dry Lake Valley are possible, such effects are extremely unlikely to occur or would be insignificant if they did occur (Note: use of the term “insignificant” is as applied under the Act; i.e., a person would not be able to meaningfully measure, detect, or evaluate these effects). This conclusion is based solely on our hydrologic analyses of potential pumping-induced impacts to discharge of Delmue Springs and water levels in the vicinity of Condor Canyon. These analyses are presented below under *Hydrologic Analyses- Panaca Spring (Panaca Valley), Delmue Springs, and Condor Canyon (Dry Valley)*. It is our opinion that discharge of Delmue Springs and water levels in the vicinity of Condor Canyon may be affected, but available information does not support a conclusion that a significant effect would be likely.

B-1.3 HYDROLOGIC ANALYSES FOR MANLAA CONCLUSIONS

The following hydrologic analyses are provided in support of our MANLAA conclusions for specific sites within the action area with federally listed species and/or critical habitat. For some species, these sites represent their entire global range or the entirety of designated critical habitat, and thus our overall effects conclusion for the species/critical habitat is MANLAA. For other species, these sites represent a portion of their range within the action area. Where this is the case, our analysis took into consideration potential impacts to all sites occupied and/or designated as critical habitat within the action area, and our overall effects conclusion may differ from our conclusion for a particular site. Table 1-4 in Chapter 1 lists our effects call for each species and each site where the species/critical habitat occurs; the table also directs the reader to the sections of this Opinion where supporting analyses can be found. Below, we summarize the MANLAA calls by species:

- Moapa dace at Muddy River Springs Area: MANLAA
- Ute ladies'-tresses at Panaca Spring: MANLAA
- Big Spring spinedace at Condor Canyon: MANLAA
- Southwestern willow flycatcher at Lower Meadow Valley Wash and Muddy River Springs Area: MANLAA
- White River spinedace potential recovery habitat and/or unoccupied critical habitat at Lund Spring, Preston Big Spring, Ellison Creek, and Moon River Spring: MANLAA

B-1.3.1 *Muddy River Springs Area (Moapa Dace)*

B-1.3.1.1 Hydrologic Analysis

The Muddy River Springs are the most southerly of 3 major groundwater discharge areas within the White River Groundwater Flow System (Eakin 1966) (the flow system of Cave, Dry Lake, and Delamar valleys, White River Valley, Pahranagat Valley, and the Muddy River Springs Area), for all practical purposes the terminal discharge area of the flow system (Dettinger et al. 1995). The regional carbonate-rock aquifer, which underlies Coyote Springs Valley and all basins upgradient of the Muddy River Springs Area in the flow system (Eakin 1966), is the source of the Muddy River Springs (NSE 1997). Most of the spring discharge (32–40 cubic feet per second [cfs] or 23,000–29,000 acre-feet per year [afy], USGS 2012a) leaves the Muddy River Springs Area as the Muddy River, which flows through California Wash and Lower Moapa Valley to Lake Mead (Eakin 1966). Available water temperature data (Beck et al. 2006) suggest that the maximum depth of circulation of the spring discharge is approximately 853–914 m (2,800–3,000 feet) below ground surface (bgs)[1].

The Service has been asked to consult on the effects of project pumping to 75 years after FBO, a finite period of time. These effects depend on various factors, including the rate of propagation of drawdown from the proposed wellfields to resources of concern, in this case from Cave, Dry Lake, and/or Delamar valleys to the Muddy River Springs. Given the complexity of the groundwater flow system and the added challenge of accounting for the rate of propagation of drawdown (and recovery), we begin our analysis with an evaluation of the available regional Central Carbonate Rock Province (CCRP) model predictions— as a starting point for additional analysis that considers uncertainties associated with the regional model and regional model predictions.

The CCRP Model simulations suggest that project-induced drawdown in the regional carbonate-rock aquifer at the location of the Muddy River Springs would be negligible within the timeframe of this analysis (SNWA 2012b). However, this information alone is not sufficient to conclude that the proposed pumping in Cave, Dry Lake, and/or Delamar valleys would have no effect on the discharge of the springs, since the magnitude of the predicted drawdown at the location of the springs is uncertain and the rate of propagation of drawdown from the project basins to the springs is particularly uncertain. The model may underestimate project-induced drawdown in the regional carbonate-rock aquifer at the location of the Muddy River Springs due

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[1] Maximum depth of circulation estimated using a geothermal gradient of 1.5 ˚F per 100 feet (Mifflin 1968; as cited by SNWA 2009b).

to a number of factors related to the construction and calibration of the model, including but not limited to the following:

- The effects of simulating excess net inputs to Dry Lake and Delamar valleys, as well as Garden, Coal, and Pahroc valleys (groundwater recharge and interbasin inflows, less groundwater evapotranspiration and pre-existing groundwater rights), on the bulk calibration of aquifer parameters in the vicinity of Dry Lake, Delamar, and Pahranagat valleys
- Uncertainties concerning the extent to which project-induced drawdown may propagate from southern Delamar Valley into Coyote Springs Valley, rather than southern Pahranagat Valley as largely simulated by the CCRP Model
- Uncertainties regarding the degree to which the proposed pumping in Dry Lake and Delamar valleys will result in capture from Pahranagat Valley versus the Muddy River Springs within the timeframe under consideration, due to a range of unknowns, including the degree to which project-induced drawdown may propagate directly into Coyote Springs Valley
- Inaccurate reproduction of the discharge of the Muddy River Springs under current conditions, with potential impacts to the calibration of aquifer parameters for the regional carbonate-rock aquifer in Coyote Springs Valley and the Muddy River Springs Area (a result of uncertainty in the simulated water budget)
- An under-assignment of in-place groundwater recharge (as a percentage of total groundwater recharge) throughout the White River Groundwater Flow System portion of the model (including Dry Lake, Delamar, Pahranagat, Kane Springs, and Coyote Springs valleys) compared to BCM estimates, with potential effects on the calibration (assignment) of aquifer parameters for the regional carbonate-rock aquifer and predictions of the rate of propagation of project-induced drawdown to the springs

In view of these uncertainties, we conclude that the proposed pumping in Cave, Dry Lake, and Delamar valleys (to 75 years after FBO) may affect the discharge of the Muddy River Springs.

Additional uncertainties exist concerning the degree to which the effects of project pumping, in combination with existing and reasonably foreseeable future pumping, would be compounded by climate-related increases in air temperature (and consequent increases in groundwater evapotranspiration) and potential decreases in precipitation and changes in the timing of precipitation (possible decreases in groundwater recharge) within the timeframe under consideration. The CCRP Model simulations provided to the Service in support of this consultation suggest that maximum drawdown in the regional carbonate-rock aquifer at the location of the Muddy River Springs (due to project pumping to 75 years after FBO) would occur in excess of 100 years after any cessation of pumping[2] (SNWA 2012b), i.e., beyond year 2225 (assuming project pumping ceases at 75 years after FBO), with the effects of that pumping persisting for a significant period beyond the time of maximum impacts. We note that changes in air temperature and precipitation (both spatial and temporal) in connection with potential long-term climate change are not only possible, but perhaps likely in this area over the next 200 or more years (Redmond 2010) and could have an effect on the water budgets of Dry Lake Valley, Delamar Valley, Pahranagat Valley, Coyote Springs Valley, the Muddy River Springs Area, and

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[2] We note that recovery simulations were run by the project proponent to several hundred years. However, the results provided to the Service were truncated at 100 years of recovery.

other valleys of the White River Groundwater Flow System upgradient of the Muddy River Springs (inputs and outputs to the hydrologic system in the form of groundwater recharge and evapotranspiration); climate-related changes could also impact the aggregate effects of project pumping.

At the same time, considerable uncertainty exists regarding the likelihood of significant project-induced impacts to the discharge of the Muddy River Springs within the timeframe under consideration, due to the following:

- The finite and relatively limited duration of project pumping (pumping to 75 years after FBO), in combination with uncertainties concerning the rate of propagation of project-induced drawdown through the regional carbonate-rock aquifer to the springs
- The considerable distance between the proposed wellfields in Cave, Dry Lake, and Delamar valleys and the springs
- The complexity of the intervening hydrogeology (heterogeneity of the regional carbonate-rock aquifer, hydraulic properties of the Pahranagat Shear Zone, etc.)

Consequently, we conclude that the proposed pumping in Cave, Dry Lake, and Delamar valleys (to 75 years after FBO) may affect the discharge of the Muddy River Springs, but that available information does not support a conclusion that a significant effect would be likely.

B-1.3.2 *Panaca Spring (Ute Ladies'-tresses); Delmue Springs and Condor Canyon (Big Spring Spinedace)*

B-1.3.2.1 Hydrologic Analysis

Available water temperature data (SNWA 2008) suggest that the maximum depth of circulation of discharge from Panaca Spring (in Panaca Valley) is approximately 762 m (2,500 feet), well within the regional carbonate-rock aquifer at the location of the spring. However, any project-induced impacts to Panaca Spring, as well as Delmue Springs or Condor Canyon (in Dry Valley), would be due to the propagation of drawdown of the water table from pumping in Dry Lake Valley.

CCRP Model simulations provided to the Service in support of this consultation suggest that drawdown of the water table at the location of Panaca Spring, Delmue Springs, and Condor Canyon due to project pumping in Dry Lake Valley would be negligible (SNWA 2012b). However, this information alone is not sufficient to conclude that project pumping would have no effect on the discharge of the springs or water levels in the vicinity of Condor Canyon, since the magnitude of the predicted drawdown at the locations of these resources is uncertain and the rate of propagation of drawdown from Dry Lake Valley to the resources is particularly uncertain. The model may underestimate project-induced drawdown of the water table at the locations of the springs and Condor Canyon due to a number of factors related to the construction and calibration of the model, including but not limited to the following:

- The effects of simulating excess net inputs to Dry Lake Valley (groundwater recharge and interbasin inflows, less groundwater evapotranspiration and pre-existing groundwater rights) on the bulk calibration of aquifer parameters in the vicinity of the project basin (compared to values recognized by the Nevada State Engineer [NSE 2012b])

- An assignment of (and uncertainty regarding) low hydraulic conductivity (0.12 m [0.4 feet]/day, SNWA 2012b), and consequently low transmissivity, to saturated rocks of the regional carbonate-rock aquifer along a portion of the boundary between Dry Lake and Panaca Valley (a “window” for the potential propagation of project-induced drawdown into Panaca and Dry valleys)
- Uncertainties regarding the assignment of specific storage to upper valley fill in Panaca Valley, with implications for the rate of propagation to Panaca Spring, Delmue Springs, and Condor Canyon and for the magnitude of project-induced drawdown at these locations.
- An assignment of runoff recharge to Panaca Valley that greatly exceeds available BCM estimates (Heilweil and Brooks 2011), with implications for the bulk calibration of aquifer parameters for upper valley fill in the basin

In view of these uncertainties, we conclude that the proposed pumping in Dry Lake Valley (to 75 years after FBO) may affect the discharge of Panaca Spring and Delmue Springs, as well as water levels in Condor Canyon.

Additional uncertainties exist concerning the degree to which the effects of project pumping, in combination with existing and reasonably foreseeable future pumping, would be compounded by climate-related increases in air temperature (and consequent increases in groundwater evapotranspiration) and potential decreases in precipitation and changes in the timing of precipitation (possible decreases in groundwater recharge) within the timeframe under consideration. The CCRP Model simulations provided to the Service in support of this consultation suggest that maximum drawdown at the location of Panaca Spring due to the proposed pumping in Dry Lake Valley, albeit exceedingly small, would occur in excess of 100 years after any cessation of project pumping[3] (SNWA 2012b), i.e., beyond year 2225 (assuming project pumping ceases at 75 years after FBO), with any effects persisting for a significant period beyond the time of maximum impacts. We note that changes in air temperature and precipitation (both spatial and temporal) in connection with potential long-term climate change are not only possible, but perhaps likely in this area over the next 200 or more years (Redmond 2010) and could have an effect on the water budgets of Dry Lake, Panaca, and Dry valleys (inputs and outputs to the hydrologic system in the form of groundwater recharge and evapotranspiration) and the aggregate effects of project pumping.

At the same time, considerable uncertainty exists regarding the likelihood of significant project-induced impacts to the discharge of the springs and water levels in Condor Canyon within the timeframe under consideration, due to the following:

- The finite and relatively limited duration of project pumping (pumping to 75 years after FBO), in combination with uncertainties concerning the rate of propagation of project-induced drawdown from Dry Lake Vaelly to Panaca and Dry valleys
- The distance from the proposed wellfield(s) in Dry Lake Valley to the resources in question
- The complexity of the intervening hydrogeology

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[3] We note that recovery simulations were run by the project proponent to several hundred years. However, the results provided to the Service were truncated at 100 years of recovery.

Consequently, we conclude that the proposed pumping in Dry Lake Valley (to 75 years after FBO, a total of 105 years ending in year 2125) may affect the discharge of Panaca Spring and Delmue Springs and may affect water levels in the vicinity of Condor Canyon, but that available information does not support a conclusion that a significant effect would be likely.

B-1.3.3 *Lower Meadow Valley Wash (Southwestern Willow Flycatcher)*

B-1.3.3.1 Hydrologic Analysis

The CCRP model predicts that 0.6–0.9 m (2–3 feet) of drawdown of the water table would be produced on the northwest side of the range-bounding fault on the northwest side of Kane Springs Valley as a result of the proposed pumping in Delamar Valley. The model additionally predicts that project-induced drawdown would be reduced to a few tenths of a foot on the southeast side of this fault, represented in the model as a horizontal flow barrier, such that negligible drawdown would occur at the location of southwestern willow flycatcher habitat in northern Lower Meadow Valley Wash within the timeframe of this analysis (SNWA 2012b). The drawdown predicted on the northwest side of the range-bounding fault is <3 m (10 feet) and therefore, because of the regional nature of the model, not reliable for quantitative purposes per BLM (BLM 2012a,b). In addition, considerable uncertainty exists concerning the hydrologic properties of the intervening materials (a collection of calderas, basement rocks, and plutons between Delamar Valley and the fault). Despite these uncertainties, we note that drawdown of the magnitude predicted in northwestern Kane Springs Valley (0.6–0.9 m [2–3 feet]) would be significant; the uncertainties regarding the hydrologic properties of the range-bounding fault allow for the possibility that some amount of drawdown of the water table could be produced at the location of flycatcher habitat in northern Lower Meadow Valley Wash by the proposed pumping to 75 years after FBO.

Any effects of project pumping to southwestern willow flycatcher habitat in northern Lower Meadow Valley Wash would be by way of the propagation of drawdown from Delamar Valley across Kane Springs Valley through a number of small calderas located southwest of the Caliente Caldera Complex. Additionally, Harrill (2007) estimates that little to no interbasin outflow occurs from Delamar (or southern Dry Lake) Valley to Kane Springs Valley or Lower Meadow Valley Wash under current conditions (despite the presence of a hydraulic gradient), consistent with an assessment that the conductivity of the intervening materials is low. Consequently, we conclude that the proposed pumping in Delamar and Dry Lake valleys (to 75 years after FBO, a total of 105 years ending in year 2125) may affect the elevation of the water table (depth to water) in the vicinity of southwestern willow flycatcher habitat in northern Lower Meadow Valley Wash, but that available information does not support a conclusion that a significant effect would be likely.

B-1.3.4 *Lund Spring, Preston Big Spring, Ellison Creek, and Moon River Spring (White River Spinedace)*

B-1.3.4.1 Hydrologic Analysis

Lund Spring, Preston Big Spring, and Moon River Spring (in White River Valley) discharge from the regional and/or upper carbonate-rock aquifers; this conclusion is based on their proximity to faults (SNWA 2007a) and available water temperature data (SNWA 2008). Ellison Creek overlies rocks of the upper carbonate-rock aquifer.

The CCRP Model simulations provided to the Service in support of this consultation suggest that drawdown due to the proposed pumping in Spring Valley may propagate across Steptoe Valley to the eastern margin of White River Valley, resulting in as much as 0.15–0.3 m (0.5–1 feet) of drawdown in the regional carbonate-rock aquifer at the location of Lund Spring. As such, we conclude that the proposed pumping in Spring Valley may have an effect on the discharge of Lund Spring. However, due to the great distance between the proposed pumping in Spring Valley and the eastern margin of White River Valley, the complexity of the intervening hydrogeology, and the finite and relatively limited duration of the pumping on which the Service has been asked to consult, we conclude that a significant effect to the discharge of Lund Spring is unlikely. By extension, we conclude that the proposed pumping in Spring Valley may have an effect on the discharge of Preston Big Spring or Ellison Creek, both of which are more centrally located in White River Valley, north of Lund Spring. However, available information does not support a conclusion that a significant effect would be likely. The regional model simulations additionally suggest that drawdown in the regional carbonate-rock aquifer at the location of Moon River Spring in southern White River Valley due to pumping in southern Cave Valley (to 75 years after FBO) would be negligible. Given uncertainties associated with the transmissivity and diffusivity of the regional carbonate-rock aquifer, we conclude that the proposed pumping in Cave Valley may affect the discharge of Moon River Spring, but available information does not support a conclusion that a significant effect would be likely.

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Appendix C

Additional ACM for Cave Valley

SOUTHERN NEVADA WATER AUTHORITY
1001 South Valley View Boulevard • Las Vegas, NV 89153
(702) 258-3939 • snwa.com

November 7, 2012

Ms. Penny Woods, Project Manager
Bureau of Land Management
Nevada Groundwater Projects Office
1340 Financial Boulevard
Reno, Nevada 89502

Dear Ms. Woods:

Subject: Clark, Lincoln, and White Pine Counties Groundwater Development Project, Cave Valley Applicant Commitments

On September 13, 2012, the Southern Nevada Water Authority (SNWA) sent to you a letter describing additional applicant-committed measures for Cave Valley, as part of the for the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project). By letter dated September 14, 2012, the Bureau of Land Management (BLM) indicated that it would include these additional measures in the Record of Decision, and has requested that the U.S. Fish and Wildlife Service (Service) include them in the Section 7 Consultation for the GWD Project.

The Service has identified some questions regarding these Cave Valley measures; thus, SNWA provides the following clarifications:

1) SNWA's commitment to install two additional groundwater monitoring wells to monitor for potential groundwater drawdown propagating from southern Cave Valley towards Flag Springs is not intended to preclude the potential for additional monitoring wells, and/or other hydrologic monitoring such as discharge monitoring, that may be determined necessary by the BLM and/or Service as part of future tiered National Environmental Policy Act (NEPA) or Endangered Species Act (ESA) processes. SNWA anticipates that the BLM and Service would conduct site-specific analyses of future groundwater production locations during the tiered NEPA and ESA processes and, as part of those processes, would review existing monitoring to determine if it is adequate or whether additional monitoring is needed.

2) SNWA committed to three stages of groundwater development in Cave Valley. The triggers, or early warning indicators, for management action to ensure that the long-term protection of the White River spinedace would apply to any level of groundwater development, from the initiation of groundwater development through the life of the

project. Hydrologic and biological monitoring data collected from the beginning and throughout the life of the project would continue to be provided to the BLM and the Service, as required by the BLM and Service in future tiered NEPA and ESA processes and as described in the Delamar, Dry Lake and Cave Valleys Stipulated Agreement.

3) SNWA committed to development of triggers for management action associated with GWD Project pumping in Cave Valley. The purpose of the triggers would be to ensure that groundwater pumping would be modified, reduced, or ceased if necessary to ensure the long-term protection and survival of the White River spinedace. Other management actions could include biological measures, or other site- and species-specific measures as determined necessary and as approved by the BLM and the Service. SNWA understands that the triggers and management actions developed prior to future tiered NEPA and ESA processes for groundwater production may include an agreed process to receive input from external parties with specific expertise, such as the U.S. Geological Survey or Nevada Department of Wildlife.

If you have any questions, or we can provide any further clarification, please don't hesitate to contact me at (702) 875-7080 or Lisa Luptowitz at (702) 862-3789.

Sincerely,

John J. Entsminger
Senior Deputy General Manager

c: Ted Koch, Nevada State Supervisor, U.S. Fish and Wildlife Service
Amy Lueders, Nevada State Director, Bureau of Land Management

SOUTHERN NEVADA WATER AUTHORITY
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September 13, 2012

Penny Woods, Project Manager
Bureau of Land Management
Nevada Groundwater Projects Office
P.O. Box 12000
Reno, NV 89520-0006

Dear Ms. Woods:

SUBJECT: CLARK, LINCOLN, AND WHITE PINE COUNTIES GROUNDWATER DEVELOPMENT PROJECT, ADDITIONAL APPLICANT-COMMITTED MEASURES FOR CAVE VALLEY

As part of the ongoing Endangered Species Act Section 7 consultation for the Clark, Lincoln, and White Pine Counties Groundwater Development Project (GWD Project), the U.S. Fish and Wildlife Service (Service) is evaluating the potential effects of the GWD Project on the endangered White River spinedace. The Service's present ongoing evaluation regarding potential impacts to the White River spinedace is based in part on certain uncertainties inherent in the groundwater model used to simulate potential drawdown impacts.[1] To provide additional relevant information and address these uncertainties, the Southern Nevada Water Authority (SNWA) proposes to add additional applicant-committed measures pertaining to our future groundwater development in Cave Valley.

As the Bureau of Land Management (BLM) identified in the Final Environmental Impact Statement (FEIS) for the GWD Project, the Nevada State Engineer granted SNWA water rights totaling 5,235 afy in Cave Valley. *See* FEIS at 2-106. The FEIS also explains that the Delamar, Dry Lake, and Cave Valley Stipulated Agreement describes actions that the various parties to the agreement would take prior to the commencement of groundwater development in those basins, including: (1) the installation of monitoring wells within the Cave, Dry Lake, and Delamar hydrologic basins and in adjacent hydrologic basins, such as White River; (2) constant-rate aquifer tests, groundwater chemistry sampling, and spring and stream discharge measurements; (3) preparation of annual monitoring reports; and (4) preparation of a written Hydrologic Management and Mitigation Operation Plan (the Plan) that identifies and defines early warning indicators for adverse impacts. FEIS at 2-15. SNWA does not object to adding additional applicant-committed measures at this time which refine the framework for implementing and

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[1] As noted in the Final Environmental Impact Statement for the GWD Project, the groundwater model is a reasonable tool for estimating probable regional-scale drawdown patterns and trends over time but is not designed to predict drawdown impacts on a more localized scale. FEIS at 3.3-90, 3.3-91.

monitoring groundwater development in Cave Valley even though the Plan likely will not be prepared for a number of years.

Accordingly, SNWA proposes adding the following applicant committed measures as part of the GWD Project:

1) **Staged groundwater development in Cave Valley**

SNWA would develop its 5,235 acre-feet per year (afy) of permitted water rights in Cave Valley in staged development. A staged-development approach of the Cave Valley permits would allow for the collection of data while ensuring that pumping effects are confined to Cave Valley and do not propagate across the hydrographic basin boundary to springs supporting habitat for the White River spinedace. Specific details regarding the staged development, such as production well locations, would be developed in consultation with, and approved by, the BLM and the Service prior to and as part of future tiered Section 7 consultations and National Environmental Policy Act (NEPA) processes. Development phases would be implemented essentially as follows:

a. Stage 1 Development: Pumping pursuant to the water right permits shall be limited to 2,600 afy, which is approximately one-half of the permitted rights. This would provide for a pumping stress that will allow for the collection of reliable transient-state data and effective calibration of a groundwater flow model. Before the increase in pumping associated with Stage 2 development can occur, SNWA would pump at least 85% but not more than 100% of the Stage 1 development amount (2,210 – 2,600 afy) for a period of five years. Data from those five years of pumping would be submitted to the BLM and the Service as part of the annual hydrologic-monitoring report prepared by SNWA. The data would be reviewed by the BLM and the Service, and SNWA may increase pumping to the Stage 2 development at the end of the fifth year of pumping if the BLM and the Service determine the risk to the White River spinedace remains at an acceptable level and/or can be mitigated.

b. Stage 2 Development: Pumping pursuant to the water right permits shall be limited to a total of 3,900 afy, which is the Stage 1 development level plus 1,300 afy. The 1,300 afy is approximately one half of the permitted amount of 2,635 afy remaining after Stage 1 development. This pumping would provide additional pumping stresses that would allow for collection of more reliable transient-state data and continued calibration of the groundwater flow model. SNWA would be required to pump at least 85% but not more than 100% of the combined Stage 1 and Stage 2 development amounts (3,315– 3,900 afy) for a period of five years. Data from those five years of pumping would be submitted to the BLM and the Service as part of the annual hydrologic-monitoring report prepared by SNWA. The data would be reviewed by the BLM and the Service, and SNWA may increase pumping to the Stage 3 development at the end of the fifth year of pumping if the BLM and the Service determine the risk to the White River spinedace remains at an acceptable level and/or can be mitigated.

c. Stage 3 Development: Pumping pursuant to the water right permits shall be limited to the full permitted amount of 5,235 afy. SNWA would continue to conduct monitoring and provide information as required under the Stipulated Agreement, Section 7 consultations, and NEPA processes.

The above three staged approach for developing SNWA's Cave Valley water rights is similar to the staged development approach required by the Nevada State Engineer in Ruling 6164 for the development of SNWA's water rights in Spring Valley. Additionally, it considers minimum flow criteria for pipeline operations. The Stage 1 development quantity is based on American Water Works Association criteria C651 for flushing of water mains to prevent sedimentation in the pipeline. This criteria is a flow of 2.5 to 3 feet per second, which equates to approximately 1,550 gallons per minute or 2,500 afy, and was considered in the selection of the Stage 1 development quantity.

A Theis analysis (Theis, 1935) was conducted by SNWA to evaluate this proposed staged development. Theis has many underlying assumptions, which are documented in detail in Burns et al. (2007), and is imprecise the further away it is used from the pumping well. However, this approach provides a general estimate of potential drawdowns that can support the selection of the initial phased development approach. The Theis analysis considered pumping from a single location near the current location of SNWA well CAV6002X at a volume of 1,622 gallons per minute (approximately 2,600 afy) for a period of 5 years to determine the extent of simulated drawdowns. The aquifer properties selected for this analysis were those determined during an aquifer test between Cave Valley wells CAV6002X and CAV6002M. The results of the Theis analysis, with all of its documented uncertainties, indicate that a simulated 1 foot drawdown contour would spread approximately 8 miles from the CAV6002X site. Flag Springs is located 11.4 miles in a direct line from CAV6002X. Thus, using the best available information, the initial stage of development could be conducted without posing a risk to White River spinedace at Flag Springs.

SNWA believes staged development of its water rights in Cave Valley, coupled with comprehensive hydrologic and biological monitoring and adaptive management, will allow for sustainable development of the Cave Valley water rights in a manner that protects the White River spinedace. The detailed hydrologic and biological monitoring will be developed in consultation with, and approved by, the BLM and the Service as part of future tiered Section 7 consultations and NEPA processes prior to initiation of groundwater pumping in Cave Valley.

2) **Additional monitoring wells**

SNWA would install two (2) additional groundwater monitoring wells to monitor for the potential of groundwater drawdown propagating from southern Cave Valley towards Flag Springs and other springs supporting habitat for the White River spinedace in White River Valley. The specific location of, and details for these wells, would be determined following input by the Delamar Dry Lake and Cave Valley Stipulated Agreement Technical Review Panel (TRP), and would be approved by the BLM and Service.

These two additional monitoring wells would be in addition to the monitoring well required under the Stipulated Agreement, which has been sited by the TRP near Shingle Pass, but has not yet been installed.

The above three monitoring wells would be installed such that baseline data could be collected for a minimum of five years prior to the initiation of groundwater pumping in Cave Valley.

3) Establishment of trigger levels

SNWA would agree to develop and commit to triggers (early warning indicators) for management action associated with GWD Project pumping in Cave Valley, to ensure the long-term protection of the White River spinedace. These triggers would be developed in consultation with, and approved by, the BLM and FWS, and would be included in future Section 7 consultations and NEPA analyses prior to initiation of groundwater pumping in Cave Valley.

Summary

SNWA believes that this phased pumping approach for Cave Valley, accompanied by extensive monitoring, will provide additional information about the hydrogeology of the Cave Valley. This refined approach provides a mechanism to address some of the uncertainty in and facilitate the refinement of the groundwater model in future project-specific consultations to be tiered to the programmatic biological opinion being prepared for the GWD Project.

SNWA appreciates the Service's approach on development of conservation recommendations for the GWD Project Section 7 consultation. However, SNWA suggests that the potential baseline and data gap information needed to inform future Section 7 consultations would be best presented in a brief summary list, with the details to be developed during future discussions between BLM, the Service, and SNWA. SNWA would collect the baseline data necessary for future tiered Section 7 consultations and NEPA analyses prior to groundwater development.

SNWA will incorporate the above additional applicant-committed measure in the final Conceptual Plan of Development, and requests that BLM include it in the Record of Decision and notify the Service that such an approach will be incorporated into the agency action for purposes of Section 7 consultation.

If you have any questions about these measures or need additional information, please contact me at 702-875-7080 or Lisa Luptowitz at 702-862-3789.

Sincerely,

John J. Entsminger

John J. Entsminger
Senior Deputy General Manager

JJE:LML:df

c: Ted Koch, U.S. Fish and Wildlife Service
Amy Leuders, Bureau of Land Management
Zane Marshall, SNWA

References:

Burns, A.G., Watrus, J.M., and Dixon, G.L., 2007, Water-related effects analysis related to Southern Nevada Water Authority groundwater applications in Cave, Dry Lake, and Delamar valleys: Presentation to the Office of the Nevada State Engineer: Southern Nevada Water Authority, Las Vegas, Nevada.

Theis, C.V., 1935, The Relation between the Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Groundwater Storage, American Geophysical Union Trans., vol. 16, pp. 519-524.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Nevada State Office
1340 Financial Boulevard
Reno, Nevada 89502-7147
http://www.blm.gov/nv

SEP 17 2012

In Reply Refer To:
2800 (NV910)
N-78803

Ted Koch
U.S. Fish and Wildlife Service
1340 Financial Blvd. Suite 234
Reno, NV 89502

Dear Mr. Koch:

The Bureau of Land Management (BLM) Groundwater Projects Office provided your office with our Revised Biological Assessment for the Clark, Lincoln, and White Pine Counties Groundwater Development Project on May 11, 2012. Since that time, our office has coordinated with you in meetings, phone calls, and via e-mail regarding new information and updates to the Final EIS. This letter is to document our request for you to consider the new information presented in the Final EIS, and to provide you with a new Applicant Committed Measure (ACM) recently submitted by the Southern Nevada Water Authority (SNWA) that we would like your office to consider in development of the Biological Opinion (BO). We would also like to use this opportunity to document our intention to carry our mitigation measures through to the Record of Decision.

In June, 2012 the BLM had completed our analysis of the comments received on the Draft Environmental Impact Statement (EIS) and began finalizing the Final EIS. During this time we were also working through the FWS conservation recommendations provided through the Technical Assistance Process; many of these conservation recommendations were also relative to listed species. On June 14, 2012 we met with your staff in Ft. Collins, CO to discuss how the conservation recommendations were being treated in the Final EIS. We also had several phone conversations with your staff during the months of June and July, 2012 to provide frequent updates regarding changes to the Final EIS that may inform the BO analysis.

On July 27, 2012 our office met with your staff and provided an early copy of specific sections of the Final EIS:

- Chapter 3.5 (Vegetation);
- Chapter 3.6 (Terrestrial Wildlife);
- Chapter 3.7 (Aquatic Biological Resources); and
- Chapter 3.20 (Monitoring and Mitigation Summary, which included Table 3.20-1, a summary of all mitigation measures presented in the Final EIS).

During this meeting, we reviewed the material provided from the Final EIS. Our office requested that FWS consider this new information in the continued development of the BO. We noted some measures that we felt were of particular interest, such as the COM Plan process described in Chapter 3.20, the data gaps and associated process for dealing with them described in Chapter 3.20, and mitigation measures GW-WR-3a, GW-WR-3b, GW-WR-7, GW-VEG-2, as well as several other new vegetation and wildlife measures. Table 3.20-1 lists all mitigation, and identifies if each measure is within or outside of BLM's jurisdiction. Please note that it is our intention to include in the Record of Decision (ROD) for this project all those measures within our jurisdiction. We also intend to include in the ROD a revised version of the COM Plan, which will include the process BLM will use for future actions as well as those conservation recommendations from the BO that BLM determines fit the process.

On September 13, 2012, the Southern Nevada Water Authority (SNWA) provided the enclosed letter to the BLM describing new Applicant Committed Measures (ACMs) for the Clark, Lincoln, and White Pine Counties Groundwater Development Project. The new ACMs are specific to Cave Valley, and are focused on potential impacts to the endangered White River spinedace. Among the ACMs are commitments from SNWA to: 1) stage groundwater development in Cave Valley, 2) install additional monitoring wells, and 3) establish trigger levels prior to initiation of groundwater pumping in Cave Valley.

We request that the FWS considers the mitigation measures presented in the Final EIS, the COM Plan process and related information presented in Chapter 3.20 of the Final EIS, and the new SNWA ACMs as part of the agency action for the section 7 consultation under the Endangered Species Act. The BLM intends to include in the ROD all of the above mentioned items.

If you have any questions or concerns, please contact me at (775) 861-6466 or pwoods@blm.gov.

Sincerely,

Penelope D Woods

Penelope Dunn Woods
Project Manager
Nevada Groundwater Projects Office

cc: Lisa Luptowitz, SNWA
Alicia Styles, BLM
Laurie Averill-Murray, FWS

Enclosure: September 13, 2012 Letter from SNWA regarding the Clark, Lincoln, and White Pine Counties Groundwater Development Project Additional Applicant-Committed Measures for Cave Valley