3.5 Vegetation Resources

3.5.1 Affected Environment

3.5.1.1 Overview

The GWD Project is located in the Basin and Range Geographic Province. The northern two-thirds of the project lies within Great Basin Desert (also known as the Intermountain Region) and the southern one-third is within the Mojave Desert. The transitional area between these two regions is located in Delamar Valley and southern Dry Lake Valley.

QUICK REFERENCE

ET – evapotranspiration

NRS – Nevada Revised Statutes

TCWCP – Tri-County Weed Control Project

ESA – Endangered Species Act

BARCAS – Basin and Range Carbonate Rock Aquifer System

Hot, dry Mojave Desert lowlands are characterized by low shrub vegetation dominated by a few common perennial species. Characteristic Mojave vegetation includes burrobush (*Ambrosia dumosa*), creosote bush (*Larrea tridentata*), and Fremont's dalea (*Psorothamnus fremontii*) (Bowers 1993). Joshua tree (*Yucca brevifolia*) is an important component of lowland elevations up to approximately 6,500 feet and has been regarded by some plant geographers and ecologists as an indicator of Mojave Desert vegetation (Baldwin et al. 2002). Historically, fire has not been an important ecological component of the Mojave Desert as the native perennial vegetation is relatively resistant to fires. The spread of non-native species, specifically red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*), has increased fuels and fire occurrence in this ecological system.

Great Basin Desert lowlands are characterized by low shrub vegetation. Common shrub species of the central Great Basin include big sagebrush (*Artemisia tridentata*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *Wyomingensis*), black sagebrush (*Artemisia nova*), rubber rabbitbrush (*Ericameria nauseous*), fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), winterfat (*Kraschennikovia lanata*), and greasewood (*Sarcobatus vermiculatus*). Common understory perennial grasses include Indian ricegrass (*Achnatherum hymenoides*), needle-and-thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), basin wildrye (*Leymus cinereus*), Sandberg bluegrass (*Poa secunda*), James'galleta (*Pleuraphis jamesii*), and inland saltgrass (*Distichlis spicata*). The spread of non-native annual grass species has increased fuels and fire occurrence in this ecological system.

Open evergreen woodlands consisting of Utah juniper (*Juniperus osteosperma*), singleleaf pinyon (*Pinus monophylla*), or curlleaf mountain-mahogany (*Cercocarpus ledifolius*) are found on the slopes of most ranges. Cottonwoods (*Populus* ssp.) and willows (*Salix* ssp.) proliferate in low elevation areas with dependable water. Historically, an intermittent fire regime occurred in the Great Basin. Fire is an integral part of the ecological process for many of the vegetation types, most of the vegetation types are adapted to the effects of fire. Fire most often occurs in this area during drought cycles.

Community characterizations were compiled based on literature research, agency consultation, field survey reports, aerial photograph interpretation, SWReGAP Land Cover descriptions (USGS 2005), and information from the Las Vegas and Ely RMPs. Species nomenclature is consistent with the NRCS Plants Database (NRCS 2009).

A work group process, designated as the Natural Resources Group (NRG), was used to obtain the following types of information for biological resources: 1) compile and evaluate baseline data on biological resources (vegetation, wildlife, and aquatic species); 2) prepare a summary of the data; and 3) assist the BLM and AECOM in developing the impact analysis approach for the EIS and make recommendations for monitoring and mitigation. The NRG included representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, Utah Division of Wildlife Resources (UDWR), Southern Nevada Water Authority (SNWA), and AECOM (BLM's EIS Contractor). The BLM directed the activities of the NRG. As a result of the NRG work, a report entitled the *Natural Resources Baseline Summary Report – Clark, Lincoln, and White Pine Counties Groundwater Development EIS* (ENSR/AECOM 2008) was prepared in support of the EIS.

The *natural resources region of study* consisted of the 5 hydrologic basins proposed for groundwater development, along with 28 other hydrologic basins which collectively encompass all or a portion of 5 flow systems (Las Vegas Wash Flow System, White River Flow System, Meadow Valley Wash Flow System, Goshute Valley Flow System, and Salt Lake Desert Flow System). The natural resources region of study differed from the water resources model area in that four basins (Long, Jakes, Garden, and Coal) were excluded on the eastern boundary due to a lack of sensitive species habitat. The natural resources region of study also included four basins (Pine, Wah Wah, Tule, and Deep Creek) that were not part of the water resources model area. These four basins contained game or special status species.

3.5.1.2 Right-of-way Areas

Land Cover Types

The regional SWReGAP Land Cover types were grouped into broader cover classes to provide a description of the major wildlife habitat types (see Section 3.6, Wildlife) (**Figure 3.5-1)**. The ROW study area is defined as the maximum potential project surface disturbance footprint associated with the pipeline and ancillary facilities, including the staging Caliente construction support area (Lower Meadow Valley Wash). **Table 3.5-1** provides the cover types, the hydrologic basins where the ROW study area coincides with these cover types, and the relative percentage of each cover type that would be occupied by ROW facilities. The ROW areas are dominated by three major cover types: sagebrush shrubland (48 percent), Mojave mixed desert shrubland (25 percent), and greasewood/salt desert shrubland (24 percent). All other cover types represent 3 percent or less.

Table 3.5-1 Land Cover Types that Occur within the GWD Project Right-of-way Study Area and Hydrologic Basins

Cover Type	ROW Area by Hydrologic Basin	Percentage of ROW Area Occupied by Cover Type
Agriculture/Developed	LMV	Less than 1
Annual Invasive Grassland	D,H,LMV	Less than 1
Barren	D	Less than 1
Greasewood/Salt Desert Shrubland	C,D,DL,H,L,LMV,P,SN,SP,ST	24
Marshland	LMV	Less than 1
Mojave Mixed Desert Shrubland	CS,D,DL,G,HV,LV,P	25
Perennial Grassland	D,DL,L,SN,SP,	Less than 1
Pinyon-Juniper Woodland	C,DL,H,L,LMV,SN, SP,ST	2
Playa	CS,D,DL,	Less than 1
Riparian Woodland and Shrubland	LMV	Less than 1
Sagebrush Shrubland	C,D,DL,H,L,LMV,P,SN,SP,ST	48

C= Cave Valley, CS = Coyote Springs Valley, D = Delamar Valley; DL = Dry Lake Valley, G = Garnet Valley, H = Hamlin Valley, HV = Hidden Valley, L = Lake Valley, LV = Las Vegas Valley, LMV = Lower Meadow Valley Wash, P = Pahranagat Valley, SN = Snake Valley, SP = Spring Valley, ST = Steptoe Valley.

Figure 3.5-1 Vegetation Land Cover (SWReGAP reclassified)

United States Army Corps of Engineers Jurisdictional Determinations

SNWA conducted a jurisdictional determination (SNWA 2008) within all ROW segments to determine the location and extent of any Waters of the U.S. for which a USACE 404 Permit would be required for constructing the water pipeline and ancillary facilities. A total of 68 ephemeral washes were identified as Waters of the U.S., with channel widths averaging 2 feet. This inventory of crossings is combined with 51 ephemeral washes identified in a prior permit application for a total of 119 ephemeral wash crossings for the GWD Project. Snake Creek (in the Snake Valley) was identified as a perennial stream. The stream channel is lined by a narrow band of sandbar willows (*Salix exigua*) classified as an obligate wetland species. The USACE (2009) confirmed the jurisdictional determination findings.

Wildland Fire Risk

Within each vegetation community type, there is a characteristic fire regime. A fire regime is a general description of the role fire would play across a landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning (Agee 1993, Brown 1995). Historical fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of replacement) of the fire on the dominant overstory vegetation. Generally the fire frequency is inversely related to fire intensity. For example, due to higher precipitation levels and cooler mean temperatures (which foster plant growth), there are higher fuel loads in pinyon-juniper woodlands and upper montane forest vegetation types as compared to lowland shrublands. In addition, the higher precipitation amounts and cooler temperatures provide higher resistance to fire for longer periods. This leads to fires of high intensity that occur infrequently. The reverse is true in grasslands where fine fuel types lead to fires at a high frequency that burn rapidly with low intensity. Other factors that determine fire behavior include site topography, weather conditions, time of year, type of plant community, health of the ecosystem, fuel moisture levels, depth and duration of heat penetration, fire frequency and site productivity. The highest potential rates of spread occur in areas with flashy fuels such as cured-out annual bromes, and steep brushy mountain slopes.

Wildland fire risk tends to be high in disturbed grasslands and forblands dominated by non-native noxious and invasive species, specifically the annual brome species such as cheatgrass and red brome (BLM 2010). Areas dominated by crested wheatgrass tend to have lower fire risk because this species stays green during the early part of the fire season, and because grass clumps within rows are widely spaced as the result of drill seeding.

The response and revegetation potential of each vegetation type varies depending on actual fire conditions, the seasonal timing, pre- and post-fire vegetation, elevation and post-fire weather patterns. Vegetation in low-intensity fire areas (for example areas, where native perennial bunchgrass cover and site productivity are high) can frequently revegetate naturally without seeding. High intensity fires in areas with dense sagebrush or pinyon-juniper stands can result in scorched, water-resistant soils that become unproductive until the condition changes which could take several years. Extremely severe fires have been known to sterilize soils and lead to the permanent loss of productivity. **Appendix F3.5** describes general fuel conditions, fire frequency, and succession timelines for vegetation communities present in the ROW.

The Mojave Desert region historically had few, very infrequent fire events due to the limited amount of herbaceous understory vegetation between and around shrub species (Rogstad et al. 2009). The spread of invasive species, specifically annual invasive grass, such as red brome and cheatgrass, into these interspaces has dramatically increased the fuel load in these communities (Brooks and Matchett 2006).

Fire Regime Condition Class (FRCC) is a discrete metric that describes how similar a landscape's fire regime is to its natural or historical state. FRCC quantifies the amount that current vegetation has departed from the simulated historical vegetation reference conditions (Hann and Bunnell 2001; Hardy et al 2001; Barrett et al. 2010; Holsinger et al. 2006). The three condition classes describe low departure (FRCC 1), moderate departure (FRCC 2), and high departure (FRCC 3). Landscapes determined to fall within the category of FRCC 1 contain vegetation, fuels, and disturbances characteristic of the natural regime; FRCC 2 landscapes are those that are moderately departed from the natural regime; and FRCC 3 landscapes reflect vegetation, fuels, and disturbances that are uncharacteristic of the natural regime. A map of Fire Regime Condition Classes along the project ROW can be found in **Appendix F3.5**. The FRCC layer depicted in this figure represents the departure of current vegetation conditions from simulated historical reference conditions according to the methods outlined in the *Interagency Fire Regime Condition Class Guidebook*

(Barrett et al. 2010). Full descriptions of the FRCC categories, their associated fire regimes, and management options are found in **Appendix F3.5**.

Noxious and Non-native Invasive Weeds

Under the Federal Plant Protection Act of 2000 (formerly the Noxious Weed Act of 1974 [7 USC SS 2801-2814]), a noxious weed is defined as "any plant or plant product that can directly or indirectly injure or cause damage to crops, livestock, poultry, or other interests of agriculture, irrigation, navigation, the natural resources of the U.S., the public health, or the environment" (Animal and Plant Health Inspection Service 2000; Institute of Public Law 1994). Each state is federally mandated to uphold the rules and regulations set forth by this act and manage its lands accordingly. In addition, the federal Noxious Weed Act of 1974, as amended (7 USC Secs.2801 et seq.) requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds.

The State of Nevada also regulates noxious weeds. Under the NRS, a noxious weed is defined as "any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate" (NRS 555.005 – Control of insects, pests, and noxious weeds). Noxious weeds are classified into three categories based on the statewide importance, distribution, and the ability of eradication or control measures to be successful. Category A weeds are not currently found or are limited in distribution throughout the state (control is required by the state in all infestations); Category B weeds are found in scattered populations in some counties of the state (control is required by the state in areas where populations are not well established or previously unknown to occur); and Category C weeds are currently established and generally widespread in many counties of the state (control is at the discretion of the state quarantine officer) (NRS 555.010).

The spread of noxious weeds has resulted in substantial economic impacts on some sectors in Utah. As a result, Utah has enacted laws requiring the control of noxious weed species (Utah State Legislature 2008). Under the Utah Noxious Weed Act, a "noxious weed" is defined as any plant the commissioner determines to be especially injurious to public health, crops, livestock, land, or other property (Utah State Legislature 2008). In 2008, the Utah Noxious Weed Act was amended to allow for the categorization of weeds into three categories: Class A (Early Detection Rapid Response) Class B (Control) and Class C (Containment). Class A Early Detection Rapid Response weeds are noxious weeds not native to the state of Utah and that pose a serious threat to the state and should be considered as a very high priority for control and prevention. Class B Control weeds are noxious weeds not native to the state that pose a threat to the state and should be considered a high priority for control. Lastly, Class C Containment weeds are noxious weeds that are not native to the state, are widely spread, and pose a threat to the agriculture industry and to agricultural products, and control methods should focus on stopping invasion.

The BLM considers plants invasive if they have been introduced into an environment where they did not evolve. As a result, they usually have no natural enemies to limit their reproduction and spread (Westbrooks 1998 as cited in BLM 2010). An invasive species is defined as a species that is: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health (National Invasive Species Council 2001).

Data from the Tri-County Weed Control Project (2007) and the BLM Ely District Office (BLM 2009) were compiled and integrated into a GIS database. Weed occurrences within the ROW study area and hydrologic basins were then compiled. Based on field surveys conducted within the ROW study area between 2001 and 2008 (BLM 2010), infestations of the following species are known to occur within 1,000 feet of the ROWs for all alternatives: Russian knapweed (*Acroptilon repens*), Sahara mustard (*Brassica toumefortii*), Spotted knapweed (*Centaurea stoebe*), Canada thistle (*Cirsium arvense*), poison hemlock (*Conium maculatum*), hoary cress (*Lepidium draba*), tall whitetop (*Lepidium latifolium*), Dalmation toadflax (*Linaria dalmatica*), Scotch thistle (*Onoporodum acanthium*), salt cedar (*Tamarix sp*.), and Malta starthistle (*Centaurea solstitalis*).

The biological characteristics of noxious weeds are provided in **Appendix F3.5** including; 1) status; 2) general distribution in the world, USA or North America; 3) general habitat; 4) life history and flowering period; 5) any details regarding a species' propensity to invade wildlands and any specific mechanisms for doing so (if available); and 6) any preferred control measures (if available). Information on invasive species that are widely distributed within the ROW area, including red brome, cheatgrass, and salt lover (*Halogeton glomeratus*), also is provided.

An Ely District Integrated Weed Management Plan and Preliminary Environmental Assessment (BLM 2009) was prepared by the Ely District for application across all field offices (**Appendix F3.5**). A project-specific weed risk management plan (BLM 2010) was prepared, based on guidance contained in the integrated weed management plan.

Cactus and Yucca

Nevada state law regulates the removal or possession of native cacti and yucca in commercial quantities. A permit must be obtained from the Nevada Department of Forestry to remove and transplant these species. Within the ROW area, 23 protected species of cactus and yucca were identified (**Appendix F3.5**). Surveys for these species were conducted by SNWA (Wildland 2009; Jones & Stokes 2005). Surveys consisted of a complete inventory and total stem count within the proposed ROW and associated ancillary facility sites. These surveys were used to calculate the density of species per acre along the proposed ROW, as well as the number of stems per linear mile. For the ancillary facilities, the stems per acre by species were calculated.

Within the Mojave Desert portion of the project from the south end of Delamar Valley to the pipeline terminus near Las Vegas, approximately 35,000 cacti representing 11 species were inventoried within the ROW. Additionally, approximately 106,000 Mojave yuccas (*Yucca schidigera*); 4,250 Joshua trees (*Yucca brevifolia*); and 2,670 banana yuccas (*Yucca baccata*) were inventoried (Jones & Stokes 2005). Additional yucca and cactus surveys were conducted in Dry Lake and Delamar valleys (Wildland 2009). Joshua trees, banana yuccas, Wiggins' cholla (*Cylindropuntia echinocarpa*), and grizzly bear pricklypear (*Opuntia polyacantha* var. *erinacea*) were the most abundant species. Cactus and yucca density was 1,299 stems per mile in Dry Lake Valley. Cactus and yucca populations were much lower in the remaining valleys crossed by proposed facilities.

Special Status Plant Species

Occurrence data for special status species in the ROW area were obtained from the NNHP. Additional occurrence information was obtained through field surveys sponsored by SNWA (Wildland 2009, 2007; Jones & Stokes 2005). The overall list includes 35 BLM sensitive species, 17 USFS sensitive species, six Nevada protected critically endangered species, 24 Nevada protected cactus or yucca species, and one federally threatened species (**Appendix F3.5**). Additional species of concern that may occur in the ROW were identified by a technical cooperating agency group that was comprised of representatives from the BLM in Nevada and Utah, USFWS in Nevada and Utah, NDOW, and UDWR.

Individuals of six special status species were found to occur within the construction ROW and suitable habitats for five species were identified, based on nearby survey occurrences (**Table 3.5-2**).

3.5.1.3 Groundwater Development Areas

Land Cover

Nine land cover types are mapped within the groundwater development areas (**Table 3.5-3**). The greasewood/salt desert shrubland and sagebrush shrubland are the dominant cover types in all development areas. The Mojave mixed desert shrubland represented 22 percent of the land cover in Delamar Valley. The remaining cover types provide less than 20 percent cover in the individual hydrologic basins.

United States Army Corps of Engineers Jurisdictional Wetlands

No jurisdictional wetland delineations have been completed for potential future GWD Project ROWs in any of the groundwater development areas within the proposed pumping basins.

Table 3.5-2 Special Status Plant Species Occurrence and Suitable Habitat within the Right-of-way Area

Common Name/Scientific Name	Status	Occurrence
Eastwood milkweed *Asclepias eastwoodiana*	BLM Sensitive	ROW
Threecorner milkvetch *Astragalus geyeri* var. *triquetrus*	BLM Sensitive	Habitat in ROW
Long-calyx eggvetch (egg milkvetch) *Astragalus oophorus* var. *lonchocalyx*	BLM Sensitive	ROW
White River Catseye *Cryptantha welshii*	BLM Sensitive	ROW
Las Vegas buckwheat *Eriogonum corymbosum* var. *nilesii*	USFWS Candidate, BLM Sensitive	Low potential habitat identified in ROW
Yellow twotone beardtongue *Penstemon bicolor* ssp. *Bicolor*	BLM Sensitive, USFS Sensitive	ROW
Rosy twotone beardtongue *Penstemon bicolor* var. *roseus*	BLM Sensitive, USFS Sensitive	ROW
Blaine's fishhook cactus *Sclerocactus blainei*	BLM Sensitive; Nevada Harvest Regulated	ROW
Meadow Valley sandwort (*Arenaria stenomeres*)	BLM Sensitive	Habitat in ROW
Nachlinger catchfly (*Silene nachlingerae*)	BLM Sensitive	Habitat in ROW
White bearpoppy (*Arctomecon merriamii*)	BLM Sensitive	Habitat in ROW

Table 3.5-3 Percent Cover of Land Cover Types Within GWD Project Groundwater Development Areas

	Cave Valley	Delamar Valley	Dry Lake Valley	Snake Valley	Spring Valley
Agriculture/Developed	0	0	0	< 1	0
Annual Invasive Grassland	0	< 1	< 1	3	0
Greasewood/Salt Desert Shrubland	23	20	36	43	32
Mojave Mixed Desert Shrubland	0	22	< 1	0	0
Perennial Grassland	0	< 1	< 1	0	< 1
Marshland	0	< 1	0	0	< 1
Barren	0	< 1	< 1	0	< 1
Pinyon-Juniper Woodland	16	< 1	11	6	7
Playa	0	4	1	0	< 1
Riparian Woodland and Shrubland	0	0	0	< 1	0
Sagebrush Shrubland	61	53	51	47	61
Groundwater Development Area Size (acres)	34,787	71,889	168,769	92,703	361,795

Source: SWReGAP (USGS 2005).

Noxious Weed Species

The data sources and field surveys for noxious and non-native invasive weed species in the groundwater development areas are the same as described for the ROW. Noxious weed species found in the groundwater development areas by hydrologic basin are presented in **Appendix F3.5**. Nine noxious weed species have been documented in the groundwater development areas: Russian knapweed, hoary cress, musk thistle, spotted knapweed, water hemlock, Canada thistle, tall whitetop, Scotch thistle, and tamarisk.

Special Status Species

A summary of special status plant species known or potentially present within the groundwater development areas is presented in **Table 3.5-4**. There were five species observed in the groundwater development areas, and three species with potential habitat. Potential habitat was based on the similarity in associated vegetation, soils, and slopes to areas occupied by known populations.

Table 3.5-4 Special Status Species Known or Potentially Present within Groundwater Development Areas

Common/Scientific Name	Status	Occurrence
Eastwood milkvetch *Astragalus eastwoodiae*	BLM Sensitive, USFS Sensitive	Dry Lake Valley, Muleshoe Valley – populations found in groundwater development areas
Meadow milkvetch *Astragalus diversifolius*	USFS Sensitive	Spring Valley – Moderate potential habitat
Long-calyx egg milkvetch *Astragalus oophorus* var. *lonchocalyx*	BLM Sensitive	Spring Valley – one population with two individuals
White River Catseye *Cryptantha welshii*	BLM Sensitive	Cave Valley – 2 populations; Spring Valley – 27 populations
Tunnel Springs beardtongue *Penstemon concinnus*	BLM Sensitive, USFS Sensitive	Spring Valley – Low potential habitat Snake Valley – Moderate potential habitat
Parish's phacelia *Phacelia parishii*	BLM Sensitive	Dry Lake Valley – Large population along playa margin Cave Valley – Very large population (estimated at more than a million plants)
Blaine fishhook cactus *Sclerocactus blainei*	BLM Senstive, Nevada Harvest Regulated	Dry Lake Valley – one individual was observed, and low to high potential habitat identified on 12 transects
Ute ladies'-tresses *Spiranthes diluvialis*	USFWS Threatened, BLM Sensitive, USFS Sensitive	Spring Valley – Based on field surveys, the potential for orchid occurrence was estimated as High at the following springs: Keegan Ranch (Middle) and Keegan Ranch (South); Stonehouse Spring; Swallow Spring, and West Spring Valley Complex (North). No Ute ladies'-tresses orchids were located during 2007 surveys (BIO-WEST 2007a,b) Snake Valley – Based on field surveys, the potential for orchid occurrence was not estimated as High at any location. No Ute ladies'-tresses orchids were located during 2007 surveys (BIO-WEST 2007a,b)

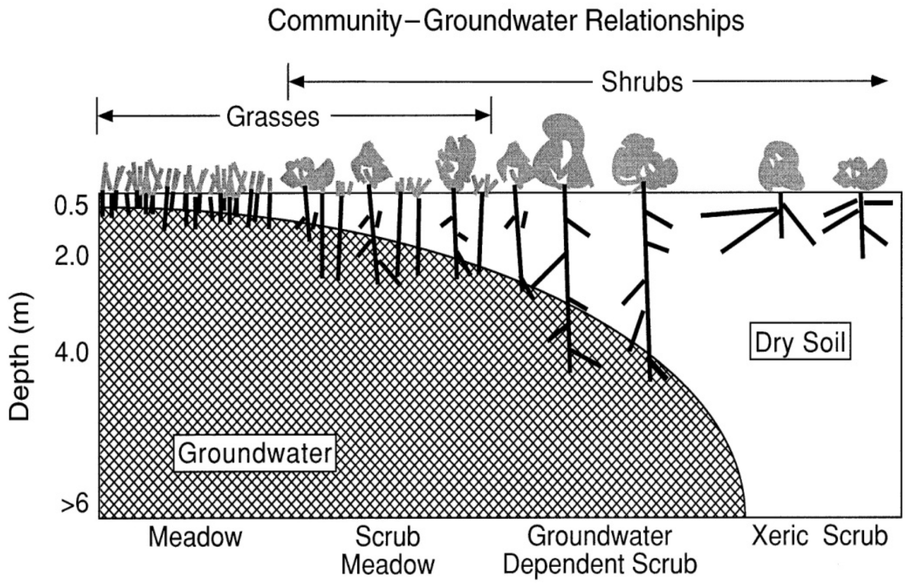
The Ute ladies'-tresses was listed as threatened under the ESA on January 17, 1992 (USFWS 1992). The species is threatened due to scarcity of populations, small population sizes, and loss of habitat due to urbanization and stream channelization for agriculture and development, as well as competition from non-native plant species, and vegetation succession (NatureServe 2009). The species typically inhabits moist, sub-irrigated, or seasonally flooded soils at elevations between 4,200 to 5,300 feet amsl (USFWS 1995). A wide variety of soils are suitable for this species, including sandy or coarse, cobbly alluvium to calcareous, histic (high in organic matter) fine-textured clays, and loams. Primary habitats include valley bottoms, gravel bars, and floodplains along springs, lakes, rivers, or perennial streams that receive periodic disturbance from over-bank flooding and livestock grazing.

3.5.1.4 Region of Study

Overview

The focus of this section is on surface and groundwater dependent vegetation resources located within hydrologic basins potentially affected by future groundwater pumping. **Figure 3.5-2** provides a generalized relationship of groundwater dependent vegetation to groundwater depths. Where groundwater remains at or near the surface for the majority of the growing season, wetland plants such as sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes

(*Schoenoplectus* spp.) and cattails (*Typha* spp.) are commonly the dominant community components. Root systems of these plants are typically shallow, because the roots are in contact with the groundwater surface over the majority of the year. These wetland plants are characteristic of meadows that form below the spring discharge points. Water dependent shrubs such as willows and cottonwoods often line the channel of streams with perennial to intermittent flow.



Source: Elmore et al. 2003.

Figure 3.5-2 Relationship of Plant Community Components to Groundwater Depths

As groundwater depths increase, perennial grasses and shrubs that are capable of extending their root systems to greater soil depths can take advantage of both precipitation and groundwater soil moisture. Several of these species are classified as phreatophytes, which are discussed below. Species that are adapted to grow on soils with no sub-surface moisture provided by groundwater are classified as xerophytes.

Spring Vegetation

Section 3.3, Water Resources, provides detailed information on spring locations and flows within the region of study. **Figures 3.5-3** and **3.5-4** illustrate the major springs of high biological importance within the hydrologic study area. Aquatic and wetland communities that have developed around and downgradient of springs were mapped into dominant species associations (BIO-WEST 2007a). Spring meadow vegetation in these areas ranges from herbaceous wetlands to woody plants along drainages. A summary of the vegetation community types associated with springs sampled within hydrologic basins in eastern Nevada and western Utah is provided in **Table 3.5-5**.

Figure 3.5-3 Phreatophytes and Springs of Biological Interest (North)

Figure 3.5-4 Phreatophytes and Springs of Biological Interest (South)

Table 3.5-5 Vegetation Community Characteristics for Example Spring Systems Sampled in Hydrologic Basins within the Region of Study

Nevada Hydrologic Basins Proposed for Project Groundwater Pumping	
Spring Valley. 19 spring systems mapped.	Dominant aquatic vegetation in the Unnamed Springs East of Cleve Creek, South Millick Spring and South Bastion Spring in northern Spring Valley include watercress (*Rorippa nasturtium aquaticum*), fine-leaf pondweed (*Suckenia filiformis*), horsehair algae (*Chlorophyceae* sp.), and stonewort (*Chara vulgaris*). Arctic rush and spike rush (*Eleocharis* sp.) are the dominant wetland species. Dominant aquatic vegetation in southern Spring Valley springs (Willard, Minerva, and Swallow) is similar to that in the northern part of Spring Valley.
Snake Valley 21 spring systems mapped.	Dominant aquatic vegetation in the Big Spring system, South Little Spring, and North Little Spring include watercress, horsehair algae, and muskgrass (*Chara vulgaris*). The dominant wetland species include Arctic rush, Nebraska sedge (*Carex nebrascensis*), redtop (*Agrostis gigantea*), spikerush, and three square bulrush (*Schoenoplectus americanus*).
Cave Valley 2 small springs identified, no access.	Cave Spring, Unnamed Spring at Parker Station.
Dry Lake Valley 3 spring systems mapped.	Bailey, Coyote, and Fence Springs. Very small springs (less than 1 acre each). Primarily introduced species in the herbaceous layer: curly dock (*Rumex crispus*), sweet clover (*Melilotus officinalis*). Shrubs: skunkbush (*Rhus trilobata*). Trees: Fremont cottonwood (*Populus fremontii)*.
Delamar Valley 1 spring system mapped.	Grassy spring. Highly disturbed small spring, developed for stock watering. Open water with no vegetation, small areas of hardstem bulrush (*Schoenoplectus acutus*).
Other Hydrologic Basins within the Region of Study	
White River Valley, Nevada 9 spring systems mapped.	The most abundant aquatic species include horsehair algae and watercress. The most abundant emergent wetland species include Arctic rush, Olney's three-square bulrush (*Schoenoplectus americanus*), broadleaf cattail (*Typha latifolia*), saltgrass, and spike rush. Some trees (cottonwoods, boxelder, black locust, and Russian olive) were established in several wetlands sampled.
Pahranagat Valley (including Pahranagat NWR), Nevada 8 spring systems mapped.	Dominant species composition is similar to that of the White River Valley, with the addition of yerba mansa (*Anemopsis californica*). An extensive emergent wetland system is supported by spring flows in the Pahranagat Valley between Hiko and Alamo (Pahranagat NWR).
Lake Valley, Nevada 1 spring system mapped.	Wambolt Spring Complex. Mare's tail (*Hippuris vulgaris*) and watercress are the primary aquatic species. Dominant emergent wetland species are Nebraska sedge and spikerush.
Panaca Valley, Nevada 1 spring system mapped.	Panaca Big Spring. Algae, the sole aquatic vegetation type, covered about 30 percent of the wet area. Olney's three-square bulrush was the dominant emergent wetland species.
Tule Valley, Utah 4 spring systems mapped.	Coyote, South Tule, Tule (4a), and Willow Springs. Horsehair algae and watercress are the dominant aquatic species; Olney's three-square bulrush, Arctic rush, salt grass, and common reed (*Phragmites australis*) are the dominant emergent wetland species.
Fish Springs NWR (Fish Springs Flat), Utah 8 spring systems mapped.	Species composition is similar to that described for Tule Valley. Willows, cottonwood trees, and tamarisk also are present.

Woody Riparian

Mountain streams flow for short distances onto the valley floors before being diverted for agriculture or infiltrating into coarse outwash materials on valley side slopes. Surface water from the mountain snowpack and groundwater from springs contribute to the base flows of these perennial streams (see Section 3.3, Water Resources). Examples of mountain streams with well developed bands of riparian vegetation include Cleve Creek on the east side of the Schell Creek Range and Snake Creek, Lehman Creek, Baker Creek, and Big Wash that drain from watersheds in GBNP on the east side of the Snake Range. Woody riparian species occur in narrow bands adjacent to perennial stream reaches.

Example riparian woody species include narrowleaf cottonwood (*Populus angustifolia*), Fremont cottonwood (*Populus fremontii*), willows, chokecherry (*Prunus virginiana*), and water birch (*Betula occidentalis*) (GBNP 2007). A tall riparian shrubland lines the channel of larger regional stream systems (Meadow Valley Wash, Muddy River) in the southern portion of the region of study. These riparian species include cottonwoods, various willow species *(Salix spp.),* and tamarisk (*Tamarix spp*.). These riparian areas have been distinguished as a distinct ET (DeMeo et al. 2008) (see next section).

Evapotranspiration Areas and Phreatophytes

ET areas are ground surface locations where groundwater is discharged (lost to the atmosphere) from plant transpiration, and evaporation from soils and open water bodies. The ET areas within individual hydrologic basins were mapped as an input variable for estimating groundwater discharge (see Section 3.3, Water Resources). ET rates are an essential input to groundwater recharge and discharge budgets, which are in turn used to define sustainable groundwater yields. A variety of reconnaissance studies have been conducted to estimate ET rates from major water supply basins (Harrill et al. 1988; Nichols 2000).

To estimate ET, the amount of water entering the atmosphere from vegetation leaves must be included. Transpiration is the loss of water from the leaves of plants as the result of cellular respiration, and as a response to high atmospheric temperatures and low relative humidity. Water is withdrawn from the soil root system and transported through the stems and branches to the leaves. Water transported upward from the roots replaces water lost from the leaves through pores called stomata.

Certain plants, called phreatophytes, are capable of withdrawing water from the groundwater through a deep and extensive root system. The plants then release a fraction of that water to the atmosphere. There are various definitions for phreatophytes: 1) they are plants dependent on groundwater as a moisture source (Robinson 1958; Busch et al. 1992); 2) they grow where there is insufficient precipitation and thus require groundwater for survival (Naumburg et al. 2005); 3) they habitually obtain their water supply from the saturated zone (Le Maitre et al. 1999); 4) they obtain at least some water from shallow groundwater (Cooper et al. 2006) and through root system adaptations they normally reach and consume groundwater. Plants usually classified as phreatophytes access groundwater by deep roots and can achieve high transpiration rates even during times of low precipitation (Busch et al. 1992; Dileanis and Groeneveld 1989; Le Maitre et al. 1999; Naumburg et al. 2005).

The phreatophyte shrub greasewood (*Sarcobatus vermiculatus*) is a key indicator of relatively shallow groundwater depths in the Great Basin. Studies of root depths of this shrub species in relation to groundwater depth indicate that rooting depths range from the soil surface to as much as 50 feet. Recent studies in the Snake, Spring, and White River valleys (Moreo et al. 2007; Devitt 2008) indicate that depth to groundwater ranged between 10 and 45 feet on sites dominated by greasewood. Greasewood is highly adapted to utilizing water from precipitation as well as groundwater because of the distribution of its root system from near the soil surface down to the groundwater capillary fringe. The sources for plant respiration and growth vary seasonally. Micro-meteorological studies of plant transpiration losses and evaporation from adjacent soils indicated that greasewood shrubs first consumed available shallow soil moisture during the early part of the growing season. As surface soils dried out, the shrubs increasingly transpired water from groundwater source and groundwater depths declined seasonally (Nichols1993; Moreo et al. 2007).

Evapotranspiration (ET): Water lost to the atmosphere from the ground surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants whose roots tap the capillary fringe of the groundwater table.
Source: USGS 2010.

ET Area: An area of similar vegetation composition and density with similar evapotranspiraton rates.

Transpiration: Evaporation of water from plant leaves. The rate of evaporation is affected by temperature, relative humidity, and wind and air movement.
Source: USGS 2010.

Capillary Fringe: The subsurface layer in which groundwater seeps up from a water table by capillary action to fill pores.

Three populations of an unusual Rocky Mountain juniper "swamp cedar" community occur in Spring Valley. Two of these three populations are described by Charlet (2006) in a study of interbasin water transport in Spring Valley. The northern (north of U.S. Highways 6 and 50) population of swamp cedar is approximately 1.5 square miles, and the southern (south of U.S. Highways 6 and 50) population occupies about 2.5 square miles. Another small population is located in the vicinity of Shoshone Ponds in southern Spring Valley. The northern swamp cedar community in Spring Valley is a BLM ACEC (see further discussion in Section 3.14, Special Designations). Charlet (2006) reports that common shrub associates include greasewood, yellow rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush, shadscale saltbush, and Basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). Native grasses associated with these woodlands include basin wildrye (*Leymus cinereus*), saltgrass, and alkali cordgrass (*Spartina gracilis*). Permanently wet areas around springs may support arctic rush (*Juncus arcticus*) and bulrush (*Scirpus* sp.). Depending on conditions, the community structures vary from an open park-like savanna to dense woodlands and thickets.

The "swamp cedar" communities in Spring Valley are unique to the low elevation landscape that occurs in seasonally flooded valley bottoms. Rocky Mountain juniper is not assigned a wetland indicator status by the USDA, as it is considered an upland species throughout its range. The two distinct low-elevation populations of swamp cedars occurring in the Project area are unique biological systems occurring on the edge of this species' geographic distribution. While no quantitative research has been conducted on these populations to determine the ecological factors that allow them to exist at these low-elevation sites, it is hypothesized that their occurrence is the result of more water being available to the trees than is available solely from precipitation. **Table 3.5-6** lists plant species commonly occurring in ET areas mapped for this project that can function as phreatophtyes, depending upon the availability of shallow groundwater. Big sagebrush, four wing saltbush, shadscale saltbush, rubber rabbitbrush, and greasewood can exploit shallow groundwater systems and therefore function as phreatophytic plants. These species can take advantage of groundwater when present but also can tolerate periods of low water availability (Barbour et al. 1987).

Table 3.5-6 Occurrence of Representative Species within Evapotranspiration Areas Mapped in the GWD Project Region of Study

Species	Life Form	Wetland/Meadow	Basin Shrubland	Riparian Shrubland
Big sagebrush (Artemisia tridentata ssp. tridentata)	Shrub		X	X
Fourwing saltbush (Atriplex canescens)	Shrub		X	X
Shadscale saltbush (Atriplex confertifolia)	Shrub		X	
Saltgrass (Distichlis spicata)	Herb	X	X	X
Rubber rabbitbrush (Ericameria nauseosa)	Shrub		X	X
Basin wildrye (Leymus cinereus)	Herb	X	X	X
Cottonwoods (Populus ssp.)	Tree	X		X
Willows (Salix ssp.)	Shrub	X		X
Greasewood (Sarcobatus vermiculatus)	Shrub		X	X
Alkali sacaton (Sporobolus airoides)	Herb	X	X	X

A first step for estimating water lost to the atmosphere from plant transpiration is to map the distribution and abundance of phreatophyte shrub and herbaceous communities within a hydrologic basin. If the annual transpiration rate can be determined for the dominant phreatophyte species, then the transpiration losses over large areas of similar vegetation composition and density (ET) can be calculated. In groundwater supply reconnaissance studies conducted from the 1940s through 1960s, phreatophyte shrubs that were transpiring groundwater were identified by examining the relative shrub foliage vigor during the summer months (after winter precipitation soil moisture had been evaporated, or taken up by plants). Actively photosynthesizing (green) foliage was considered to be sustained by groundwater. Shrubs with low or no photosynthetic activity (often dormant) were assumed not to be sustained by groundwater. Ground reconnaissance estimates of phreatophyte foliar activity were augmented by the use of multi-spectral satellite imagery to identify and map photosynthetically active vegetation over large areas, based on infrared light reflectance (Nichols

2000). Satellite imagery also allows examination of vegetation in multiple seasons and multiple years. This multiple sampling approach provides a tool for assessing the variability of phreatophyte and other vegetation dependence on underlying groundwater.

The USGS (Smith et al. 2007) used multiple sources of information to map nine ET areas within several of the region of study basins (Snake, Spring, White River, Lake, and Cave) (**Table 3.5-7**). This mapping was a component of the BARCAS studies to estimate the groundwater resources within these basins. The ET boundaries were established from: 1) existing land cover mapping SWReGAP; 2) analysis of certain infrared wavelength bands within LandSat Thematic Mapper Imagery to identify photosynthetically active vegetation; 3) field measurements of ET losses; and 4) inspection of relative vigor of phreatophyte and other vegetation from ground reconnaissance within each basin. The ET areas were aggregated so that relative loss of water from transpiration and evaporation could be estimated for individual hydrologic basins.

Table 3.5-7 Evapotranspiration Areas Established within the GWD Project Hydrologic Region of Study

USGS Vegetation ET (Smith et al. 2007)	Characteristic Species (Smith et al. 2007)	Range of depths to groundwater (feet) (Smith et al. 2007)	SNWA ET (BIO-WEST 2007a)	Combination of units for EIS display and analysis
Marshland	Dense wetland vegetation – tall reeds, rushes, some grasses.	Less than 1; soil nearly always saturated	Wetland/Meadow	Wetland/Meadow
Meadowland	Dominated by short, dense perennial grasses; may include shrubs and trees (e.g., Rocky Mountain juniper, cottonwoods).	Less than 5 feet; soil typically moist except late summer	Wetland/Meadow	Wetland/Meadow
Grassland	Dominated by short perennial grasses, including salt grass, sod and pasture grasses. Includes desert shrubs and occasional trees (Rocky Mountain juniper, cottonwoods).	Less than 8 feet; soil damp to dry	Wetland/Meadow	Wetland/Meadow
Dense Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover greater than 25 percent.	3 to 50	Phreatophyte/Medium Vegetation	Basin Shrubland
Moderately Dense Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover ranges from 10 to 30 percent.	3 to 50	Phreatophyte/Medium Vegetation	Basin Shrubland
Sparse Desert Shrubland	Mixture of desert shrubs (greasewood, rabbitbrush, shadscale, big sagebrush, and saltbush). Vegetation cover ranges from 5 to 15 percent.	3 to 50	Bare Soil/Low Vegetation	Basin Shrubland
Recently Irrigated Cropland	Irrigated cropland.	Generally greater than 5	Agriculture	Agriculture
Moist Bare Soil	Moist playa – no vegetation.	At or near the soil 4	Playa	No category
Dry Playa	Dry playa – no vegetation.	Greater than 10	Playa	No category
No Category	Not Applicable	Greater than 10	Wetland/Meadow	Wetland/Meadow (Riparian Shrubland)

The SNWA mapped ET areas in the same hydrologic basins using similar methods to those of the USGS (BIO-WEST 2007a; SNWA 2009). The SNWA ET areas were divided into six categories; the correlation of these units with those identified by the USGS is displayed on **Table 3.5-7**. SNWA also included the riparian shrublands along Meadow Valley Wash and the Muddy River in the wetland/meadow ET area.

For purposes of mapping the vegetation ET areas for impact analysis in this EIS, the three herbaceous meadow types defined by the USGS were combined into a single wetland/meadow ET area (consistent with a similar consolidation by SNWA) (**Table 3.5-6**). Depth to water under all three areas is less than 10 feet, with decreasing soil moisture at or near the surface from marshland to grassland.

The three USGS shrub density classes were consolidated into a single ET area called Basin Shrubland. The species composition of these three shrubland ET areas is similar; the primary difference among them is the relative density of shrubs. The Riparian Shrublands mapped along the Meadow Valley and Muddy River drainages (DeMeo et al. 2008) were distinguished from Basin Shrublands because of the differences in species composition and water supply sources (surface and groundwater). Areas currently used for irrigated agriculture are mapped, based on recent satellite imagery.

Figures 3.5-3 and **3.5-4** illustrate the location of the ET areas, and the vegetation communities that comprise these areas. The same ET areas are illustrated by individual basin in Section 3.3, Water Resources. **Figure 3.5-5** illustrates the relationship of groundwater depth to the occurrence of ET areas in Spring and Snake valleys.

Special Status Plant Species

There is one known Nevada population of Ute ladies'-tresses in the Panaca Springs near Panaca in Lincoln County. There also is a record of Ute ladies'-tresses from the Utah portion of Snake Valley in Juab County. BIO-WEST (2007a,b) conducted habitat surveys for this species in spring-fed meadows in several project and adjacent hydrologic basins. Populations were not found in these surveys, but suitable habitat was identified.

Culturally Significant Plants

The Confederated Tribes of the Goshute Reservation (Steele 2010), the Paiute Indian Tribe of Utah, and the Ely Shoshone submitted lists of plants to the BLM that are culturally significant to members of these tribes. These plants have traditional values for food, medicine, and tools. The lists were combined to identify important plants to all three Tribes, as well as plants unique to each Tribe (**Table 3.5-8)**. The plant species known to be dependent, or partially dependent, on surface and groundwater sources are noted. The Tribal correspondence concerning culturally significant plants is contained in **Appendix F3.5**.

Figure 3.5-5 ET Unit Cross-sections Ground Surface and Groundwater Elevations

Table 3.5-8 Culturally Significant Plants

Scientific Name	Common Name	Tribe		
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone
FORB/HERB				
Achillea millefolium	Common yarrow	X		
Agastache urticifolia	Nettleleaf giant hyssop		X	
Allium bisceptrum	twincrest onion	X	X	
Allium nevadense	Nevada onion			X
*Anemopsis californica**	Yerba mansa	X		
Anethum graveolens (Peucedanum graveolens)	Dill		X	
Apios sp.	Groundnut	X		
Apocynum androsaemifolium	Spreading dogbane		X	
Apocynum cannabinum	Indianhemp	X		X
Argemone munita	Flatbud prickly poppy			X
Artemisia campestris	Field sagewort	X		
Artemisia dracunculus	Tarragon	X		
Artemisia ludoviciana	White sagebrush	X		
Asclepias fascicularis	Mexican whorled milkweed	X		
*Asclepias speciosa**	Showy milkweed	X		
Asclepias tuberosa	Butterfly milkweed	X		
Atriplex truncata	Wedgescale saltbush		X	
Balsamorhiza hookeri	Hooker's balsamroot		X	
Balsamorhiza sagittata	Arrowleaf balsamroot	X	X	
Calandrinia ciliata	Fringed redmaids	X		
Calochortus flexuosus	Winding mariposa lily			X
Calochortus nuttallii	Sego lily		X	
Camassia scilloides?	Camas			X
*Camassia quamash**	Small camas		X	
Carum gairdneri	Gairdner's yampah [1]		X	
Castilleja angustifolia?	Indian paintbrush			X
Chenopodium atrovirens	Pinyon goosefoot			X
Cirsium eatoni	Eaton's thistle		X	
Cirsium undulatum	Wavy leaf thistle		X	
Claytonia caroliniana	Carolina springbeauty		X	
Cirsium eatonii	Eaton’s thistle		X	
Cymopterus longipes	Longstalk springparsley		X	
Dichelostemma capitatum	Bluedicks	X		
Dracocephalum parviflorum	American dragonhead		X	
Echinacea angustifolia	Blacksamson echinacea	X		
*Erigeron philadelphicus**	Philadelphia fleabane	X		

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe		
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone
Eriogonum jamesii	James' buckwheat		X	
Eriogonum umbellatum	Sulfur-flower buckwheat		X	
Erythronium grandiflorum	Yellow avalanche-lily		X	
Fragaria vesca	Woodland strawberry	X		
Fragaria virginiana	Virginia strawberry	X		
Fritillaria affinis	Checker lily	X		
Fritillaria pudica	Yellow fritillary		X	
Ipomopsis aggregata	Scarlet gilia		X	
Heliomeris longifolia	Showy goldeneye		X	
Helianthus annuus	Common sunflower	X	X	
Ipomopsis aggregata (same as above)	Scarlet gilia, scarlet trumpet, skyrocket		X	
*Iris missouriensis**	Rocky Mountain iris	X		
Lewisia rediviva	Bitter root	X		
Linum lewisii	Lewis flax			X
*Lobelia cardinalis**	Cardinal flower	X		
Lobelia siphilitica	Great blue lobelia	X		
Lomatium dissectum var. *multifidum*	carrotleaf biscuit root		X	
Lomatium multifidum	Biscuit root		X	
Agastache urticifolia	Nettleleaf giant hyssop		X	
Sphaeralcea munroana	Munro's globemallow		X	
*Mentha arvensis**	Wild mint		X	
Mentha Canadensis	Mint		X	
Mentzelia dispersa	Bushy blazingstar	X		
Monarda fistulosa	Wild bergamot	X		
Nicotiana attenuata	Coyote tobacco		X	
Oenothera sp.	Evening primrose	X		
Penstemon eatonii	Firecracker penstemon			X
Penstemon grandiflorus	Large beardtongue	X		
Phlox longifolia	Longleaf phlox			X
Proboscidea parviflora	Doubleclaw	X		
Ratibida columnifera	Upright prairie coneflower	X		
Rumex salicifolius	Willow dock			X
*Sagittaria cuneata**	Arumleaf arrowhead	X		
*Sagittaria latifolia**	Broadleaf arrowhead	X		
*Salicornia europaea**	Glasswort		X	
Salicornia herbacea	Brittlewort		X	
Salvia columbariae	Chia			X

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe		
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone
Salvia sp.	Chia	X		
Sisymbrium canescens	Tansy mustard		X	
*Trifolium wormskioldii**	Cows clover	X		
*Typha domingensis**	Southern cattail	X		
*Typha latifolia**	Broadleaf cattail	X	X	
Urtica dioica	Stinging nettle			X
Wyethia amplexicaulis	Mule's ear		X	
Zigadenus elegans (Anticlea elegans)	Mountain deathcamas		X	
Zigadenus nuttallii	Nuttall's deathcamas		X	
CACTUS				
Carnegiea sp.	Saguaro	X		
Hesperoyucca whipplei	Chapparal yucca	X		
GRAMINOID				
Achnatherum hymenoides	Indian ricegrass			X
Carex rossii	Ross' sedge	X		
Elymus elymoides	Bottlebrush squirreltail	X		
Elymus glaucus	Blue wildrye	X		
Festuca ovina	Sheep fescue	X		
*Hierochloe hirta**	Northern sweetgrass	X		
*Juncus arcticus**	Mounatin rush	X		X
*Juncus effusus**	Common rush	X		
Leymus cinereus	Basin wildrye			X
Muhlenbergia rigens	Deergrass	X		
*Phragmites australis**	Common reed			X
Pseudoroegneria spicata	Bluebunch wheatgrass	X		
Schoenoplectus acutus var. *occidentalis*	Tule	X		
*Schoenoplectus californicus**	California bulrush	X		
*Schoenoplectus pungens**	Common threesquare	X		
Schoenoplectus acutus var. *acutus **	Hardstem bulrush		X	
Sporobolus airoides	Alkali sacaton	X		
*Triglochin maritima**	Seaside arrowgrass		X	
SHRUB				
Amelanchier alnifolia	Serviceberry (Saskatoon serviceberry)	X	X	
Arctostaphylos uva-ursi	Kinnikinnick	X		
Artemisia frigida	Prairie sagewort	X		
Artemisia tridentata	Big sagebrush	X	X	

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe: Paiute Indian Tribe of Utah	Tribe: Confederated Tribes of the Goshute Reservation	Tribe: Ely Shoshone
Atriplex confertifolia	Shadscale saltbush		X	
Chrysothamnus viscidiflorus	Yellow rabbitbrush			
Ceanothus herbaceus	Jersey tea	X		
Celtis laevigata	Sugarberry	X		
Cercis orbiculata	California redbud	X		
Cercocarpus ledifolius	Curl leaf mountain mahogany	X		
Cercocarpus montanus	Mountain mahogany		X	
Ericameria nauseosa	Rubber rabbitbrush		X	
Cornus sericea	Redosier dogwood	X		
Cornus sericea ssp. *occidentalis*	Western dogwood	X		
Cornus stolonifera[2*]	Redosier dogwood		X	
Cylindropuntia acanthocarpa	Buckhorn cholla	X		
Elaeagnus commutata	Silverberry			X
Ephedra nevadensis	Nevada jointfir	X		
Ephedra sp.	Jointfir		X	
Ephedra viridis	Mormon tea	X		
Ericameria teretifolia	Green rabbitbrush	X		
Krascheninnikovia lanata	Winterfat		X	
Gutierrezia sarothrae	Broom snakeweed	X		
Juniperus pinchotii	Pinchot's juniper	X		
Mahonia nervosa	Cascade barberry	X		
Nolina microcarpa	Sacahuista	X		
Poliomintha incana	Frosted mint	X		
Prosopis glandulosa	Honey mesquite	X		
Prosopis glandulosa var. *torreyana*	Western honey mesquite	X		
Prosopis pubescens	Screwbean mesquite	X		
Prunus americana	American plum	X		
Prunus demissa[3]	Chokecherry	X	X	
Purshia tridentata	Antelope bitterbrush	X		
Quercus undulata	Scrub oak		X	
*Ribes aureum**	Golden currant	X		
Ribes cereum	Wax currant		X	
Ribes sp.	Gooseberry or currant			X
Rosa californica	California wildrose		X	
Rosa fendleri[4]	Rose hips		X	
Rosa woodsii	Wood's rose	X		X
Rubus idaeus	American red raspberry	X		
Rubus spectabilis	Salmonberry	X		

Table 3.5-8 Culturally Significant Plants (Continued)

Scientific Name	Common Name	Tribe		
		Paiute Indian Tribe of Utah	Confederated Tribes of the Goshute Reservation	Ely Shoshone
*Salix amygdaloides**	Peachleaf willow	X		
*Salix exigua**	Narrowleaf willow	X		
Salix lucida	Shining willow	X		
Salix scouleriana	Scouler's willow	X		
Sambucus nigra var. *cerulea*	Blue elderberry			X
Sambucus racemosa	Red elderberry	X		
Sambucus sp.	Common elderberry	X		
Shepherdia canadensis	Russet buffaloberry	X		
Shepherdia sp.	Buffalo berry		X	
Vaccinium deliciosum	Cascade bilberry	X		
Vaccinium membranaceum	Thinleaf huckleberry	X		
TREE				
Abies concolor	White fir	X		
Abies lasiocarpa	Subalpine fir	X		
Cercis canadensis	Eastern redbud	X		
Juniperus communis	Common juniper	X		
Juniperus osteosperma	Utah juniper		X	
Juniperus scopulorum	Rocky Mountain juniper	X		
Pinus edulis	Twoneedle pinyon	X		
Pinus monophylla	Singleleaf pinyon pine	X	X	
Pinus ponderosa	Ponderosa pine	X		
*Populus fremontii**	Fremont cottonwood	X		
Populus sp.	Aspen	X		
Pseudotsuga douglasii[5]	Douglas-fir	X	X	
Quercus gambelii	Gambel oak	X		
Salix sp.	Willow		X	
Washingtonia filifera	California fan palm	X		

1 Scientific name changed to *Perideridia gairdneri* ssp. *gairdneri* within the USDA PLANTS database.
2 Scientific name changed to *Cornus servicea* within the USDA PLANTS database.
3 Scientific name changed to *Prunus virginiana* var. *demissa* within the USDA PLANTS database.
4 Scientific name changed to *Rosa woodsii* and the common name changed to Woods' rose within the USDA PLANTS database.
5 Scientific name changed to *Pseudotsuga menziesii* within the USDA PLANTS database.
* Species identified as facultative wetland (FACW) or facultative wetland (occur in wetlands 67 to 99 percent of the time) and obligate species occur in wetlands 99 percent of the time per the Region 8 National Wetlands Inventory Plant List (USFWS 1988).

3.5.2 Environmental Consequences

3.5.2.1 Rights-of-way

Issues

The following issues for vegetation resources are evaluated for ROW construction and facility maintenance:

- Short-term, long-term, and permanent loss of vegetation communities due to surface disturbance and conversion of natural vegetation to industrial uses, as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional tribes.

Assumptions

The following assumptions were used in the impact analysis for vegetation resources:

- Vegetation community disturbance calculations were based on the proposed construction and operational configurations (footprints) presented for each pipeline, power facility, and ancillary facility ROW in Chapter 2, Proposed Action and Alternatives A through E and Alignment Options 1 through 4.
- Construction disturbances, while temporary in nature, have been defined as "long-term" for all vegetation cover types due to existing vegetation structure and composition, long recovery times, and limiting revegetation factors (e.g., low precipitation rates, soil chemistry constraints, and low levels of soil moisture over most the year for most vegetation communities).
- The mainline pipeline ROW would not be realigned or curved to avoid sensitive plant populations because of the large diameter of the pipeline. Temporary work space along the construction ROW may be narrowed to avoid sensitive resources. Access roads and power line pole locations can be adjusted to avoid sensitive plant populations.
- No woody plant maintenance would be required within the permanent pipeline ROW because of the very slow growth and low stature of shrub, pinyon pine, and junipers.

Methodology for Analysis

Construction surface disturbance impacts by alternative were evaluated according to the following steps:

- The area of vegetation communities and the extent of special status species that would be removed temporarily or permanently during project facility resource construction were estimated, based on SWReGAP cover types and field surveys for special status plants.
- Recovery times for disturbed vegetation communities were estimated from a literature review. Recovery times were based on ecological characteristics, fire response, and climatic factors.
- The risk of weed invasion was estimated from field surveys conducted by SNWA and from a weed occurrence database maintained by the BLM Ely District.
- The BLM RMP management actions and BMPs, as well as ACMs available were evaluated to limit the extent and duration of predicted impacts. Additional mitigation measures were recommended to reduce or offset impacts; mitigation measure effectiveness was estimated and a residual impact summary was developed for each impact issue.

3.5.2.2 Proposed Action, Alternatives A through C

Construction and Facility Maintenance

Vegetation Community Surface Disturbance and Restoration

Pipeline, power facility, and ancillary facility construction activities would clear and blade shrub and herbaceous vegetation from the construction ROW. The root systems and dormant seeds would be piled in excavated topsoil along the ROW margins. Excavated soil would then be replaced over the disturbed construction ROW after construction was completed. Disturbed soils within the ROW would be reseeded with an approved seed mixture. **Table 3.5-9** summarizes construction surface disturbance to each cover type for all project facilities. Estimates of vegetation community recovery are based on post-fire responses (see **Appendix F3.5**). A breakdown of surface disturbance by land cover types within the hydrologic basins is contained in **Appendix F3.5**.

Table 3.5-9 Proposed Action and Alternatives A through C – Construction Disturbance, Operational Conversion of Land Cover Types, and Estimated Vegetation Recovery Periods

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to aboveground industrial uses) (acres)	Estimated Vegetation Community Recovery Time (years)
Agriculture/Developed	9	9	2
Annual Invasive Grassland	30	7	2
Barren	1	0	0
Greasewood/Salt Desert Shrubland	2,983	252	20-50
Marshland	6	6	2-5
Mojave Mixed Desert Scrub	3,052	260	100-200
Perennial Grassland	28	2	5-15
Pinyon-Juniper Woodland	262	26	100-200
Playa	21	1	0
Riparian Woodland and Shrubland	5	5	20-50
Sagebrush Shrubland	5,906	445	20-50
Grand Total	12,303	1,013	

Pipeline, power facility, aboveground facility ROW, construction access roads, and temporary construction areas would remove vegetation for the long-term from approximately 12,300 acres. Of this amount, the land cover types that would be most affected include: sagebrush shrubland (48 percent); Mojave mixed desert shrubland (25 percent); and greasewood/saltbush shrubland (24 percent). Installation of aboveground facility and access road ROWs would result in the commitment of approximately 1,000 acres to long-term industrial uses. These areas would not be restored until after abandonment, which is considered a permanent land use commitment.

Site stabilization and restoration techniques, as presented in the POD (**Appendix E**), would minimize the duration of vegetation disturbance and provide the framework for a successful vegetation restoration program. ACMs include topsoil segregation and salvage and an integrated Restoration Plan including a restoration monitoring protocol. These measures are described in **Appendix E**, as part of general construction practices, general operation practices, and restoration monitoring. Preservation of intact root systems during grading (ACM A1.20), topsoil, and seedbank protection (ACM A.1.23), and topsoil erosion control measures (ACM A.1.25) would be implemented. Commitments to prepare a detailed Restoration Plan are included in ACM A.1.69 and ACM A.1.70.

Post-construction revegetation and restoration of each vegetation cover type back to its baseline structure and composition may vary depending on various factors such as soil mixing, timing and duration of disturbance, topography, slope, soil moisture, and precipitation. Reclamation efforts likely would reestablish an early seral vegetation community within two growing seasons following construction for all herbaceous- and woody-dominated communities; however, full recovery of shrub-dominated and pinyon-juniper woodland communities to baseline structure and composition would take longer due to poor soil and low moisture conditions. The shrub component in these cover types would require 50 to 100 years or more to recover to former height and density. Some plant communities (e.g., winterfat) may not return to a pre-construction density because of specialized soil structure requirements that would be permanently altered by soil removal and replacement during pipeline trench excavation.

Documentation of restoration trends would follow the interagency Nevada guidelines for successful revegetation (ACM A.1.70). Restoration success would be reported to the BLM; restoration would be considered successful when the area met a specified percentage of vegetation cover and species density as compared to adjacent reference sites. Restoration efforts would continue as required by the BLM until SNWA received a written release from the BLM (ACM A.2.9, and ACM A.2.10). Some areas would recover more quickly than others; therefore, the BLM would issue incremental restoration releases for segments of the ROW over time.

Conclusion. Approximately 12,208 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 64 acres of annual and perennial grassland and marshland cover types would require from 2 to 15 years for recovery. Approximately 1,004 acres of natural land cover types would be permanently converted to aboveground industrial uses. Operational maintenance activities are expected to disturb small areas, primarily within the permanent ROW. The area of vegetation communities affected by construction surface disturbance would represent less than 1 percent of the surface area of these cover types within the hydrologic basins occupied by the Proposed Action.

ACMs include measures to salvage and preserve soil and during construction, to follow best practices for revegetation seeding and erosion control, to follow a long-term restoration monitoring program, and to obtain a written release of restoration success from the BLM. These measures provide the framework for meeting the desired conditions for vegetation community types specified in the Ely District RMP within the time frames expected for natural recovery of these communities.

Proposed mitigation measures:

None.

Residual impacts include:

- The long (20 to 200 years) restoration periods for shrublands and woodlands on 12,208 acres of disturbed ROWs because of sparse and uncertain precipitation, and soil-induced growth constraints (salinity, alkalinity, shallow soil depths);
- The permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from approximately 1,000 acres required for permanent aboveground facilities; and
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

The prevention of the spread of noxious and non-native invasive weed species and the eradication of known populations are high priorities of Nevada, Utah, and the BLM. Vegetation removal and soil disturbance during construction would create optimal conditions for the establishment of weed species. Construction equipment travelling from weed-infested areas into weed-free areas could disperse weed seeds and propagules, resulting in the establishment of noxious weeds in previously weed-free locations.

BLM (2010) prepared a noxious and invasive weeds risk assessment for the GWD Project (**Appendix F3.5**). The Ely District weed inventory indicated that infestations of 11 listed weeds were located within 1,000 feet of the proposed ROWs; infestations of 14 listed weed species were located within 3 miles of the ROWs along roads or drainages. Several of these species are highly persistent and spread in patches from underground rhizomes. Examples include Russian knapweed (*Acroptilon repens)* and tall whitetop (*Lepidium latifolium).* These species are highly resistant to herbicide treatment. The assessment concluded that the risk of noxious/invasive weeds spreading into the project is "High – Heavy infestations of noxious/invasive weeds are located within or immediately adjacent to the project area. Project activities, even with preventive management actions, are likely to result in the establishment and spread of noxious/invasive weeds on disturbed sites throughout much of the project area." The assessment indicates that facilities would be located in several currently weed-free areas, including the power line routes across the Schell Range between Steptoe and Spring valleys; the pipeline lateral from Lake Valley to Snake Valley; the east side of the Fortification Range; and the main pipeline route that crosses Muleshoe, Dry Lake, and Delamar valleys. The assessment notes that several recent fires have expanded the dominance of cheatgrass and red brome throughout the burn areas. These fires have occurred in the southern portion of Lincoln County in Pahrangat Valley. Approximately 34 acres of the construction ROW have been directly impacted by these fires and likely have non native invasives present in higher densities than unburned areas. An increase of red brome or cheatgrass could alter the fire regime throughout the project area and increase the fire frequency. This would have detrimental impacts on native vegetation. SNWA also sponsored weed surveys along the ROWs.

The BLM noxious and invasive weed risk assessment (**Appendix F3.5**) includes a list of measures to be included in an Integrated Weed Management Plan within the project Construction, Operation, and Maintenance Plan that would be approved by the BLM Weed Coordinator. Example measures include requirements for removal of manually controlled weeds; use of weed-free seed mixtures and mulches; use of weed-free soil from borrow areas; the use of equipment wash stations to prevent weed spread; minimization of overall surface disturbance; stockpiling of weed-infested soils to prevent spread; avoidance of weed contamination from water sources used for fire suppression; herbicide management to prevent contamination of water bodies and unintended effects on special status species, residences, and recreation areas; selection of revegetation species capable of outcompeting weeds; and project proponent responsibilities for monitoring and controlling weeds within the ROW and for infestations that spread outside the ROW.

SNWA applicant-committed weed management measures (ACMs A.1.5, A.1.26, A.1.35, A.1.82 through A.1.89, and A.2.12 [**Appendix E**]) are consistent with the preventive measures and proponent control responsibilities outlined in the BLM noxious and invasive weed risk assessment.

ACMs for Noxious Weeds

- **A.1.82** SNWA will prepare and submit an integrated Weed Management Plan to the BLM for approval before construction begins. Noxious weeds will be controlled during and following construction activities.
- **A.1.83** ROW areas with pre-existing noxious weed infestations will be treated with a BLM-approved control method, two to three years prior to the start of construction activities, as feasible.
- **A.1.84** Borrow or fill material be inspected by a qualified biologist or weed scientist to ensure it is free of noxious weeds or others in the approved Integrated Weed Management Plan for the project.
- **A.1.85** Organic products used during construction, restoration, operations, maintenance, or for stabilization will be certified weed free.
- **A.1.86** Vehicles and equipment will be cleaned with a high pressure washer to prevent or minimize the introduction or spread of noxious weeds.

  A.1.87 Specific vehicle washing stations will be designated within the ROW for vehicle and equipment washing. Growth of noxious weeds in that area will be treated.
- **A.1.88** SNWA or its certified licensed contractor will submit a Pesticide Use Proposal to the BLM before application of any herbicide. A Pesticide Application Record will be produced following the application.
- **A.1.89** Herbicides will not be sprayed within or around an exclusion area containing sensitive resources. Removal shall be accomplished by alternative method(s) approved by the BLM.

<u>Conclusion</u>. The proposed ROWs for 306 miles of buried water pipelines and 323 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. Construction and operational maintenance equipment travelling from weed-infested areas into weed-free areas could disperse weed seeds and propagules, resulting in new weed establishment. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA would continue to monitor and control weeds within the ROW in accordance with overall restoration responsibilities.

Proposed mitigation measures:

The BLM noxious and invasive weed risk assessment states that "green stripping" should be considered as a part of an integrated weed control plan. Green stripping involves planting revegetation species (usually fast growing non-native grasses with low livestock forage values) on disturbed surfaces that are at high risk of weed invasion from adjacent noxious and invasive weed populations. The purpose of this type of revegetation procedure is to prevent the spread of weeds through competition by seeded species and to provide a green firebreak during the early fire season to help limit the spread of wildfires. Green stripping can reduce plant diversity, wildlife habitat suitability, and the recovery of shrublands over the long term. The appearance of a wide ROW dominated by herbaceous species can strongly contrast with adjacent shrublands. To provide flexibility in addressing both the risks of weed invasion and wildfires, while accounting for other resource values, additional mitigation measure ROW-VEG-1 would include the use of green stripping revegetation methods in areas where weed invasion and wildfire risks are high, and the reductions in other resource values (wildlife habitat, grazing, visual resources) can be accommodated under current and future BLM land management actions.

ROW-VEG-1: Green Stripping. SNWA, in consultation with the BLM, would develop a green stripping revegetation prescription where BLM and SNWA preventive and control measures may be inadequate to mitigate risks of weed invasion and wildfire. Green stripping is defined as ROW revegetation with fast-growing herbaceous species that can out compete annual and perennial weeds and can provide a green firebreak. Locations where this measure may be applied shall be identified in the Restoration Plan, Integrated Weed Management Plan, and Fire Prevention Plan (see ROW-VEG-2), and approved by the BLM Visual Resource Management Coordinator. For example, it would be applied primarily to Great Basin Desert low elevation bottomlands, with limited applications to open evergreen woodlands (due to low risk for weed invasion) and Mojave Desert lowlands (due to low risk as a fire disturbance ecosystem). Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The extent and number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat and grazing. To minimize visual resource impacts, the green stripping prescription shall avoid straight line seeding, and the seed mix shall contain shrubs and grasses with plant and structural diversity to harmonize with the existing colors and textures of surrounding vegetation to the extent feasible. Where VRM is a priority (within 1,000 feet adjacent to scenic byways U.S. 50/6/93, at the junction of U.S. 50/6/93, and in Cave and Delamar Valleys, other BLM BMPs and ACMs shall first be utilized first to mitigate fire risk and weed infestations.

ACM for Special Status Plants

- **A.5.9** Pre-construction surveys during the blooming or fruiting season will verify plant identification. Locations of sensitive plants will be recorded for salvage or seed collection.
- **A.5.10** Construction activities will avoid any identified sensitive plant populations within the ROW when possible.
- **A.5.11** If sensitive plant species cannot be avoided, SNWA will implement plant or seed salvage before construction.
- **A.5.12** SNWA will consult with the BLM on appropriate plant and/or seed salvage if previously unknown special status plant species are discovered within the ROW.
- **A.5.13** The on-site biological monitor can temporarily halt non-emergency construction activities if protected plant species are discovered within the ROW during construction.
- **A.5.14** SNWA will avoid exclusion areas created for sensitive plants when spraying herbicides.
- **A.5.15** Construction practices will be modified to avoid known Blaine's fishhook cacti identified within the ROW in Dry Lake Valley.

Residual impacts include:

- Implementation of these weed methods would prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide-resistant perennial weed species that are already established within, or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Approximately 150,000 cacti and yucca plants have been inventoried in the construction ROW in the Las Vegas, Garnet, Hidden, Coyote Springs, Delamar, Pahranagat and Dry Lake valleys. Cacti and yuccas would be salvaged and replanted (ACMs A.1.71 through A.1.78, A.1.80). Excavated plants would be brought to nursery areas and maintained until the next suitable planting season. Salvaged plants would be replanted back into the ROW and watered. In addition to other exceptions, Joshua trees (*Yucca brevifolia*) and banana yucca (*Yucca baccata*) over 6 feet tall, and all cacti and yucca less than 1 foot tall (with the exception of special status species) would not be salvaged (ACM A.1.71).

Based on recent field inventories, surface disturbance associated with pipeline, power facility, and/or construction access roads would remove individuals of six BLM, USFS and USFWS special status plant species within ROW construction areas and would remove suitable habitat for five additional species. SNWA would salvage topsoil and implement avoidance, transplant, and seed collection measures, depending on the species and location within the ROW. None of these species are federally listed by the USFWS and there are multiple (5 or more) known populations of each of these species in Nevada and adjacent Utah (NNHP 2010).

Protection measures for special status plants include pre-construction species-specific surveys, avoidance and minimization practices, and salvage techniques (ACMs A.5.9 through A.5.15). To reduce the long-term loss of individual plants as a result of pipeline construction activities and access road usage, SNWA has committed to a pre-disturbance salvage or seed collection program for the Eastwood milkweed (*Asclepias eastwoodiana*), long-calyx egg milkvetch, White River catseye, pinto beardtongue, sagebrush cholla, pincushion cactus, and Great Basin fishhook cactus populations. Blaine's fishhook cactus individuals located in the construction ROW would be avoided, or salvaged and transplanted immediately into suitable adjacent habitat on BLM land that will not be disturbed. Impacts to the white bearpoppy, threecorner milkvetch, and Las Vegas buckwheat would be limited to loss of suitable habitat.

<u>Conclusion</u>: Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Mature Joshua trees and immature cacti would not be salvaged, and therefore would be removed from existing plant populations along the ROW. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Transplanting and seed gathering of special status plant species would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special plant species is not likely to lead to future federal listings because there are five or more populations of these species elsewhere in Nevada and Utah.

Many species of cacti and yucca potentially impacted by the Project - which include sagebrush cholla (*Grusonia pulchella)*, pincushion cactus (*Pediocactus* sp.), Great Basin fishhook cactus (*Sclerocactus pubispinus)*, and Blaine fishhook cactus (*Sclerocactus spinosior* spp. *blainei*) - may be suitable candidates for salvage and relocation as survival rates in the Great Basin are generally good (Abella and Newton 2009). Studies of *Opuntia basilaris* (Newton 2001) and *Ferocactus cylindraceus* indicate high success rates for both species after two years with 92 percent survival for *O. basilaris* and 85 percent survival of F. cylindraceus. Eighteen years of monitoring data for Knowlton's cactus in New Mexico similarly show good success rates with 41 to 65 percent survival on average (Sivinski and McDonald 2007). Other research indicates that Saguaros, ocotillos, and barrel cacti can be transplanted with success (Archuleta and Dhruv 1995; Harris et al. 2004), except during the winter rainy season when cool temperatures and moisture promotes decay in fresh transplants.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be lower populations of yucca, cacti, and six special status species within the construction ROWs after surface disturbance and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance and seed germination and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover; annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

Accidental wildfires ignited as a result of pipeline, power facility, and ancillary facility construction activities could affect vegetation communities in a variety of ways. Impacts may include, but are not limited to, the following: partial to complete removal of aboveground plant cover and belowground components (e.g., roots, rhizomes, and seed bank); soil moisture loss and possible subsequent hydrophobic soil; loss of cacti, yucca, and special status plant species and/or their associated habitats; propensity to increase the spread or introduction of noxious and non-native invasive weed species; and loss of suitable habitat for wildlife and grazing animals.

The land cover type with the highest overall risk of accidental fires spreading upon ignition is sagebrush shrubland, which occupies 48 percent of the overall length of the ROWs. The risk of fire spread in the sagebrush cover type would largely depend on the shrub interspaces and the cover of the herbaceous understory. Wide interspaces among shrubs and low herbaceous cover would limit fire spread, while dense sagebrush shrub stands, and/or extensive herbaceous plant cover would increase the risk of fire spread. Areas dominated by invasive exotic grasses (red brome, cheatgrass) represent less than 1 percent of the ROW length.

Post-wildfire revegetation to a pre-disturbance baseline structure and composition may vary depending on physical, environmental, and physiological factors such as the severity, intensity, and duration of the wildfire; extent of disturbance; topography; slope; soil moisture; precipitation; and sensitivity of the impacted species. Vegetation cover type recovery time frames would be generally consistent with those described in **Table 3.5-9**.

Conclusion. Accidental wildfires ignited as a result of pipeline, power facility, and ancillary facility construction activities could result in the partial to complete removal of aboveground plant cover. Areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 50 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW. ACM A.1.47 specifies that fire suppression equipment would be present in construction areas, as well as individuals trained in fire suppression. A comprehensive wildland fire readiness and response plan is needed to insure adequate training for construction staff; to provide additional fire suppression capability on the construction site (water); and to insure immediate notification of local and federal agencies that would respond to wildfires (ROW-VEG-2).

Proposed mitigation measures:

ROW-VEG-1: Green Stripping. This measure would be applied as a method to create a vegetative fire break in areas of annual weed infestation, and other fire prone areas. Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

ROW-VEG-2: Fire Prevention Plan. SNWA would prepare a Wildfire Response Plan that would be approved by the BLM. This plan would include: notification procedures for local firefighting agencies, including the BLM; provisions for temporary water sources in the construction area to provide additional fire suppression capability; and training programs for all employees in methods to prevent accidental fires. Construction water sources would be made available for other fire-fighting efforts as needed. Effectiveness: This measure would be moderately to highly effective. Additional emergency response notification, additional fire-fighting equipment, and training would improve the likelihood that fires could be prevented, small fires could be controlled within a small area, and the response time for larger fire events would be more rapid, reducing the area burned. Effects on other resources: There would be no effect of implementing this measure on other environmental resources.

Residual impacts include:

- There would be no impacts to vegetation communities if no accidental construction or operation-related fires occur. Should an accidental fire occur under adverse weather conditions (high winds, low relative humidity, dry vegetation), the area of the resulting wildfire could be several thousands of acres.

Culturally Significant Plants

Individuals and portions of plant species populations used for Tribal traditional uses (**Table 3.5-8)** may be removed during ROW clearing and grading. The majority of these species grow in uplands, commonly in association with sagebrush, greasewood, and mixed desert shrublands, which occupy the largest surface areas among the regional vegetation cover types. All of the identified traditional uses plants are distributed widely in the Great Basin and Mojave Desert regions.

Conclusion. Abundance of Tribal traditional use plants vary from place to place and none are restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of these plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins.

3.5.2.3 Alternative D

Construction and Facility Maintenance

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through C would apply to Alternative D, which would require 225 miles of pipeline and 208 miles of power lines in Clark and Lincoln counties. **Table 3.5-10** provides a summary of the estimated surface disturbance within vegetation cover types.

Table 3.5-10 Alternative D – Construction Disturbance and Operational Conversion of Land Cover Types

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to Aboveground Industrial Uses) (acres)
Agriculture/Developed	9	9
Annual Invasive Grassland	29	7
Barren	1	0
Greasewood/Salt Desert Shrubland	1,673	179
Marshland	6	6
Mojave Mixed Desert Scrub	3,052	260
Perennial Grassland	13	1
Pinyon-Juniper Woodland	183	17
Playa	21	1
Riparian Woodland and Shrubland	5	5
Sagebrush Shrubland	3,851	337
Grand Total	**8,843**	**822**

Please see **Table 3.5-9** for Estimated Vegetation Community Recovery Time.

Vegetation Community Surface Disturbance and Restoration

Conclusion. Approximately 8,764 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 10 acres of annual and perennial grassland and marshland cover types would require from 2 to 20 years for recovery. Approximately 800 acres of natural land cover types would be permanently converted to aboveground industrial uses. ACMs include measures to salvage and preserve soil during construction; to follow BMPs for re-vegetation seeding and erosion control; to follow a long term restoration monitoring program; and to obtain a written release of restoration success from the BLM. Implementation of these measures would insure that vegetation species cover and composition would recover within time frames similar to natural recovery rates, or potentially more quickly over the majority of the surface disturbance areas.

Proposed mitigation measures:

None.

Residual impacts include:

- The long (20- to 200-years) restoration periods for shrublands and woodlands on 8,764 acres of disturbed ROWs because of sparse and uncertain precipitation, and soil-induced growth constraints (salinity, alkalinity, shallow soil depths);
- The permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from 800 acres required for aboveground facilities; and
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Conclusion. The proposed ROWs for 225 miles of buried water pipelines and 208 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. SNWA would implement a variety of measures to be included in an integrated weed management plan. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA will continue to monitor and control weeds within the ROW until released by the BLM, in accordance with overall restoration responsibilities.

Proposed mitigation measures:

ROW-VEG-1: Green Stripping. Green Stripping may be applied in certain areas with existing weed infestations or risk of infestation from adjacent areas. Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- Implementation of these weed methods will prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide resistant perennial weed species that are already established within or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season.

Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Mature Joshua trees and immature cacti would not be salvaged, and therefore removed from existing plant populations along the ROW. Five special status plant species populations have been identified within proposed construction ROWs. Transplanting and seed gathering would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special plant species is not likely to lead to future federal listings because there are five or more populations of these species elsewhere in Nevada and Utah.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be lower populations of yucca, cacti, and five special status species within the construction ROWs after surface disturbance, and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance, seed germination, and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover; annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

Project areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 44 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW.

Proposed mitigation measures:

ROW-VEG-1: Green Stripping. Green Stripping would be applied as a method to create a vegetative fire break in areas of annual weed infestation and other fire prone areas. Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

ROW-VEG-2: Fire Prevention Plan. Development of a Wildfire Response Plan to train construction staff to prevent accidental fires. Effectiveness: This measure would be moderately to highly effective. Additional emergency response notification, additional fire-fighting equipment, and training would improve the likelihood that fires could be prevented, small fires could be controlled within a small area, and the response time for larger fire events would be more rapid, reducing the area burned. Effects on other resources: There would be no effect of implementing this measure on other environmental resources.

Residual impacts include:

- There would be no impacts to vegetation communities if no accidental construction- or operation-related fires occur. Should an accidental fire occur under adverse weather conditions (high winds, low relative humidity, dry vegetation), the area of the resulting wildfire could be many thousands of acres.

Culturally Significant Plants

Conclusion. All of the identified traditional-use plants are distributed widely in the Great Basin and Mojave Desert regions. Abundance of these plants varies from place to place and none are restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of tribal traditional use plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area.

The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of 8,843 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins.

3.5.2.4 Alternative E

Construction and Facility Maintenance

The same ROW construction and facility maintenance issues discussed for the Proposed Action and Alternatives A through D would apply to Alternative E, which would require 263 miles of pipeline and 280 miles of power lines in Clark and Lincoln counties. **Table 3.5-11** provides a summary of the estimated surface disturbance within vegetation cover types.

Table 3.5-11 Alternative E – Construction Disturbance and Operational Conversion of Land Cover Types

Land Cover Type	Construction Disturbance (acres)	Operation (Conversion to Aboveground Industrial Uses) (acres)
Agriculture/Developed	9	9
Annual Invasive Grassland	29	7
Barren	1	0
Greasewood/Salt Desert Shrubland	2,292	223
Marshland	6	6
Mojave Mixed Desert Scrub	3,052	260
Perennial Grassland	23	2
Pinyon-Juniper Woodland	256	26
Playa	21	1
Riparian Woodland and Shrubland	5	5
Sagebrush Shrubland	5,003	421
Grand Total	**10,697**	**960**

Please see **Table 3.5-9** for Estimated Vegetation Community Recovery Time.

Vegetation Community Surface Disturbance and Restoration

Conclusion. Approximately 10,608 acres of native shrublands and woodlands removed or disturbed by construction would require 20 to more than 200 years for recovery to similar species composition and vertical structure as adjacent undisturbed areas. Approximately 55 acres of annual and perennial grassland and marshland cover types would require from 2 to 20 years for recovery. Approximately 960 acres of natural land cover types would be permanently converted to aboveground industrial uses. ACMs include measures to salvage and preserve soil and, during construction; to follow BMPs for revegetation seeding and erosion control; to follow a long-term restoration monitoring program; and to obtain a written release of restoration success from the BLM. Implementation of these measures would insure that vegetation species cover and composition would recover within time frames similar to natural recovery rates, or potentially more quickly over the majority of the surface disturbance areas.

Proposed mitigation measures:

None.

Residual impacts include:

- The long (20 to 200 years) restoration periods for shrublands and woodlands on 10,608 acres of disturbed ROWs because of sparse and uncertain precipitation and soil-induced growth constraints (salinity, alkalinity, and shallow soil depths);
- The permanent removal of shrubland (primarily sagebrush shrubland, greasewood/salt desert shrubland, Mojave mixed desert scrub) from 904 acres required for aboveground facilities; and
- An unknown fraction of some disturbed communities would not recover to previous composition and density because of specialized soil requirements (e.g., winterfat on hardpan/caliche soils within the greasewood/salt desert shrubland type).

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Conclusion. The proposed ROWs for 263 miles of buried water pipelines and 280 miles of overhead power lines are at high risk for invasion by noxious and non-native weed species. These measures include management of weed contaminated topsoil, pre-construction weed treatments, and equipment wash stations to prevent the transport of weed plants and seeds along the ROW into new areas. SNWA will continue to monitor and control weeds within the ROW until released by the BLM, in accordance with overall restoration responsibilities.

Proposed mitigation measures:

ROW-VEG-1: Green Stripping. Green Stripping may be applied in certain areas with existing weed infestations, or risk of infestation from adjacent areas. Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

Residual impacts include:

- Implementation of weed control and monitoring methods will prevent expansion of existing weed populations into new areas, but may be insufficient to control highly herbicide resistant perennial weed species that are already established within, or adjacent to the ROWs.

Cacti and Yucca, Special Status Plants

Conclusion. Several thousand yucca and cacti would be salvaged from the ROWs over a distance of approximately 100 miles, retained in nurseries along the ROW, and replanted and watered in the next appropriate planting season. Criteria that would be used to determine which cacti and yucca would be salvaged is listed in **Appendix E**, ACM A.1.71. Mature Joshua trees and immature cacti would not be salvaged, and therefore would be removed from existing plant populations along the ROW. Five special status plant species populations have been identified within proposed construction ROWs. Transplanting and seed gathering would assist in restoration of disturbed sites, but would not likely replace existing populations at an equivalent level. The net reduction in individuals and seeds of directly affected special plant species is not likely to lead to future federal listings because there are additional (five or more) populations of these species elsewhere in Nevada and Utah.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be lower populations of yucca, cacti, and six special status species within the construction ROWs after surface disturbance, and the initiation of restoration efforts. The recovery times for these species would depend on tolerance to surface disturbance and seed germination and growth rates. Perennial tall desert species such as Joshua trees would require many years (100 to 200) to recover, while annual and short-lived perennial herbaceous species could potentially recover in a few (2 to 5) years.

Accidental Wildfires

Project areas most susceptible to fire are estimated to be sagebrush shrublands and invasive annual grasslands, which occupy about 47 percent of the length of the GWD Project ROWs. SNWA would provide fire suppression equipment and trained personnel to respond to fires that originate on the construction ROW.

Proposed mitigation measures:

ROW-VEG-1: Green Stripping. Green stripping would be applied as a method to create a vegetative fire break in areas of annual weed infestation and other fire prone areas. Effectiveness: This measure may be highly to moderately effective in reducing the spread of annual weeds into the ROW from adjacent areas. Effects on other resources: The number of locations where this measure may be applied may be limited by the management considerations for other resources. Application may require evaluation for management consistency for other resource values including wildlife habitat, grazing, and VRM.

ROW-VEG-2: Fire Prevention Plan. Development of a Wildfire Response Plan to train construction staff to prevent accidental fires. Effectiveness: This measure would be moderately to highly effective. Additional emergency response notification, additional fire-fighting equipment, and training would improve the likelihood that fires could be prevented, small fires could be controlled within a small area, and the response time for larger fire events would be more rapid, reducing the area burned. Effects on other resources: There would be no effect of implementing this measure on other environmental resources.

Residual impacts include:

- There would be no impacts to vegetation communities if no accidental construction or operation-related fires occur. Should an accidental fire occur under adverse weather conditions (high winds, low relative humidity, dry vegetation), the area of the resulting wildfire could be several thousands of acres.

Cultural Significant Plants

All of the identified traditional uses plants are distributed widely in the Great Basin and Mojave Desert regions. Abundance of these plants varies from place to place, and none are restricted to a single small area. It is not expected that project clearing and grading operations would affect the overall availability or abundance of Tribal traditional use plants, unless project surface disturbance is located in a highly localized, traditional plant gathering area. The ethnographic interviews did not reveal any such highly specific plant gathering areas that would be directly affected by proposed project surface disturbance.

Proposed mitigation measures:

None.

Residual impacts include:

- There would be minor reductions in the availability of plant species used for Tribal traditional uses as the result of approximately 10,700 acres of project surface disturbance, relative to the large areas where these species occur in individual hydrologic basins.

3.5.2.5 Alignment Options 1 through 4

Table 3.5-12 presents impacts for the Alignment Options (1 through 4) in relation the relevant underground or aboveground facility segment(s) of the Proposed Action.

Table 3.5-12 Potential Effects on Vegetation Resources from Implementation of GWD Project Alignment Options 1 through 4 as Compared to the Proposed Action

Alignment Options	Analysis
Alignment Option 1 (Humboldt-Toiyabe Power Line Alignment) **Option Description**: Change the locations of a portion of the 230-kV power line from Gonder Substation near Ely to Spring Valley. **Applicable To**: Proposed Action and Alternatives A through C and E.	• The option transmission line route would result in 24 fewer acres of surface disturbance and less removal of mature pinyon pine and juniper trees. • The option transmission line would be located adjacent to an existing transmission line and would represent an expansion of an existing ROW. The corresponding segment of the Proposed Action would require a new 100-foot-wide ROW.
Alignment Options	**Analysis**
Alignment Option 2 (North Lake Valley Pipeline Alignment) **Option Description**: Change the locations of portions of the mainline pipeline and electrical transmission line in North Lake Valley. **Applicable To**: Proposed Action and Alternatives A through C and E.	• This option would require 23 more acres of sagebrush shrubland clearing to construct the mainline pipeline and transmission line. • This option would require additional acreage (approximately 5 acres) to be committed to long-term industrial uses for an additional pump station along U.S. 93.
Alignment Option 3 (Muleshoe Substation and Power Line Alignment) **Option Description**: Eliminate the Gonder to Spring Valley transmission line and construct a substation with a interconnection with an interstate, high voltage power line in Muleshole Valley. **Applicable To**: Proposed Action and Alternatives A through C and E.	• This option would eliminate all vegetation clearing associated with construction of a 230-kV line from Gonder Substation near Ely to Spring Valley, for a reduction of 410 acres relative to the Proposed Action. This impact reduction is based on a 33.8-mile length and 100-foot cleared ROW width. • Construction of the Muleshoe Substation would require an additional long-term land commitment of 43 acres of sagebrush shrubland for industrial uses as compared to the Proposed Action.
Alignment Option 4 (North Delamar Valley Pipeline and Power Line Alignment) **Option Description**: Change the location of a short section of mainline pipeline in Delamar Valley to follow an existing transmission line. **Applicable To**: All alternatives.	• The option would be located adjacent to an existing transmission line and would be shorter by 2 miles (representing 24 fewer acres of surface disturbance) as compared to the Proposed Action. However, a 10-acre pump station (5-acre permanent, 5-acre temporary) would be constructed adjacent to U.S. 93. As a consequence, implementation of the option would result in a net of 14 fewer acres of Mojave mixed desert shrubland that would be disturbed and revegetated. • A population of mature and immature Joshua trees and other yucca and cacti occur throughout this portion of Delamar Valley. A comparative estimate of the number of Joshua trees that would be removed under this alternative route or the Proposed Action is not available. However, it is likely that fewer Joshua trees and other species would require salvage if the pipeline overlapped with an existing transmission line ROW.

3.5.2.6 No Action

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought and fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management Plan guidance for other public lands in the project study area would be provided by GBNP General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

3.5.2.7 Comparison of Alternatives

The total vegetation community surface disturbance impacts for each alternative are listed in **Table 3.5-13**.

Table 3.5-13 Summary of Vegetation Community Surface Disturbance Alternatives A through E

Parameter	Proposed Action, Alternatives A through C	Alternative D	Alternative E
Vegetation Community Surface Disturbance from Construction (acres)	12,303	8, 843	10,696

3.5.2.8 Groundwater Development and Groundwater Pumping

This section considers issues, assumptions, and methods related to field development and eventual pumping from up to five hydrologic basins.

Issues

Groundwater Field Development Construction and Facility Maintenance

- Short-term, long-term, and permanent loss of vegetation communities (due to surface disturbance and conversion of natural vegetation to industrial uses) as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals, or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional tribes in relation to project surface disturbance activities.

Groundwater Pumping

- Short-term, long-term, and permanent loss of vegetation communities (including spring-fed wetlands and riparian areas) and special status plant species populations due to groundwater drawdown.
- Changes in the availability of groundwater-dependent plant species traditionally used for food and fiber by regional tribes in relation to groundwater drawdown.

Assumptions

Groundwater Field Development Construction and Facility Maintenance

- The Ely and Las Vegas RMP management actions and best management practices would be applied to all proposed construction activities based on the most current Ely and Las Vegas RMPs (BLM 2008, 1998).
- The ACMs included in the SNWA POD to manage surface disturbance effects for future ROWs provide a basis for appropriate measures that may be submitted in future SNWA ROW applications. For purposes of impact analysis, it has been assumed that measures appropriate for ROW construction would be applied to ROW construction in groundwater development areas.

Groundwater Pumping

- Spring-fed meadows and riparian areas represent small areas within hydrologic basins and are best discussed by individual springs or by perennial stream reaches. The springs and perennial stream reaches of vegetation effects concern are the high and moderate risk water sources as defined in Section 3.3, Water Resources. Both inventoried and other springs are included in the enumeration of potentially affected springs and water bodies. The expected plant successional relationships in response to drawdown are discussed under drawdown effect criteria below.
- It is assumed that a groundwater depth of 50 feet or deeper in relation to the ground surface elevation is not accessible to the roots of most phreatophytic shrubs and this groundwater depth represents a reasonable boundary for: 1) estimating the deepest root zone extent of plant communities that are at least partially dependent on underlying groundwater, and 2) defining a groundwater drawdown boundary that assumes that the roots of overlying plant communities no longer have access to groundwater as a moisture source at depths greater than 50 feet. For example, the phreatophytic shrubland ET that occupies Cave Valley are underlain by existing groundwater depths greater than 50 feet. Therefore, it is assumed that these communities would not be affected by groundwater drawdown in this hydrologic basin.
- The ET areas mapped for each hydrologic basin as part of the water balance estimates (Water Resources, Section 3.3) represent the primary cover types that would be affected by drawdown over large areas. The ET areas were originally mapped primarily on the basis of vegetation density classes and not specifically by species

composition. For purposes of evaluating vegetation community response to groundwater pumping, the primary SNWA ET areas (wetland/meadow, phreatophyte/medium vegetation, and bare soil/low vegetation) were separated into two vegetation cover types (wetland/meadow and basin shrubland) (**Table 3.5-7**). These cover types are encompassed by the ET area boundaries within the primary GWD Project pumping basins and adjacent basins that may experience drawdown effects (**Figures 3.5-3** and **3.5-4**).

- The basin shrubland cover type is comprised of a mosaic of different plant communities, but is dominated by greasewood, low saltbush, big sagebrush, and other shrub species.
- The wetland/meadow cover type is dominated by perennial grasses, sedges, and rushes in spring-fed or sub-irrigated meadows. Also included in this cover type are riparian shrublands adjacent to the channel in Meadow Valley Wash and the Muddy River.
- Playas are classified as an ET areas but were distinguished separately because they are barren of vegetation.

- Based on an evaluation of plant rooting depth, physiological responses to drought, available information on groundwater levels, and seasonal soil moisture, an index drawdown contour of 10 feet is assumed to be a reasonable estimate of the point at which long-term changes in plant community vigor and composition would begin to appear. The model drawdown estimates include a wide range of uncertainty (see Water Resources, Section 3.3). Soil texture, soil chemistry, seasonal soil moisture, and rooting depths in these plant communities are highly variable. As a consequence of this variability, the depth index may encompass plant stress levels that would be initiated at shallower drawdown depths or stress that would be initiated at greater depths. Key references that were consulted on wetland and phreatophytic shrub rooting depths, physiological mechanisms to withstand drought, and seasonal water use from underlying soils include: Branson et al. (1976); Busch et al. (1992); Castelli et al. (2000); Hacke et al. (2000); Moreo et al. (2007); Pataki (2008); Sperry and Hacke (2002); Steinwald et al. (2006); Trent et al. (1997); Toft (1995); and Toft and Fraizer (2003).

  The vegetation composition and structure response of the Wetland/Meadow and Basin Shrubland ET areas to long-term drawdown stress is expected to vary widely depending on the underlying soil textures, chemistry, and water holding capacity; the relative influence of seasonal and annual precipitation; and the adaptations of individual species to drought stress. Furthermore, multiple sources of water likely support the Wetland/Meadow communities. These communities require high soil moisture during most of the growing season. High soil moisture can result from either 1) a shallow water table (i.e., groundwater within 1 to 3 meters of the soil surface) or 2) substantial amounts of surface flooding, either from outflow from adjacent wetlands or from surface runoff following spring snowmelt or 3) a perched water table, likely resulting from a soil layer with low permeability beneath the Wetland/Meadow communities. The primary source of water maintaining the perched water table is likely a local aquifer that may not be hydraulically connected to the more regional aquifer used for the GWD Project. These meadows also require perturbations sufficiently frequent to exclude dominance by shrubs. Common types of perturbation are high groundwater for at least six months of the year or frequent fires.

  A limited number of studies have addressed vegetation community responses to groundwater drawdown. These studies were used to develop a general plant successional sequence in response to groundwater drawdown. Relevant studies focused on vegetation community responses to groundwater drawdown in Owens Valley of California (Elmore et al. 2006, 2003; Groeneveld 1992; Manning 1999; Pritchett and Manning 2009; Sorenson et al. 1991). Other studies estimated groundwater drawdown effects on wetland and phreatophytic vegetation in the Great Basin, Arizona, and Colorado (Cooper et al. 2006; Cooper et al. 2003; Patten et al. 2008; Naumburg et al. 2005; Stromberg et al. 1996).

  The following general changes in these communities may be expected in response to a 10-foot or greater drawdown. As the soil moisture profile dries out and in response to periodic droughts, it is expected that wetland species would become less vigorous and less able to compete against upland species that are either able to spread via rhizomes or by establishment of seedlings that can gain a competitive advantage. In general, it is expected that drawdown-induced root zone stress would result in the following secondary successional sequence:

– Phase 1: A gradual decline in sedges, bulrushes, cattails, and willows that occupy saturated soil sites the majority of the year and an increase in Arctic rush, native grasses such as common reed (*Phragmites australis*), salt grass (*Distichlis spicata*), and alkali sacaton (*Sporobolus airoides*).

– Phase 2: A gradual decrease in grasses and rushes, and an increase in phreatophytic shrubs (rubber rabbitbrush, greasewood) and persistence of drought-tolerant and deep-rooted native grasses (e.g., Basin wildrye, inland saltgrass). Obligate wetland species such as spike rushes and sedges would largely disappear except in areas where year-round soil moisture remains in the root zone.

– Phase 3: A gradual decrease in grass cover and increase in phreatophytic shrub cover and dominance. Bare interspaces among shrubs would increase and some of these interspaces could be invaded by annual native and exotic species. Examples of native species include various species of goosefoot (e.g., *Chenopodium leptophylum*) and exotic species include annual grasses (e.g., cheatgrass, six-weeks fescue) and salt lover (*Halogeton glomeratus*).

– Phase 4: A gradual reduction in the dominance of deep-rooted phreatophytes (greasewood, rabbitbrush) and an increased dominance of species that rely primarily on shallow soil moisture and are more typical of upland as well as alkaline soil basin sites. Examples of adapted species include mat saltbush (*Atriplex gardneri* and *A. nuttallii*), fourwing saltbush (*A. canescens*) and shadscale on saline/alkaline soils, and sagebrush (*Artemisia tridentata* ssp.), and horsebrush (*Tetradymia canescens*) on non-saline sites. A variety of annual and perennial herbs and grasses would likely occupy the shrub interspaces. While it is expected that greasewood and rabbitbrush would remain in the community, the height and canopy of these species would decline. The endpoint of this successional sequence on non-alkaline or non-saline soils would likely be a sagebrush dominated community – these communities would most likely be found on alluvial fans and the outer margins of valley floors. The successional endpoint of valley floor communities likely would be a mix of the phreatophytic shrubs that already occur there, but at lower densities, more species of low stature saltbush species, and a higher fraction of annual native and exotic species. Invasion by annual grass species would likely increase the wildfire risk in these areas, resulting in fewer shrubs if wildfires occur.

In summary, it is expected that the herbaceous wetland ETs (primarily associated with larger valley floor spring systems) could slowly change toward dominance by phreatophytic shrubs and other species better adapted to lower surface soil moisture levels. Similarly, the areas dominated by greasewood, rabbitbrush, and big sagebrush may be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture, and are capable of withstanding extended droughts, either through complete or partial dormancy, or long-lived seeds.

- Assumptions about the potential changes in vegetation community composition and structure from groundwater pumping do not incorporate additional assumptions about the effects of climate change because the specific long-term effects of climate change are not presently known, and the incremental contribution of climate change effects to project effects cannot be reasonably estimated. A general discussion of climate change effects is provided in Section 3.1.3.2, Climate Change Effects to All Other Resources.

Methodology for Analysis

Groundwater Field Development Construction and Facility Maintenance

- The methods outlined under construction ROWs were applied to project surface development activities.

Groundwater Pumping

- Wetland/Meadow and Basin Shrubland. Vegetation communities within ET boundaries in each pumping basin were compared with the 50-foot or greater depth-to-water contours to determine if other sources of water may be sustaining these plant communities. For example, the depth to groundwater under ET vegetation areas mapped in southern Cave Valley are greater than 50 feet, indicating that these communities may be sustained by shallow impermeable soil layers that provide sufficient soil moisture to support phreatophytic shrubs. The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ETs (wetland/meadow, basin shrubland cover types) to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of

10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). Figures were generated that illustrate the expansion of the 10-foot drawdown contours over time in relation to the vegetation communities within the hydrologic ET boundaries.

- Springs and perennial stream reaches. Wetland and riparian shrubland communities have formed below many springs and along stream channels with perennial flows. These wetland and riparian communities typically occupy small areas of several acres in association with spring brook channels. These areas are important as wildlife and aquatic biota habitat and are expected to experience changes in vegetation composition toward non-wetland species over time. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as “at risk” from being affected by groundwater drawdown (Section 3.3, Water Resources). The springs included for analysis were those rated as presenting a “high” or “moderate” risk of effects. The number of springs and miles of perennial stream reaches potentially affected for each alternative over time are described in Section 3.3, Water Resources. The locations of the major spring complexes are illustrated on **Figures 3.5-3** and **3.5-4**.

3.5.2.9 Proposed Action

The construction and maintenance methods for well pad, gathering pipelines, access roads, and distribution power lines are anticipated to be the same as those described for the mainline pipeline and ancillary facilities. Effects on natural vegetation communities also would be similar, since future surface disturbance activities would occur in the same hydrologic basins where the mainline pipeline would be located. The major effect of future groundwater field development would be an expansion of surface disturbance activities over a large area within each hydrologic basin. Consequently, the ACMs for ROWs are applicable, and likely to be proposed as part of future ROW applications to the BLM. Because there is flexibility in the layout of well pads and roads, recommendations to reduce impacts are focused on opportunities to avoid sensitive areas.

Groundwater Development Area

Vegetation Community Surface Disturbance and Restoration

Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 3,530 to 8,265 acres. It is assumed that approximately 67 percent of the construction surface disturbance, or approximately 2,365 to 5,538 acres, would be committed to long-term industrial uses, and would not be revegetated during the project life. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland types would be most extensively disturbed.

Surface restoration, restoration monitoring measures, and mitigation measures are assumed to be those identified in SNWA **Appendix E**. The vegetation community recovery time frames would be the same as those described under ROW Construction and Facility Maintenance.

In its Programmatic Environmental Protection Measures, SNWA has stated that it would avoid locating well pads, collector pipelines, distribution power lines, and secondary substations in riparian and wetland areas (ACM B.1.1, B.1.3). SNWA also has committed to collocate pipelines, roads, and electrical service lines within groundwater development areas.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

There would be an expanded risk of noxious and non-native invasive weed species invasion of new, disturbed ROW.

The same target species and control methods as described under ROW Construction and Facility Maintenance would be addressed during the construction of groundwater well field facilities. Implementation of “green stripping” (ROW-VEG-1) to suppress exotic annual grasses and provide a fire resistant strip may be appropriate in many areas.

Cacti and Yucca, Special Status Plants

The same target cacti and yucca species would be salvaged in accordance with the procedures outlined in the ACMs A.1.71 through A.1.78. Yuccas and cacti would be primarily salvaged from the groundwater development areas within Dry Lake and Delamar valleys. Implementation of recommendation GWD-VEG-1 would reduce the loss of mature Joshua trees and other large yucca plants by avoiding these plants wherever possible during the access road and gathering pipeline planning process.

Accidental Wild Fires

The risks of, and control measures for, accidental wild fires would be the same as that discussed under ROWs, Proposed Action and Alternatives A through C. The risk of accidental fires is considered high within all groundwater development areas, with the highest risk in invasive exotic grass-dominated areas and sagebrush communities. Preparation and implementation of a wildfire training and response plan would provide opportunities to control small wildfires before they expand in size and to ensure worker safety (ROW-VEG-2).

Culturally Significant Plants

It is expected that project clearing and grading operations within groundwater development areas would slightly reduce the overall availability or abundance of Tribal traditional use plants that occupy upland woodland and shrubland types within project development basins. The ethnographic interviews did not reveal any highly specific plant gathering areas that would be directly affected by proposed project surface disturbance within the overall groundwater development areas.

<u>Conclusion</u>. Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 8,300 acres within five hydrologic basins. It is assumed that approximately 67 percent of the construction surface disturbance, or 5,540 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. It also is assumed that:

1) SNWA would implement its ROW ACMs, including measures for the BLM approval of successfully revegetated areas and long-term weed monitoring and control, as well as its commitment to avoid construction of groundwater development facilities in wetlands and riparian areas;
2) SNWA would identify and avoid special status plant species (including mature Joshua trees) as part of its infrastructure planning for its groundwater development; and
3) SNWA would develop emergency response plans to reduce the risk of starting accidental wildfires, as well as limiting fire spread.

Based on these measures, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities.

Proposed mitigation measures:

GW-VEG-1: Joshua Tree Avoidance. Mature Joshua trees (*Yucca brevifolia*) would be avoided to the extent possible when laying out access roads in Delamar Valley. <u>Effectiveness</u>: This measure would be moderately effective. Road alignments could be designed to minimize the loss of yuccas, but roads also must be designed with a minimal number of curves to ensure traffic safety. <u>Effects on other resources</u>: There would be no effect of implementing this measure on environmental resources.

No comprehensive ground surveys for special status plants have been completed within the various groundwater development areas. Based on reconnaissance surveys completed to date, five special status plant species have been identified in groundwater development areas adjacent to the proposed pipeline ROW. These five species have already been located within and adjacent to ROW areas. Implementation of GWD-VEG-2 would assist in avoiding special plant species individuals and populations as part of the groundwater development planning process. Additional special status species may be located within exploratory areas that have not yet been surveyed. The same avoidance and salvage methods that were discussed for the ROW construction are recommended for groundwater development areas.

GW-VEG-2: Special Status Plants. Pre-construction surveys for special status plants would be completed along all proposed groundwater development facility ROWs. Effectiveness: This measure would be moderately to highly effective, depending on the extent to which special status plant populations can be avoided during road alignment design. Effects on other resources: There would be no effect on environmental resources from implementing this measure.

Groundwater Pumping

Figure 3.5-6 illustrates the overlap of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins describing areas where surface and groundwater supply may be reduced. This includes the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches.

Full Build Out. Potential drawdown effects are predicted in central, southern, and northeastern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects in ET areas would expand across Spring Valley and would appear in southern Snake Valley near Baker, in the Big Springs Creek drainage, and northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The potential drawdown effects in ET areas would incrementally expand in the Snake Valley in the south of Eskdale and across the majority of the phreatophytic vegetation areas in northern Lake Valley.

The following vegetation community changes could occur in response to groundwater pumping, as outlined under the assumptions. The specific vegetation community responses cannot be predicted on a site-specific basis. The rate of change in plant community composition also would be highly variable, depending on groundwater drawdown rates and local water elevation recovery, as well as the influence of precipitation and overland and runoff in channels.

Wetland/Meadow

Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Based on the general successional model outlined in the assumptions, it is likely that wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Species composition could change toward dominance by phreatophytes and other species better adapted to low near-surface soil moisture. Over the long term, it is expected that areas occupied by this cover type could be invaded by basin shrubland vegetation units, or other upland vegetation types, depending on sources of surface moisture and soil chemistry (texture, salinity, and alkalinity). This successional progression is unlikely to be reversed, since it is expected that hydric soils would lose many of their wetland characteristic and would likely to become more similar to upland soils with better root zone aeration than hydric soils.

Basin Shrubland

Based on groundwater studies in other hydrologic basins, such as the Owens Valley of California, it is likely that the dominant phreatophytic shrubs (greasewood, rabbitbrush) would persist over the long term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths and lower suitability for shrub seedling re-establishment and growth. These areas could be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture and are capable of withstanding extended droughts, either through complete or partial dormancy, or long-lived seeds. It is likely that invasive annual grass species would become increasingly dominant and that the risk of wildfires also would likely increase.

Figure 3.5-6 Proposed Action Projected Drawdown Greater than 10' Phreatophytes, Springs, and Streams

Springs and Perennial Stream Reaches

The effects on vegetation dependent on spring flows would vary by the flow volume and flow persistence. Reductions in spring flow would likely reduce the length of the spring brook and reduce the area of wetland vegetation that is dependent on reliable surface and sub-surface soil moisture. Riparian shrubs (such as willows and birches) likely would decline in vigor and would eventually die in areas where groundwater elevations decline below the root zone. The majority of these spring drying effects are predicted to occur in Spring Valley. Potential pumping effects on waterbodies in the GBNP and adjacent to Utah are discussed in Aquatic Biological Resources, Section 3.7.2.

Special Status Species

To date, no Ute Ladies' – tresses orchid populations have been found in inventoried springs in Spring and Snake valleys, where potential habitats exist. If this species is discovered in potential habitats in the future, there is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

Culturally Significant Plants

Traditional use plants that are classified as wetland plants by the USACE (**Table 3.5-8**) occur in wetlands and meadows. Examples of common wetland species on the traditional use list that occur in spring meadows within the affected hydrologic basins include Arctic rush, California bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), and common reed (*Phragmites australis*) (**Table 3.5-5**). Groundwater drawdown effects on these species are generally described under the wetland/meadow ET area above and could range from small changes in species composition in areas where groundwater levels are maintained over the long term to a broad scale conversion of wetlands and meadow to dry grasslands and shrublands, with disappearance of wetland species over time. In summary, it is likely that traditional use wetland plant species occupying wetlands and sub-irrigated grasslands in Spring, Snake, and Lake valleys would become less abundant and less available over time.

ACMs. The stipulated agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of wetland/wet meadow communities, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

Present ACMs could be used to mitigate adverse effects resulting from groundwater pumping. The broad measures that are most applicable to addressing vegetation effects include: 1) geographic redistribution of groundwater withdrawals; 2) reduction or cessation of groundwater withdrawals; 3) acquisition of real property and/or water rights dedicated to the recovery of special status species within their current and historic habitat range; and 4) provision of resources to restore and enhance habitat on the Pahranagat NWR.

SNWA also has identified more specific biological, and land use and range management measures. Specific measures relevant to vegetation resources that are highly or somewhat dependent on groundwater sources include:

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.

The BLM's Snake Valley 3M Plan will include a vegetation component as part of a broader program to monitor sensitive aquatic species and sensitive wildlife species (**Appendix B**). The draft monitoring program includes the following elements: 1) identification of ecosystems and species that will be the targets for conservation efforts;

2) identification of key ecological attributes (KEAs) essential to the long-term viability of those targets; 3) identification of indicators to assess each KEA, including those that may be used to predict potential adverse effects and/or show early warning of effects from SNWA's or other groundwater development; and 4) integration of existing monitoring into this plan.

Proposed mitigation measures:

GW-VEG-3: Monitoring, Mitigation and Management Plan for Snake Valley. Mitigation measure GW-VEG-3 described below includes the vegetation resource components of the draft documents prepared by BLM during preparation of the draft EIS:

1) Monitoring, Mitigation and Management Plan for Snake Valley, Utah-Nevada; and

2) Guidance to Technical Working Group for Development of Snake Valley Monitoring, Mitigation and Management Plan.

The complete Monitoring, Mitigation, and Management (3M Plan) documents are provided in **Appendix B**.

SNWA, working in conjunction with the BLM and other DOI agencies, and with input from the States of Nevada and Utah, will develop and implement a long-term monitoring, management, and mitigation plan for Snake Valley (3M Plan) as outlined below. When the 3M Plan is fully developed, it will be comparable to the monitoring plans developed (or to be developed) under the existing stipulation agreements for other basins addressed in this EIS. The 3M Plan will reflect a staged approach to implementing monitoring, management, and mitigation activities because of the time period that may elapse between this EIS and construction and operation of groundwater infrastructure in Snake Valley. Building and implementing the various stages of the 3M Plan will be dependent upon triggers as SNWA moves closer to implementing groundwater development in Snake Valley.

The purpose of the 3M Plan is to insure that: 1) implementation of the ROD protects water dependent resources and water-related resources on public lands, 2) protects federal water rights managed by federal agencies, and 3) provides a process for mitigating impacts. To accomplish this purpose, the 3M Plan will establish a network of groundwater and surface water monitoring sites to collect baseline data and monitor the effects of groundwater development on water resources. The intent of the 3M Plan is to provide early warning of potential adverse impacts to water rights and water-dependent sensitive resources, and provide time and flexibility to implement management measures and gauge their effectiveness. Following this intent, the highest priority actions in the Snake Valley 3M Plan will be tied to predicted impacts from groundwater development, as identified in this EIS.

The 3M Plan would be required to be implemented and updated as long as SNWA maintains long-term plans to develop groundwater and remove it from Snake Valley. If SNWA terminates plans to develop groundwater from Snake Valley and the 3M Plan adopted for Spring Valley shows no interbasin effects from pumping in Spring Valley, then BLM may terminate the requirement for a Snake Valley 3M Plan.

Biology Provisions – The 3M Plan will include the following provisions for biologic monitoring and analysis**.** SNWA working with the technical working group, will be tasked with identifying the appropriate timing to commence biology activities in the 3M Plan, with regard to the time periods needed to establish baseline conditions before groundwater development commences.

- **Biological Monitoring Plan Objectives** – A detailed biological monitoring plan will be developed by SNWA, in conjunction with BLM and the technical working group to establish a monitoring program that will further the understanding of groundwater-influenced ecosystem dynamics and track biotic community responses to SNWA's groundwater withdrawal from the Snake Valley Hydrographic Basin. This monitoring will provide an early-warning indication as to whether, in combination with the hydrologic monitoring component, SNWA groundwater development in Snake Valley is, or causing, or may cause, adverse effects to groundwater-influenced ecosystems. It will also track ecosystem response as management response actions are implemented.

- **Biological Monitoring Plan Methodology** – The biological monitoring plan utilizing the Nature Conservancy's Conservation Action Planning (CAP) process, or some other similar process. This process adopted should allow the technical working group to systematically organize, incorporate, and analyze biological information for vegetation, special status species, other priority species, and their habitats for the development of the Snake Valley Biological Monitoring Plan. Specifically, the CAP, or similar, process will assist in: 1) identification of ecosystems and species that will be the targets for conservation efforts; 2) identification of key ecological attributes (KEAs) essential to the long-term viability of those targets; 3) identification of indicators to assess each KEA, including those that may be used to predict potential adverse effects and/or show early warning of effects from SNWA's groundwater development; and 4) integration of existing monitoring into this plan. Other components of the CAP process include an assessment of the current status and determination of an acceptable range of variation for attributes and indicators.
- **Biological Monitoring Plan Indicators and Parameters** – Biological monitoring will require population level monitoring of sensitive species, or their surrogates, at representative locations. Monitoring of selected KEAs will coincide with the population level monitoring to track habitat condition relative to SNWA groundwater development. KEAs will be identified based on the following criteria: 1) strongly related to the status of the groundwater-influenced ecosystem and possibly essential to its viability; 2) good indicator of ecosystem health, including those that may provide early warning of adverse impacts due to SNWA groundwater withdrawal; and 3) reasonably feasible and efficient to measure. The technical working group, through the CAP process, will determine if there will be any biological monitoring needed in Utah basins adjacent to Snake Valley to fully assess impacts to certain species.

Effectiveness: It is anticipated that the Plan would be effective in identifying early warning of potentially undesirable impacts to water-dependent resources and providing a substantial amount of time and flexibility to implement management measures and gage their effects. However, since groundwater development presumes some level of vegetation change and significant reduction in groundwater levels in some parts of Snake Valley, not all impacts would be avoided by this mitigation measure.

Conclusions and Summary

Table 3.5-14 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-14 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action

Effects/Conclusions
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long-term changes in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.
Primary Affected Valleys
• Spring, Snake, and Lake

Table 3.5-14 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Proposed Action (Continued)

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 years
Wetland/meadow ET area affected by 10 feet or greater drawdown (acres).	117	5,460	8,048
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	17,702	136,990	191,506
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	8	212	305
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or more of drawdown.	6	80	112

Potential Vegetation Effects in GBNP and adjacent Utah.

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are are described in Water Resources, Section 3.3.29. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

Stipulation Agreements

The stipulation agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified. The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Monitoring Recommendations

Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring:

- Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group, Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). Lehman and Snake Creek in GBNP and adjacent Utah.
- Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).

Mitigation Recommendations

GW-VEG-3, and 3M Plan for Snake Valley

Residual Impacts

While it is likely that some selected high value wetland areas may be maintained artificially, or pumping effects may be reduced by changes in the pumping regimes, the long-term trend is expected to be an overall plant composition change in the wetland/meadow and basin shrubland ETs toward more drought-adapted and shallow-rooted species that do not rely on near-surface groundwater across the primary pumping basins (Spring and Snake Valleys).

3.5.2.10 Alternative A

Groundwater Development Area

<u>Conclusion</u>: Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,035 to 4,732 acres within 5 hydrologic basins. It is assumed that approximately 67 percent of the construction surface disturbance, or approximately 1,363 to 3,170 acres would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. Based on SNWA ACMs and the BLM recommendations, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that reductions in special status plant populations could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/salt desert shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-7 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within ET areas are predicted in central, southern, and northern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects would expand across ET areas in southern Spring Valley and would appear in southern Snake Valley near Baker, in the Big Spring drainage, and northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET boundaries would incrementally expand in central Snake Valley, the Snake Valley east of Baker, and the northern portion of Lake Valley.

Conclusion and Summary

Table 3.5-15 provides a summary of potential vegetation community effects for three model time frames.

Figure 3.5-7 Alternative A Projected Drawdown Greater than 10' Phreatophytes, Springs, and Streams

Table 3.5-15 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative A

Effects/Conclusions

- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs.
- Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater.
- Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species.
- Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

Primary Affected Valleys

- Spring, Snake, and Lake

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/meadow ET area affected by 10 feet or greater drawdown (acres).	92	4,624	6,137
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	106,414	123,714
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	115	182
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or more of drawdown.	1	58	81

Potential Vegetation Effects in GBNP and adjacent Utah.

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.10, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

Stipulated Agreements

The stipulation agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified. The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.

Table 3.5-15 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative A (Continued)

Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). Lehman and Snake Creeks in GBNP and adjacent Utah. • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
Mitigation Recommendations
GW-VEG-1, GW-VEG-2, GW-VEG-3, and 3M Plan for Snake Valley, as listed for the Proposed Action.
Residual Impacts While it is likely that some selected high value wetland areas may be maintained artificially, or pumping effects may be reduced by changes in the pumping regimes, the long-term trend is expected to be an overall plant composition change toward more drought-adapted and shallow-rooted species that do not rely on near-surface groundwater.

3.5.2.11 Alternative B

Groundwater Development Area

Conclusions: Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 4,585 acres within 5 hydrologic basins. It is assumed that approximately 67 percent of the construction surface disturbance, or 3,072 acres would be committed to long term industrial uses, and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. Based on SNWA ACMs and the BLM recommendations, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas, and that reductions in special status plant populations could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the vegetation cover types would be affected in proportion to their relative surface area within one mile of the PODs within the five groundwater development basins. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and pinyon juniper woodland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs and perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Figure 3.5-8 Alternative B Projected Drawdown Greater than 10' Phreatophytes, Springs, and Streams

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand across central and southern Spring Valley, and would appear in southern Snake Valley near Baker, in the Big Spring drainage, northeastern Hamlin Valley, Delamar, Dry Lake, Cave, White River, and Steptoe valleys.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, the Snake Valley east of Baker, and the southern portions of Lake and Hamlin valleys.

Conclusions and Summary

Table 3.5-16 provides a summary of potential vegetation community effects for the three model time frames.

Table 3.5-16 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative B

Effects/Conclusions			
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.			
Primary Affected Valleys • Spring, Snake, and Lake			
Impact Indicators By Model Time Frame	**Full Build Out**	**Full Build Out Plus 75 Years**	**Full Build Out Plus 200 Years**
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	441	5,794	9,190
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	18,304	97,174	146,998
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	41	175	288
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	3	91	120
Potential Vegetation Effects in GBNP and adjacent Utah. The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.11, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
Stipulation Agreements The stipulation agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified. The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			

Table 3.5-16 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative B (Continued)

ACMs
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts. • 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.
Monitoring Recommendations
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). Lehman and Snake Creeks in GBNP and adjacent Utah. • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
Mitigation Recommendations
GW-VEG-1, GW-VEG-2, GW-VEG-3, and 3M Plan for Snake Valley, as listed for the Proposed Action.
Residual Impacts While it is likely that some selected high value wetland areas may be maintained artificially, or pumping effects may be reduced by changes in the pumping regimes, the long-term trend is expected to be an overall plant composition change toward more drought-adapted and shallow-rooted species that do not rely on near-surface groundwater.

3.5.2.12 Alternative C

Groundwater Development Area

Conclusion: Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 2,035 to 4,732 acres within five hydrologic basins. It is assumed that approximately 67 percent of the construction surface disturbance, or approximately 1,363 to 3,170 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodlands would require 20 to 200 years. Based on SNWA ACMs for ROWs and the BLM recommendations it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Proposed mitigation measures:

GW-VEG-1: Joshua Tree Avoidance. Mature Joshua trees (*Yucca brevifolia*) would be avoided to the extent possible when laying out access roads in Delamar Valley. Effectiveness: This measure would be moderately effective. Road alignments could be designed to minimize the loss of yuccas, but roads also must be designed with a minimal number of curves to ensure traffic safety. Effects on other resources: There would be no effect of implementing this measure on environmental resources.

GW-VEG-2: Special Status Plants. Pre-construction surveys for special status plants would be completed along all proposed groundwater development facility ROWs. Effectiveness: This measure would be moderately to highly effective, depending on the extent to which special status plant populations can be avoided during road alignment design. Effects on other resources: There would be no effect on environmental resources from implementing this measure.

Groundwater Pumping

Figure 3.5-9 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in central and southern Spring Valley. Three potentially affected springs are located in Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand around the margin of central and southern Spring Valley and would appear in southern Snake Valley near Baker and in the Big Spring drainage in Snake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in southern Spring Valley and the Big Spring drainage.

Conclusions and Summary

Table 3.5-17 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-17 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative C

Effects/Conclusions
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.
Primary Affected Valleys
• Spring, Snake, and DDC

Table 3.5-17 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative C (Continued)

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	92	2,287	3,250
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	42,703	50,076
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	63	96
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	1	37	59

Potential Vegetation Effects in GBNP and adjacent Utah.

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.12, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

Stipulation Agreements

The stipulated agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified. The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys, to benefit wildlife and reduce potential air resources impacts.
- 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Monitoring Recommendations

Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring:

- Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group, Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- Lehman and Snake Creeks in GBNP and adjacent Utah.
- Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).

Mitigation Recommendations

GW-VEG-1, GW-VEG-2, GW-VEG-3, and 3M Plan for Snake Valley, as listed for the Proposed Action.

Residual Impacts

While it is likely that some selected high value wetland areas may be maintained artificially, or pumping effects may be reduced by changes in the pumping regimes, the long-term trend is expected to be an overall plant composition change toward more drought-adapted and shallow-rooted species that do not rely on near-surface groundwater.

Figure 3.5-9 Alternative C Projected Drawdown Greater than 10’ Phreatophytes, Springs, and Streams

3.5.2.13 Alternative D

Groundwater Development Area

Conclusion: Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated maximum surface disturbance of approximately 2,470 to 3,936 acres within 4 hydrologic basins. It is assumed that approximately 67 percent of the construction surface disturbance, or approximately 1,655 to 2,637 acres would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. Based on SNWA ACMs for ROWs and the BLM recommendations, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-10 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. No potential drawdown effects within the ET area boundaries are predicted in this time frame.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would occur in southern Spring Valley and in northeastern Hamlin Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand northward in southern Spring Valley, across northern Lake Valley, and within the Big Spring drainage in Snake Valley.

Conclusions and Summary

Table 3.5-18 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-18 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative D

Effects/Conclusions
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.
Primary Affected Valleys
• Spring, Snake, Hamlin, and DDC

Table 3.5-18 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative D (Continued)

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	0	1,507	4,453
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	0	16,747	81,349
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	1	41	123
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	0	4	48
Potential Vegetation Effects in GBNP and adjacent Utah. The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.13, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on streamflows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.			
Stipulation Agreements The stipulation agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified (**Appendix C**). The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.			
ACMs			
• ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community. • ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake Valley to benefit wildlife and reduce potential air resources impacts. • 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles, and then diverting the saved water to the wet meadow areas.			
Monitoring Recommendations			
Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring: • Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group, Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009). • Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).			
Mitigation Recommendations			
GW-VEG-1, GW-VEG-2, GW-VEG-3, and 3M Plan for Snake Valley, as listed for the Proposed Action.			
Residual Impacts While it is likely that some selected high value wetland areas may be maintained artificially, or pumping effects may be reduced by changes in the pumping regimes, the long-term trend is expected to be an overall plant composition change toward more drought-adapted and shallow-rooted species that do not rely on near-surface groundwater.			

Figure 3.5-10 Alternative D Projected Drawdown Greater than 10’ Phreatophytes, Springs, and Streams

3.5.2.14 Alternative E

Groundwater Development Area

Conclusions: Construction of well pads, access roads, gathering pipelines, and electrical service lines would result in an estimated surface disturbance of approximately 1,725 to 3,987 acres within 4 hydrologic basins. It is assumed that approximately 67 percent of the construction surface disturbance, or approximately 1,156 to 2,671 acres, would be committed to long-term industrial uses and would not be revegetated during the project life. Vegetation restoration times for shrublands and woodland would require 20 to 200 years. Based on SNWA ACMs for ROWs and the BLM recommendations, it is expected that natural vegetation composition and cover could be restored within the time frames for plants growing in adjacent undisturbed areas and that effects on special status plants could be minimized. There would be a small incremental reduction in the availability of Tribal traditional plants within the hydrologic basins occupied by groundwater development facilities. No specific development plans are available, so it is assumed that the habitat cover types would be affected in proportion to their relative surface area within the groundwater development areas. Consequently, it is expected that sagebrush shrubland, greasewood/saltbush shrubland, and Mojave mixed desert shrubland vegetation types would be most extensively disturbed.

Groundwater Pumping

Figure 3.5-11 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within ET area boundaries are predicted in small areas within central and southern Spring Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand in southern, central, and northern Spring Valley, and in northern Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in central and southern Spring Valley, and across northern Lake Valley.

Conclusions and Summary

Table 3.5-19 provides a summary of potential vegetation community effects for three model time frames.

Table 3.5-19 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E

Effects/Conclusions
• Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result a long change in plant species composition in the Wetland/Meadow ET area from wetland species such as rushes, sedges, and grasses, to upland species of grasses and shrubs. • Groundwater drawdowns from pumping (index of 10 feet or greater) would likely result in lower densities of phreatophytic shrubs such as greasewood and an increase in upland species of grasses and shrubs that are not completely, or partially dependent on reliable sources of groundwater. • Groundwater drawdowns from pumping (index of 10 feet or greater) and changes in spring flows would likely increase stress on spring-fed aquatic vegetation and riparian shrubs. If these water sources dried up over a long period of time (5 years or more), it is likely these communities would not recover and vegetation community composition would change to upland species. • Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.
Primary Affected Valleys
• Spring, Lake, Hamlin, and DDC

Table 3.5-19 Summary of Vegetation Resource Impacts, Applicant-committed Protection Measures, and Monitoring and Mitigation Recommendations for Alternative E (Continued)

Impact Indicators By Model Time Frame	Full Build Out	Full Build Out Plus 75 Years	Full Build Out Plus 200 Years
Wetland/Meadow ET area affected by 10 feet or greater drawdown (acres).	92	2,548	3,835
Basin shrubland ET area affected by 10 feet or greater drawdown (acres).	12,059	71,429	81,389
Total number of springs with moderate to high risk of being affected by 10 feet or more of drawdown (number).	3	55	104
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	1	7	23

Potential Vegetation Effects in GBNP and adjacent Utah.

The streams and springs within GBNP and adjacent Utah that may be affected by 10 foot drawdown or greater are discussed in Section 3.3.2.14, Water Resources. Riparian and herbaceous wetland vegetation communities that depend on stream flows may be stressed by future flow reductions and these riparian plant communities may progressively change toward more of an upland species composition.

Stipulation Agreements

The stipulation agreements for Spring and DDC valleys specify the development of monitoring programs to identify ecosystem component changes and an adaptive management framework to respond to changes identified. The mitigation efforts would be focused primarily on the protection and maintenance of springs, streams, ponds, wetlands, meadows, swamp cedars, and phreatophytic shrublands, since these communities are dependent on reliable sources of shallow groundwater in the root zone.

ACMs

- ACM C.2.4 – Prepare an ecological study of the Spring Valley swamp cedars to determine groundwater elevation requirements necessary to maintain a viable community.
- ACM C.2.5 – Conduct large-scale seeding to assist with vegetation transition from phreatophytic communities in Spring and Snake valleys to benefit wildlife and reduce potential air resources impacts.
- 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 could be accomplished by changing crop production to a less water-intensive type or changing water cycles and then diverting the saved water to the wet meadow areas.

Monitoring Recommendations

Based on anticipated drawdown effects, the following areas should be considered for vegetation community monitoring:

- Minerva Spring Complex, Swallow Spring, Shoshone Ponds, and the springbrook from Shoshone Ponds Well #2 in southern and central Spring Valley. Of this group, Minerva Spring Complex, Swallow Spring, and Shoshone Ponds, as well as the wetlands and meadows surrounding Minerva Springs and Shoshone Ponds (including in the Shoshone Ponds ACEC), are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- Springs and associated wetlands and meadows along the west side of Spring Valley north of Cleve Creek. West Spring Valley Spring Complex and Keegan Spring Complex, including associated wetlands and meadows, are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- The Big Spring drainage in Snake Valley in Nevada and Utah. Big Springs, Big Spring Creek, Lake Creek, Stateline Springs and Clay Spring (North) are being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).
- Swamp Cedar and Baking Powder Flat Blue ACECs. The swamp cedar population in the vicinity of the Swamp Cedar ACEC is being monitored under the Biological Monitoring Plan for the Spring Valley Stipulation (Biological Work Group 2009).

Mitigation Recommendations

GW-VEG-1, GW-VEG-2, GW-VEG-3, and 3M Plan for Snake Valley, as listed for the Proposed Action.

Residual Impacts

While it is likely that some selected high value wetland areas may be maintained artificially, or pumping effects may be reduced by changes in the pumping regimes, the long-term trend is expected to be an overall plant composition change toward more drought-adapted and shallow-rooted species that do not rely on near-surface groundwater.

Figure 3.5-11 Alternative E Projected Drawdown Greater than 10' Phreatophytes, Springs, and Streams

3.5.2.15 No Action

Groundwater Development Area

Conclusion: Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by Great Basin Park General Management and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Figure 3.5-12 illustrates the expansion of the 10-foot drawdown contour from existing pumping in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface water and groundwater supply may be reduced.

Full Build Out. Potential drawdown effects within the ET area boundaries are predicted in Lake Valley.

Full Build Out Plus 75 Years. The potential drawdown effects within the ET area boundaries would expand northward in Lake Valley.

Full Build Out Plus 200 Years. The 10-foot drawdown area within the ET area boundaries would incrementally expand in northern Lake Valley and a small area in southern Spring Valley.

3.5.2.16 Comparison of Alternatives

Table 3.5-20 provides a summary of impact indicators for the Proposed Action and Alternatives A through E.

Table 3.5-20 Summary of Vegetation Resource Impacts – Proposed Action, Alternatives A through E Pumping

Impact Information	Impact Indicators (three model periods)	Proposed Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Wetland/Meadow ET unit area affected by 10 feet or greater draw down (acres)	FBO[1]	117	92	441	92	0	92
	FBO + 75 Years[2]	5,460	4,624	5,794	2,287	1,507	2,548
	FBO + 200 Years[3]	8,048	6,137	9,190	3,250	4,453	3,835
Basin shrub ET unit area affected by 10 feet or greater draw down (acres)	FBO[1]	17,702	12,059	18,304	12,059	0	12,059
	FBO + 75 Years[2]	136,990	106,414	97,174	42,703	16,747	71,429
	FBO + 200 Years[3]	191,506	123,714	146,998	50,076	81,349	81,389
Total number of springs with moderate to high risk of being affected by 10 feet or greater drawdown	FBO[1]	8	3	41	3	1	3
	FBO + 75 Years[2]	212	115	175	63	41	55
	FBO + 200 Years[3]	305	182	288	96	123	104
Total miles of perennial streams with moderate to high risk of being affected by 10 feet or greater drawdown	FBO[1]	6	1	3	1	0	1
	FBO + 75 Years[2]	80	58	91	37	4	7
	FBO + 200 Years[3]	112	81	120	59	48	23

[1] Full Build Out.

[2] Full Build Out Plus 75 Years.

[3] Full Build Out Plus 200 Years.

Figure 3.5-12 No Action Projected Drawdown Greater than 10’ Phreatophytes, Springs, and Streams

3.5.3 Cumulative Impacts

3.5.3.1 Issues

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- Short-term, long-term, and permanent changes in vegetation community structure and composition (due to surface disturbance and conversion of natural vegetation to industrial uses) as a result of construction-related activities and operational maintenance.
- Potential introduction or population expansion of noxious and non-native invasive weeds due to surface disturbance.
- Loss of individuals or populations of federally listed, candidate, or special status plant species (including cacti and yucca) due to surface disturbance.
- Accidental wildfires caused by construction equipment or smoking during construction and operation.
- Availability of plant species traditionally used for food and fiber by regional Tribes.

Groundwater Pumping

- Short-term, long-term, and permanent changes in vegetation community structure and composition (including spring-fed wetlands and riparian areas) and special status plant species populations due to groundwater drawdown.
- Changes in the availability of groundwater dependent plant species traditionally used for food and fiber by regional Tribes in relation to groundwater drawdown.

3.5.3.2 Assumptions

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- Study Area. The study area is the proposed ROW project surface disturbance area (pipelines, power facilities, and roads) for each project alternative plus the total project surface disturbance estimate (well pads, roads, gathering pipelines, power lines) within groundwater development areas within each hydrologic basin. The overall rationale for this cumulative study area is that the majority of the changes in vegetation communities occur within areas where vegetation has been cleared and reseeded, while recognizing that future plant species composition changes can occur in plant communities adjacent to the ROW from the dispersal of seeds by wind and water, as well as seed consuming animals. For ROWs, a buffer of 500 feet was evaluated to account for the potential influence of adjacent or other nearby surface disturbance activities, and account for possible project effects outside the construction ROWs. For groundwater development areas, the presence of Past and Present Actions and RFFAs within the overall groundwater development area boundaries within each hydrologic basin was used as the basis for evaluating potential additive cumulative effects.
- Time frames. Effects time frames range from 2 to 5 years after surface disturbance initially occurs for herbaceous components, to 200 years, which is the estimated time for larger woody species (junipers, pinyon pine, Joshua trees) to recover to their former density and size.
- The Past and Present Actions footprints are based on utility ROWs and other surface disturbance activities identified in the BLM database and other databases (Section 2.8.1, Past and Present Actions).
- The reasonably foreseeable actions and activities are discussed Section 2.8, Agency Preferred Alternative. No cumulative effects related to surface development activities are anticipated outside hydrologic basins occupied by project water development and conveyance facilities.

Groundwater Pumping

- Study area. The study area is the boundary for the groundwater model simulations (**Figure 3.0-2**).
- Time frames. Effects time frames range from full build out of the entire project (approximately 2050) to full build out plus 200 years.
- A groundwater depth 50 feet or deeper in relation to the ground surface elevation is not accessible to the roots of nearly all phreatophytic shrubs and this groundwater depth represents a reasonable boundary for: 1) estimating the

deepest root zone extent of plant communities that are at least partially dependent on underlying groundwater; and 2) defining a groundwater drawdown boundary that assumes that the roots of overlying plant communities no longer have access to groundwater as a moisture source at depths greater than 50 feet.

- The ET areas mapped for each hydrologic basin as part of the water balance estimates (Section 3.3, Water Resources) represent the primary cover types that would be affected by drawdown over large areas within hydrologic basins. These ET areas are mapped as Wetland/Meadow and Basin Shrubland cover types.
- Based on an evaluation of plant rooting depth, physiological responses to drought, available information on groundwater levels and seasonal soil moisture, an index drawdown contour of 10 feet is assumed to be a reasonable estimate of the point at which long term changes in plant community vigor and composition would begin to appear. The expected responses of the Wetland/Meadow and Basin Shrubland are the same as those described for the project alternatives (Section 3.5.2.8).
- Spring-fed meadows and riparian areas represent small areas within hydrologic basins and are best discussed by individual springs or by perennial stream reaches. The springs and perennial stream reaches of vegetation effects concern are the high and moderate risk water sources as defined in Section 3.3, Water Resources.

3.5.3.3 Methodology for Analysis

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

- The cumulative surface disturbance effects to vegetation communities by hydrologic basin were estimated by overlaying the existing surface disturbances for Past and Present Actions and RFFAs and the development areas for the project alternative being evaluated. The estimated cumulative surface disturbance was then compared with the overall area of the hydrologic basin affected. Potential effects on vegetation communities that occupy relatively small areas within individual basins, such as wetlands, were considered.
- The cumulative surface disturbance effects to special status species (including cacti and yucca) were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of special status plants to provide a risk assessment for future effects on these species.
- The cumulative noxious and invasive species invasion risks were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the currently known distribution of noxious and invasive plant species. The risks of weed invasion were estimated from field surveys conducted by SNWA and from a weed occurrence data based maintained by the BLM Ely Field Office.
- The cumulative accidental wildfire risks were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation the relative susceptibility of various natural plant communities to wildfires.
- The potential cumulative changes in the availability of plants traditionally used for food and fiber by regional tribes were estimated from evaluating the cumulative vegetation community surface disturbance footprint in relation to the habitat requirements of food and fiber plants.

Groundwater Pumping

- Wetland/Meadow and Basin Shrubland. The area enclosed by the maximum extent of the 10-foot drawdown contour was superimposed over the area of the primary ET areas (wetland/meadow, basin shrubland cover types) to calculate the area of vegetation that could experience reductions in soil moisture and long-term vegetation community composition changes caused by groundwater drawdown of 10 feet or more at different points in time (full build out, full build out plus 75 years, and full build out plus 200 years). The cumulative analysis focuses on those basins with the primary ET areas that were predicted to be affected by each alternative. Figures were generated that illustrate the expansion of the 10-foot and greater drawdown contours over time in relation to the vegetation communities within the hydrologic ET boundaries. The figures depict the incremental effect of each alternative on vegetation resources in combination with other cumulative pumping actions.
- Springs and perennial stream reaches. The 10-foot drawdown index was applied to the springs and perennial stream reaches that were classified as being at risk from being affected by groundwater drawdown (Section 3.3). The springs included for analysis were those rated as presenting a “high” or “moderate” risk of effects. The number of springs and miles of perennial stream reaches potentially affected were enumerated for each alternative over time from the modeling results. The locations of the major spring complexes are illustrated on the same

figures as the ETs (**Figures 3.5-3** and **3.5-4**). The number of springs, and miles of perennial stream reaches potentially affected were graphed for each alternative over time from the modeling results.

3.5.3.4 No Action

Groundwater Development

Under the No Action Alternative, the proposed project would not be constructed or maintained. No project-related surface disturbance would occur. Vegetation communities would continue to be influenced by natural events such as drought, fire, and land use activities such as grazing and existing water diversions. Management activities on public lands will continue to be directed by the Ely and Las Vegas RMPs, which involve measures to maintain natural vegetation communities. Management guidance for other public lands in the project study area would be provided by GBNP General Management Plan and the Forest Plan for the Humbolt-Toiyabe National Forest.

Groundwater Pumping

Figure F3.5-1 illustrates the expansion of the 10-foot drawdown contour from existing pumping in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. The following is a summary of the incremental expansion of the groundwater drawdown area over time across the primary pumping hydrologic basins where the majority of the ET area (which encompasses basin shrubland and wetland/meadow cover types), as well as springs and perennial stream reaches whose surface and groundwater supply may be reduced (**Table 3.5-21**).

Table 3.5-21 No Action – Summary of Potential Cumulative Vegetation Effects Over Three Time Periods

Parameter	Full Build Out Plus 75 years	Full Build Out Plus 200 years
Wetland/Meadow ET (acres)	1,697	3,452
Basin shrubland (acres)	43,290	53,586
Springs potentially affected in all hydrologic basins (number)	19	28
Springs potentially affected in GBNP (number)	0	0
Springs potentially affected in Utah (number)	0	0
Streams potentially affected in all hydrologic basins (miles)	42	79

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Lake, Patterson, Clover, and Dry Lake valleys and Lower Meadow Valley Wash. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term orchid population viability.

3.5.3.5 Proposed Action

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

Vegetation Community Surface Disturbance and Restoration

Past and Present Actions consist primarily of existing roads, energy utility corridors, mining districts, and recent wildfires (**Figure 2.9-1**). Other activities that have influenced vegetation community composition and area include livestock grazing over nearly all public lands and the development of towns and rural communities (Ely, McGill, Baker, Garrison, Pioche, and Panaca). The primary future actions consist of construction of new utilities (pipelines and electrical distribution lines), roads and turbine pads for wind energy projects, which would be located in Spring and Lake valleys. The total estimated surface area disturbance for construction and maintenance of the main pipeline and ancillary facilities, plus the anticipated groundwater development facilities would be up to 20,570 acres. As described previously, the primary vegetation types that would be cleared, and then restored are greasewood/salt desert shrubland, sagebrush shrubland, and Mojave mixed desert scrub.

Cumulative Effects. The GWD Project surface disturbance (20,570 acres) would potentially overlap with Past and Present Actions and RFFAs (**Figure 2.9-1**) in all hydrographic basins.

The GWD Project would occupy the LCCRDA utility corridor from Lake Valley on the north to Garnet Valley on the south. The GWD Project would share the LCCRDA corridor with other projects as follows:

Project	Lake Valley	Dry Lake	Delamar	Pahranagat	Coyote Spring	Garnet
Past and Present Actions						
Existing Transmission Line (s)	X	X	X	X	X	X
U.S. Highway 93	X			X	X	
Proposed Project and Reasonably Foreseeable Future Actions						
GWD Project	X	X	X	X	X	X
ON Line Transmission Line	X	X	X	X	X	X
Wilson Creek Wind Project	X	X				
Eastern Nevada Transmission Line					X	X

The major additive cumulative effects within the LCCRDA corridor would be the expansion of ROW surface disturbance that would be reclaimed, the permanent addition of new service access roads within the corridor, the permanent addition of high voltage transmission line structures and conductors, and the fragmentation of native vegetation communities until they recover (5 to 200 years, depending on the vegetation community). It is not expected that cumulative development would substantially expand the surface disturbance of wetlands and riparian areas, based on the very small (11 acres) of these cover types by the GWD Project.

The GWD Project groundwater development area in northern Spring Valley would overlap with the Spring Valley Wind Project near the intersection of Highway 93 and Highway 6 and 50 west of Great Basin National Park . The GWD would add access roads, water gathering pipelines, and electrical service to well sites with areas currently proposed for electrical generation turbines. Because the specific locations of GWD Project wells have not determined, there are opportunities to share the wind energy project road system to reduce the cumulative surface disturbance footprint of the two projects.

Spread and Introduction of Noxious and Non-native Invasive Weed Species

Past and Present Actions include the historical introductions of at least 14 noxious and non-native weed species into nearly all the hydrologic basins that would be occupied by GWD Project components. Sources of weed introduction include seeds spread along railroads and highways and contaminated hay delivered to farms and livestock feed grounds over wide areas. Weed seeds then are spread by wind, water, livestock grazing, and seed eating wild animals over large areas. Some weeds that propagate by rhizomes have spread on the muddy wheels of farm and excavation machinery and from harvest and distribution of food crops harvested from soil such as potatoes. The RFFAs (renewable energy projects, electrical transmission lines, and other utilities) will disturb new areas of native vegetation, creating new opportunities for weed invasion and spread into recently disturbed ROWs and along new roadways that are periodically maintained. The GWD Project also would require surface disturbance for new ROWs in previously undisturbed native communities, particularly in the groundwater development basins (Spring, Snake, and DDC valleys).

Cumulative Effects. The locations where there would be the greatest risk of expanded additive weed invasion would be in areas where new ROWs intersect with or parallel older ROWs where weeds may already be established. These intersections include roads, utility corridors, gravel pits, and mines. There are almost no crossings of agricultural lands, so weeds associated with cultivated fields represent a very low risk. The GWD Project would intersect multiple primary and secondary roads in all hydrologic basins and would parallel an existing utility corridor from southern Lake Valley to the vicinity of Apex in Clark County. The GWD Project would likely intersect service roads for the Spring Valley Wind Project in Spring Valley. It is anticipated that all projects proposed on BLM lands would be required to identify and control noxious and invasive weed species; these requirements on new projects would likely limit the spread of weeds along new ROWs.

Cacti and Yucca, Special Status Plants

Past and Present Actions include the construction and maintenance of utility and highway ROWs that cross cacti and yucca habitats in Las Vegas, Garnet, Coyote Springs, Delamar, and southern Dry Lake valleys in Clark and Lincoln counties. The GWD Project facilities would be located in an existing utility corridor (LCCRDA) from the vicinity of Apex in Clark County to southern Dry Lake Valley in Lincoln County, with groundwater development facilities in Delamar Valley. It is estimated that the GWD Project would remove cacti and yucca from more than 3,000 acres in these valleys. A large fraction of these plants would be replanted in the disturbed ROWs.

Populations of special status plants including Parish's phacelia and Blaine pincushion cactus were identified in Dry Lake Valley; Eastwood milkvetch was identified in Dry Lake Valley; and Long calyx milkvetch was identified in Spring Valley. These species were identified during ROW surveys conducted by SNWA and additional populations of these species may be found over a larger area as the result of future surveys. A reasonably foreseeable project that could encompass populations of the Parish's phacelia, Blaine pincushion cactus, and Eastwood milkvetch is the ON Transmission Project that will use the LCCRDA and other utility corridors from Dry Lake Valley to Delamar Valley. Populations or individuals of these species were found in and adjacent to GWD Project ROWs.

Cumulative Effects. There would be an additive reduction in cacti and yucca populations within existing utility corridors, combined with surface disturbance from proposed new renewable energy projects and transmission lines and GWD Project facilities in Garnet, Coyote Springs, and Delamar valleys. It is anticipated that recovery of yucca and cacti would require many years (up to 200 years for mature Joshua trees). It is likely that there would be an additive reduction in special status plant species in Dry Lake, Muleshoe, and Spring valleys. These reductions are not likely to result in federal listing of these species, since they occur in other regional hydrologic basins.

Accidental Wildfires

There have been several recent large wildfires in southeastern Lincoln County. The source of most of these fires is lightning. The risk of accidental fires from project activities will always be present when heavy machinery is working across natural landscapes. However, this risk is site- or project-specific and not cumulative, since different projects will be constructed at different time frames and different locations. Past and Present Actions shown in **Figure 2.9-1** includes areas affected by wildfire.

Culturally Significant Plants

Cumulative Effects. Traditional use plants occur in the vegetation types that extend across all the hydrologic basins that have been affected by Past and Present Actions and would be affected by RFFAs and the proposed GWD Project facilities. As described for vegetation community surface disturbance and restoration, there would be a cumulative additive increase in vegetation surface disturbance on a regional basis. This surface disturbance would likely cause a reduction (estimated to be 1 percent or less) in the availability of traditional use plants within native plant communities.

Groundwater Pumping

Past and Present Actions are represented by the No Action pumping operations described in Section 3.3, Water. The cumulative past and present groundwater uses are presented on **Table 2.9-2**. The RFFAs are described in **Table 2.9-3**. The following discussions are based on an interpretation of the groundwater model simulations that predict groundwater drawdown elevations and changes in flow in springs and perennial stream reaches.

Figure F3.5-3 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-13** and **3.5-14** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk from the Proposed Action pumping operations. These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the Proposed Action may have a potential impact have been included in the analysis, and include (north to south): Steptoe, Hamlin, Spring, Snake, Lake valleys, and Lower Meadow Valley Wash.

Cumulative acres of potential root zone soil moisture stress from drawdown for basin shrubland and wetland/meadow ET areas have been graphed by hydrologic basin (**Figure 3.5-15** and **Figure 3.5-16**). These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the proposed action are may have a potential impact have been included in the analysis, and include (north to south): Steptoe, Hamlin, Spring, Snake, Lake, and Lower Meadow. Based on this analysis, the following conclusions were made:

- Steptoe Valley - The Proposed Action would not directly contribute to either basin shrubland or wetland meadow drawdown effects. The cumulative effects on these communities would result from cumulative pumping with No Action.
- Hamlin Valley – The Proposed Action would potentially cause relatively low levels of drawdown effects to both basin shrubland (3,065 acres) and wetland/meadow (154 acres) communities. The adverse effects on these communities would occur during the two later (full build out plus 75 years, full build out plus 200 years) model periods. The impact parameters indicate that the Proposed Action would contribute all of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin.

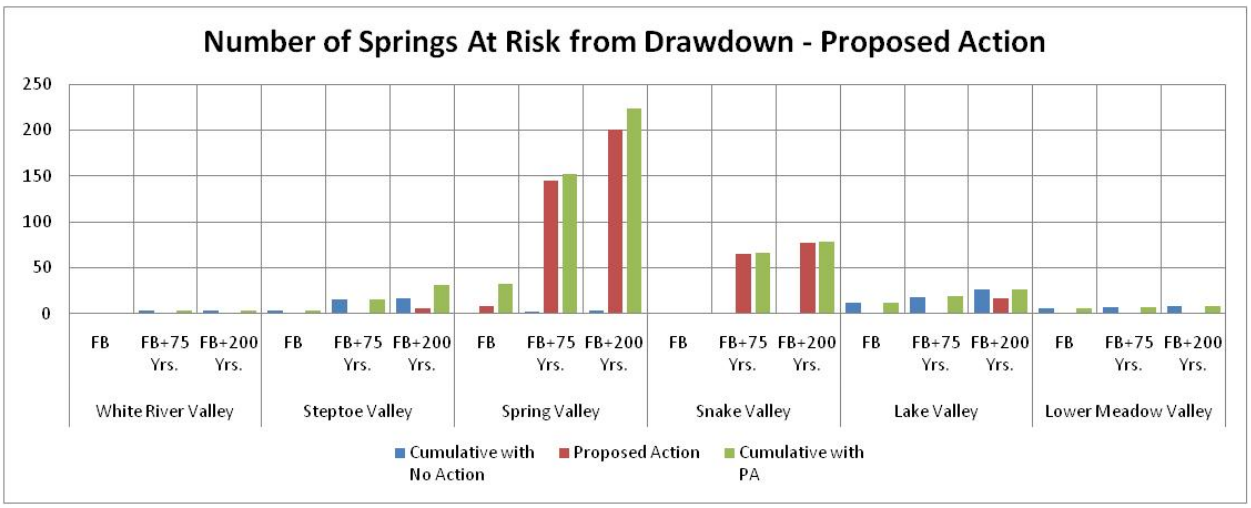


Figure 3.5-13 Number of Springs At Risk from Drawdown, Proposed Action

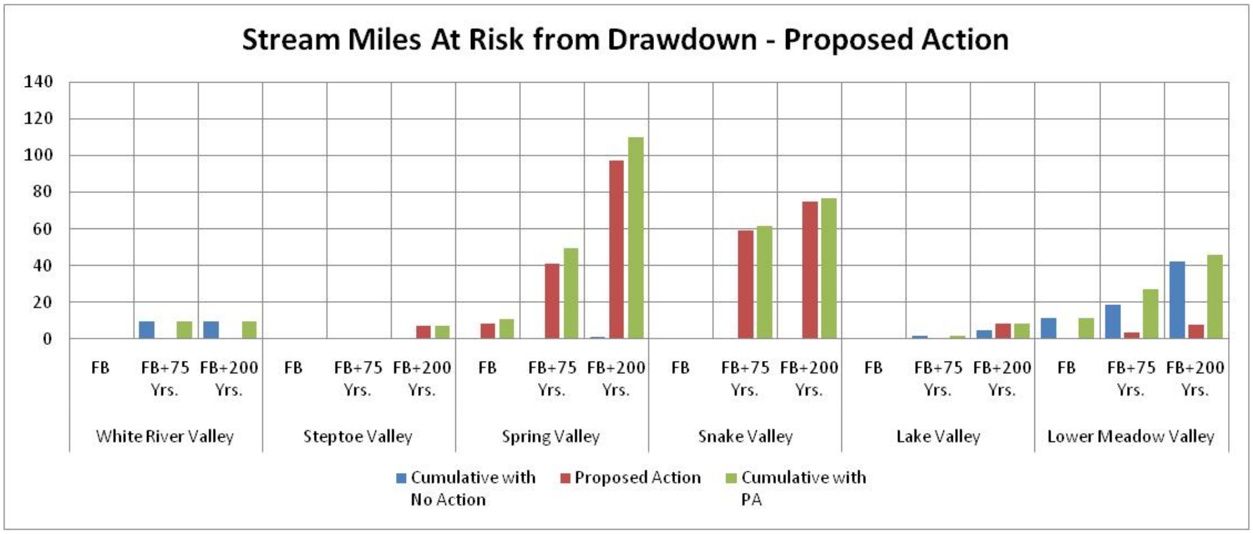


Figure 3.5-14 Stream Miles At Risk from Drawdown, Proposed Action

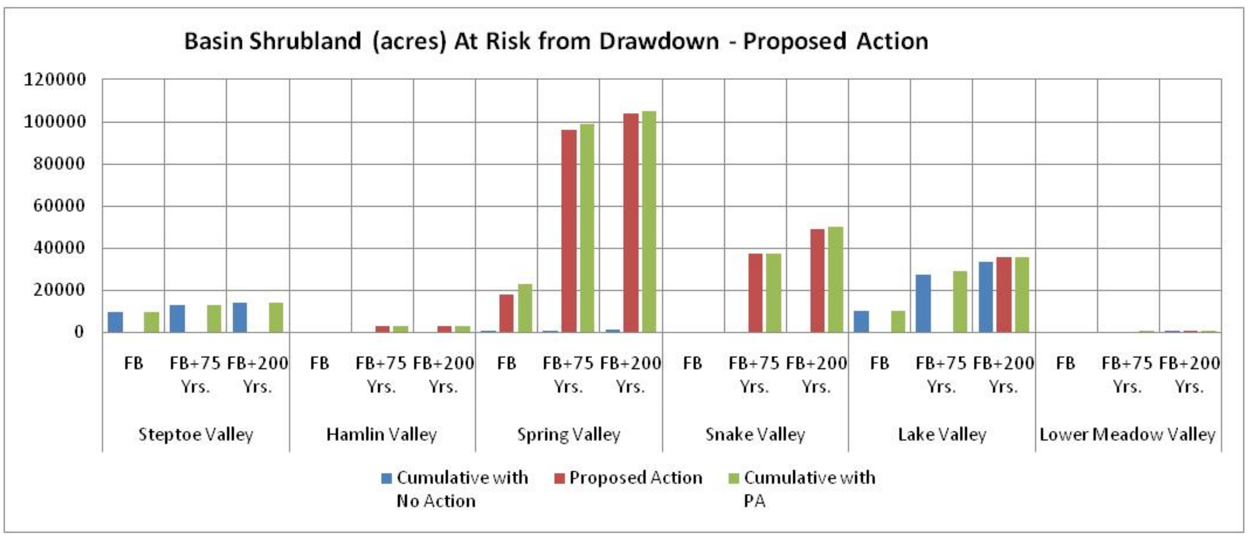


Figure 3.5-15 Basin Shrubland At Risk from Drawdown, Proposed Action

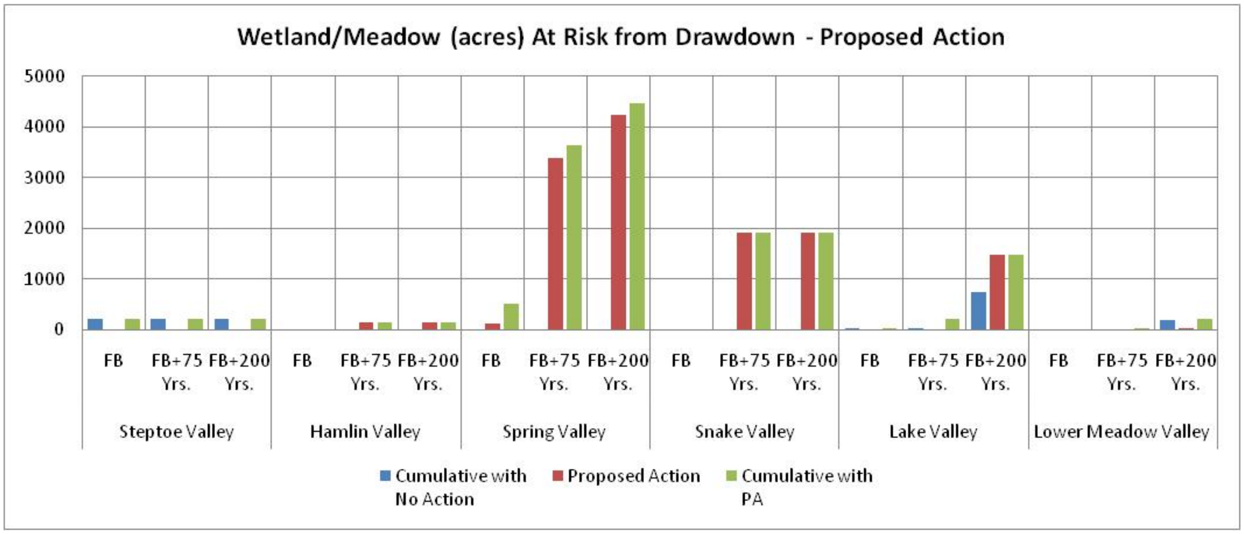


Figure 3.5-16 Wetland/Meadow At Risk from Drawdown, Proposed Action

- Spring Valley – The Proposed Action would potentially cause substantial drawdown effects to both basin shrubland and wetland/meadow communities. The adverse effects on these communities would occur in all three model periods. The impact parameters indicate that the Proposed Action would contribute most of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin. In total, the Proposed Action would affect a maximum of 103,798 acres of basin shrubland and 4,252 acres of wetland/meadow over the three model periods.
- Snake Valley – The Proposed Action would potentially cause substantial drawdown effects to both basin shrubland and wetland/meadow communities. The adverse effects on these communities would occur in all three model periods, though the greatest potential impacts would occur during the full build out plus 75 years and full build out plus 200 years model time frames. The impact parameters indicate that the Proposed Action would contribute to all of the incremental cumulative effects on basin shrubland and wetland/meadow communities in this basin. In total, the Proposed Action would affect 49,068 acres of basin shrubland and 1,927 acres of wetland/meadow for the three model periods.
- Lake Valley – The Proposed Action would potentially cause some drawdown effects to both basin shrubland (35,497 acres) and wetland/meadow (1,486 acres) communities in this basin. The drawdown effects on these communities would occur during the final (full build out plus 200 years) model period. Potential impacts during earlier modeling periods would result from cumulative pumping with No Action, particularly for basin shrubland communities.
- Lower Meadow Valley Wash – The Proposed Action would potentially cause very low levels of potential disturbance to both to basin shrubland (56 acres) and wetland/meadow (26 acres) community types. The drawdown effects on these communities would occur during the final (full build out plus 200 years) model period. The cumulative effects on these communities would result largely from cumulative pumping with No Action.

The following vegetation community changes could occur in response to groundwater pumping, as outlined under the assumptions. The specific vegetation community responses cannot be predicted on a site-specific basis. The rate of change in plant community composition also would be highly variable, depending on groundwater drawdown rates and local water elevation recovery, as well as the influence of precipitation, overland flows, and runoff in channels.

Wetland/Meadow

Plant species in vegetation communities that are directly dependent on perennial spring and stream flows would experience the greatest potential change in plant species composition. Based on the general successional model outlined in the assumptions, it is likely that wetland communities consisting of sedges, rushes, and cattails would progressively change toward a community dominated by deep-rooted grasses. The overall surface area occupied by wetland species would decrease, with persistence only in areas that continue to receive sufficient surface and groundwater for long-term survival. Species composition could change toward dominance by phreatophytes and other species better adapted to low near-surface soil moisture. Over the long-term, it is expected that areas occupied by this cover type could be invaded by basin shrubland vegetation units or other upland vegetation types, depending on sources of surface moisture and soil chemistry (texture, salinity, and alkalinity). This successional progression is unlikely to be reversed, since it is expected that hydric soils will lose many of their wetland characteristics and would likely to become more similar to upland soils with better root zone aeration than hydric soils. Included in this affected area are the swamp cedar areas in central and southern Spring Valley. Also included is the Lower Moapa Area, where riparian vegetation that is at least partially dependent on groundwater sources is present.

Basin Shrubland

Based on groundwater studies in other hydrologic basins, it is likely that the dominant phreatophytic shrubs (greasewood, rabbitbrush) would persist over the long-term, but potentially at lower densities and vigor as the result of reduced availability of soil moisture at greater depths and lower suitability for shrub seedling re-establishment and growth. These areas could be invaded by shrubs, herbs, and grasses that are adapted to seasonal shallow soil moisture and are capable of withstanding extended droughts, either through complete or partial dormancy or long-lived seeds. It is likely that invasive annual grass species would become increasingly dominant and the risk of wildfires also would likely increase. Included in this drawdown area is the habitat for the Baking Powder Flat Blue butterfly, which is protected within a BLM ACEC in central Spring Valley.

Springs and Perennial Stream Reaches

The effects on vegetation dependent on spring flows would vary by the flow volume and persistence. Reductions in spring flow would reduce the length of the spring brook and reduce the area of wetland vegetation that is dependent on reliable surface and sub-surface soil moisture. Riparian shrubs (such as willows and birches) would likely decline in vigor and would eventually die in areas where groundwater elevations decline below the root zone. The majority of these spring drying effects are predicted to occur in Spring Valley.

Special Status Species

To date, no Ute ladies'-tresses orchid populations have been found in inventoried springs in Spring and Snake valleys, where potential habitats exist. Predicted drawdowns in the Panaca Valley affecting up to eight springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability

Culturally Significant Plants

Traditional use plants that are classified as wetland plants by the USACE (**Table 3.5-8**) occur in wetlands and meadows. Examples of common wetland species on the traditional use list that occur in spring meadows within the affected hydrologic basins include Arctic rush (*Juncus balticus*), California bulrush (*Schoenoplectus californicus*), cattail (*Typha latifolia*), and common reed (*Phragmites australis*) (**Table 3.5-5**). Groundwater drawdown effects on these species are generally described under the wetland/meadow ET above, and could range from small changes in species composition in areas where groundwater levels are maintained over the long term to a broad scale conversion of wetlands and meadow to dry grasslands and shrublands, with disappearance of wetland species of time. In summary, it is likely that traditional use wetland plant species occupying wetlands and sub-irrigated grasslands in Spring, Snake, and Lake valleys would become less abundant and less available over time.

3.5.3.6 Alternative A

Rights-of-way and Groundwater Field Development Construction and Operational Maintenance

The Alternative A surface disturbance (up to 17,035 acres) would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties, and would intersect service roads for future wind energy projects in Spring and Dry Lake valleys. Cumulative effects on vegetation include:

- Fragmentation of natural vegetation communities where GWD Project facilities parallel existing utility ROWs or intersect with existing and new roads;
- An additive risk of expanded weed invasion where new ROWs intersect with or parallel older ROWs where weeds may already be established;
- An overall reduction in populations of yucca and cacti as the result of the expansion of existing utility corridors and new renewable energy projects in Coyote Springs and Delamar valleys;
- A potential reduction in special status plant species populations in Dry Lake, and Spring valleys from additional linear projects in utility corridors and construction of a wind energy project; and
- An overall reduction in the availability of Tribal traditional use plants as the result of additive vegetation surface disturbance across all GWD Project hydrologic basins.

Groundwater Pumping

Figure F3.5-4 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figure 3.5-17** and **Figure 3.5-18** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk from drawdown from Alternative A operations. These figures include impact parameter information for cumulative with No Action, Proposed Action, and cumulative pumping with the Proposed Action as a way of identifying the incremental effects of the alternative. Representative basins for which the proposed action are may have a potential impact have been included in the analysis, and include (north to south): Steptoe, Hamlin, Spring, Snake, Lake, and Lower Meadow Valley Wash.

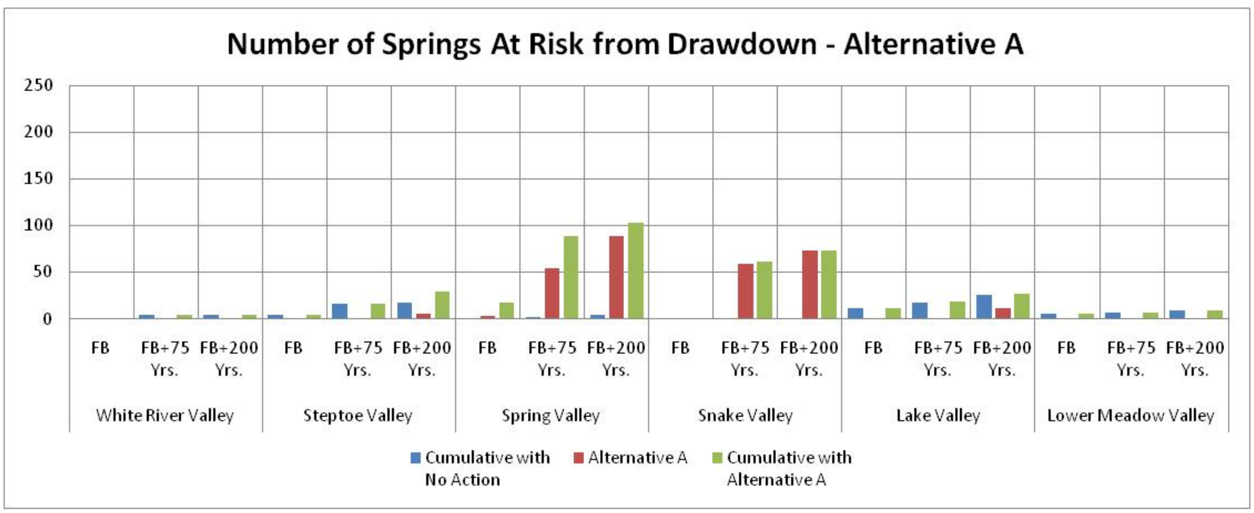


Figure 3.5-17 Number of Springs At Risk from Drawdown, Alternative A

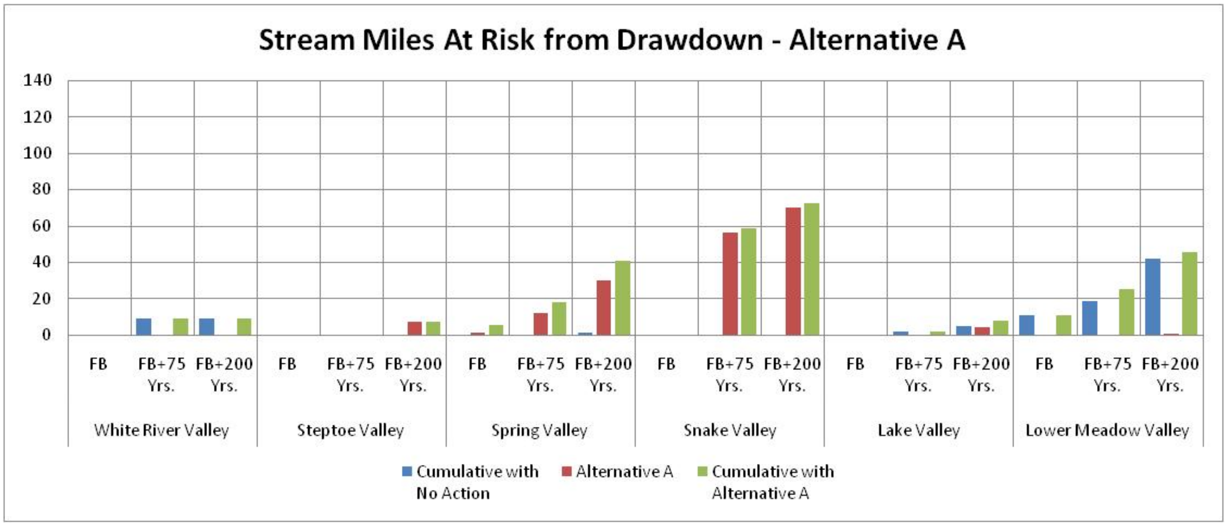


Figure 3.5-18 Stream Miles At Risk from Drawdown, Alternative A

Cumulative acres of potential drawdown effects for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figure 3.5-19** and **Figure 3.5-20**). These figures include impact parameter information for cumulative effects with No Action, Alternative A, and cumulative pumping with the Alternative A as a way of identifying the incremental effects of the alternative. Representative basins for which the alternative may have a potential impact have been included in the analysis, and include (north to south): Steptoe, Hamlin, Spring, Snake, Lake, and Lower Meadow. While a similar pattern of potential drawdown effects would occur with Alternative A, one notable difference for this cumulative pumping scenario would be that the magnitude of flow reduction would be smaller compared to cumulative pumping with the Proposed Action. Therefore, the magnitude of effects on vegetation communities would be lower in Spring, Snake and Lake valleys. Effects on communities in Steptoe, Hamlin, and Lower Meadow Valley Wash would be nearly identical.

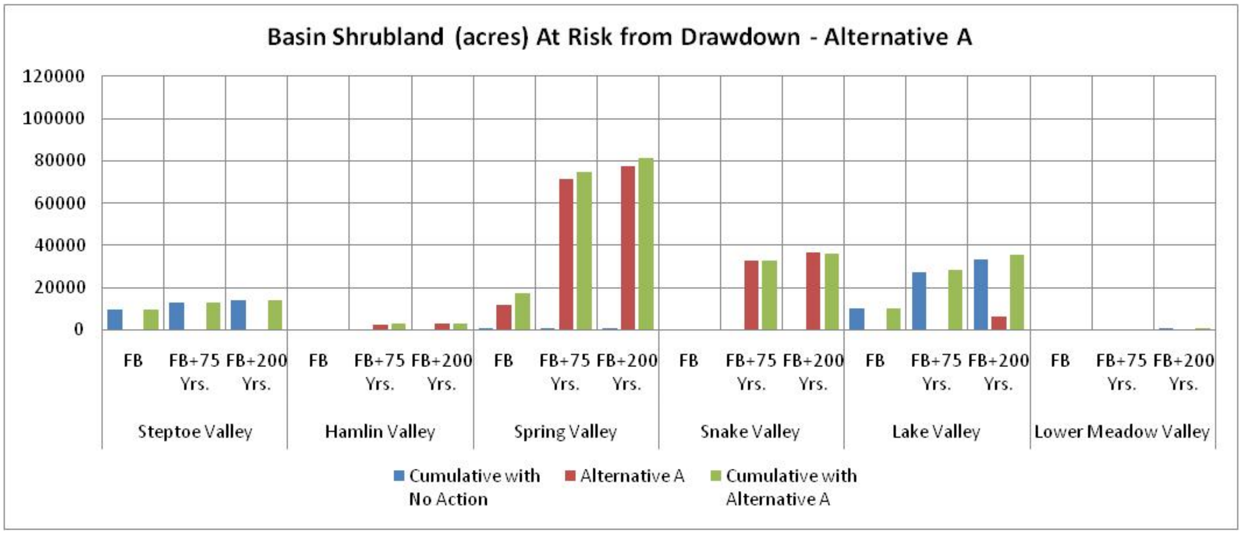


Figure 3.5-19 Basin Shrubland At Risk from Drawdown, Alternative A

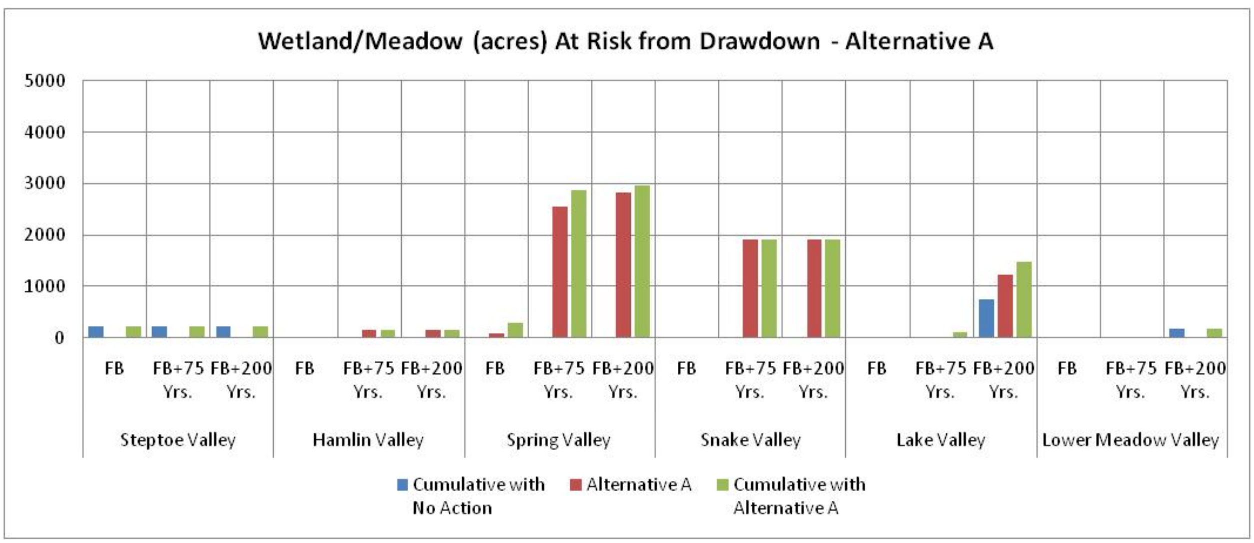


Figure 3.5-20 Wetland/Meadow At Risk from Drawdown, Alternative A

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

3.5.3.7 Alternative B

Rights-of-way Groundwater Field Development Construction and Operational Maintenance

The GWD Project surface disturbance would intersect with existing road and highway crossings in all hydrologic basins; would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties; and would intersect service roads for a wind energy project in Spring Valley. Expected cumulative effects would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-5 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-21** and **Figure 3.5-22** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk by Alternative B groundwater drawdown.

Cumulative acres of potential drawdown effects for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figure 3.5-23** and **Figure 3.5-24**). Alternative B would contribute the predominant cumulative drawdown effects to streams and springs in Spring and Snake Valleys. Alternative B is predict to cause larger effects on the Wetland/Meadow ET areas as compared to Alternative A. This difference is attributed to the wider distribution of pumping locations under Alternative A.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

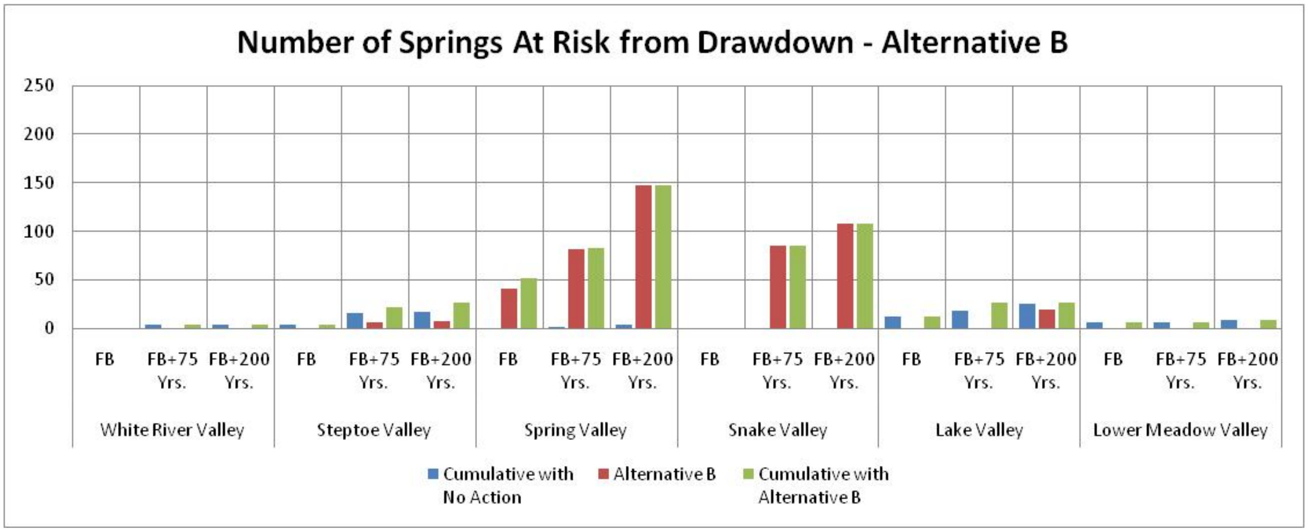


Figure 3.5-21 Number of Springs At Risk from Drawdown, Alternative B

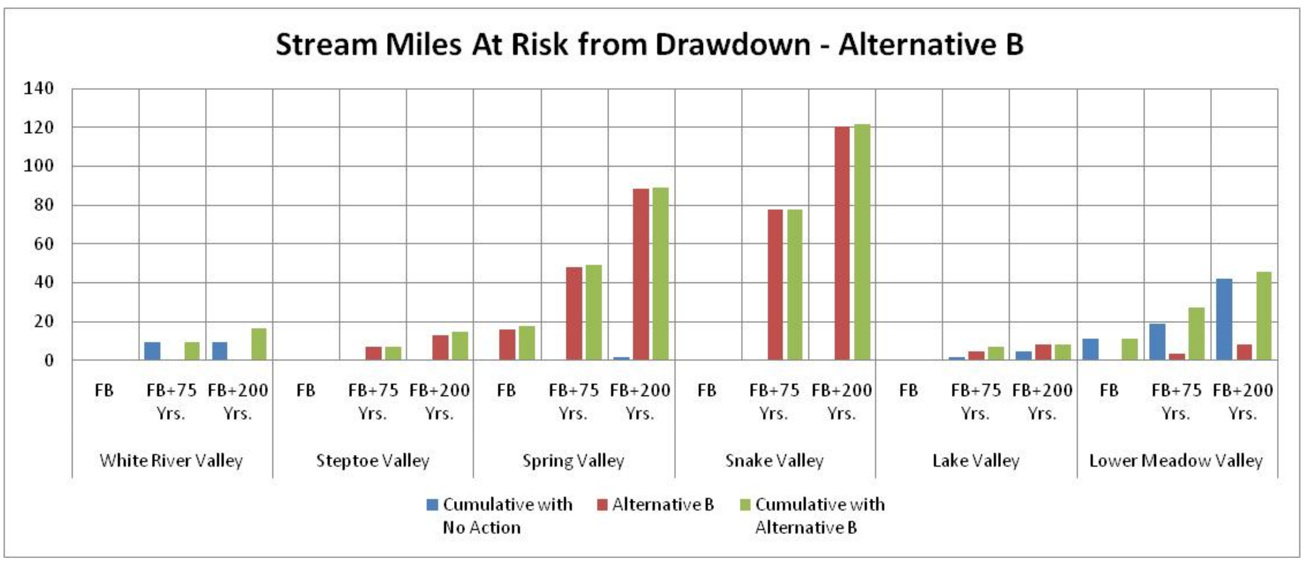


Figure 3.5-22 Stream Miles At Risk from Drawdown, Alternative B

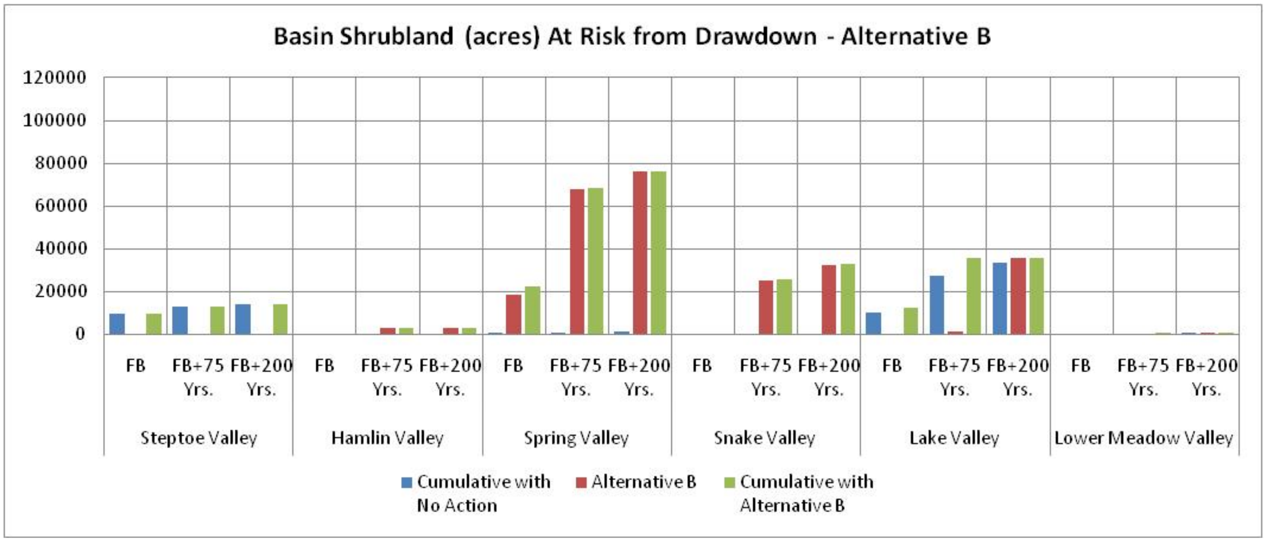


Figure 3.5-23 Basin Shrubland At Risk from Drawdown, Alternative B

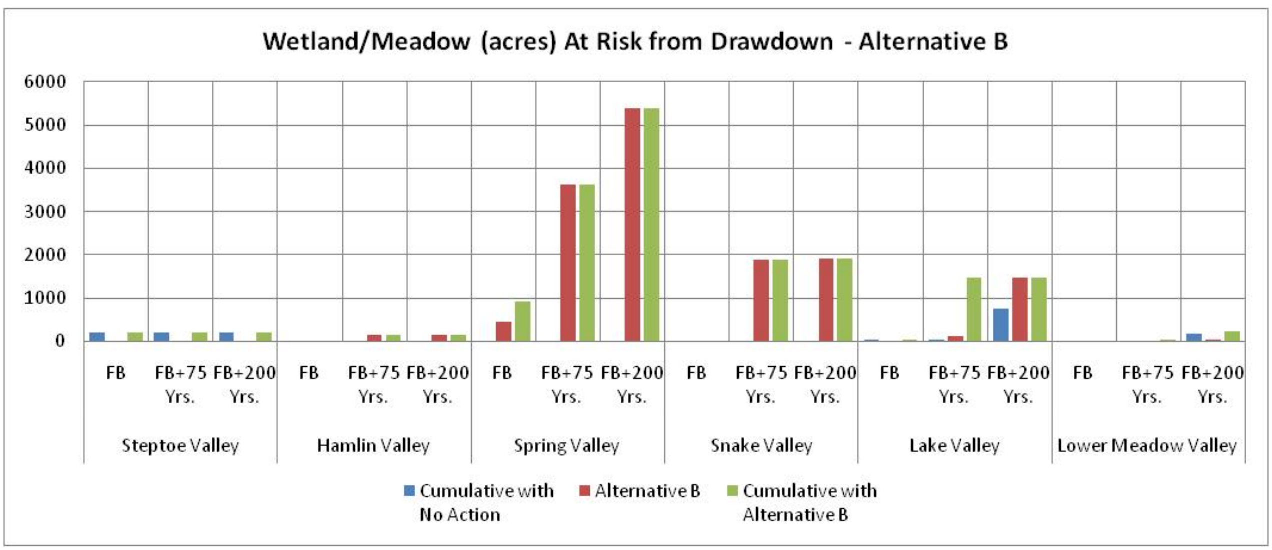


Figure 3.5-24 Wetland/Meadow At Risk from Drawdown, Alternative B

3.5.3.8 Alternative C

Rights-of-way Groundwater Field Development Construction and Operational Maintenance

The GWD Project surface disturbance would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties, and would intersect service roads for future wind energy projects in Spring and Dry Lake valleys and facilities for a solar energy project in Delamar Valley. Expected cumulative effects to resources would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-6 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figure 3.5-25** and **Figure 3.5-26** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be affected by the Alternative C drawdown. Alternative C would contribute much lower levels of drawdown effects to springs and streams in Spring and Snake Valleys relative to the cumulative effects predicted for the Proposed Action, and Alternatives and B. This difference is attributed to the overall lower groundwater withdrawal assumed for Alternative C.

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ET areas have been graphed by hydrologic basin (**Figure 3.5-27** and **Figure 3.5-28**). Similar to springs and streams, there would be lower levels of potential drawdown effects to ET areas from the cumulative contribution of Alternative C as compared to the Proposed Action, and Alternatives A and B.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring and Snake valleys. Predicted drawdowns in the Panaca Valley affecting up to four springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

The Ute ladies'-tresses orchid has not been identified in any of the hydrologic basins potentially affected by drawdown. If populations of this species are found in the future, evaluations of groundwater drawdown risk to this species would be conducted.

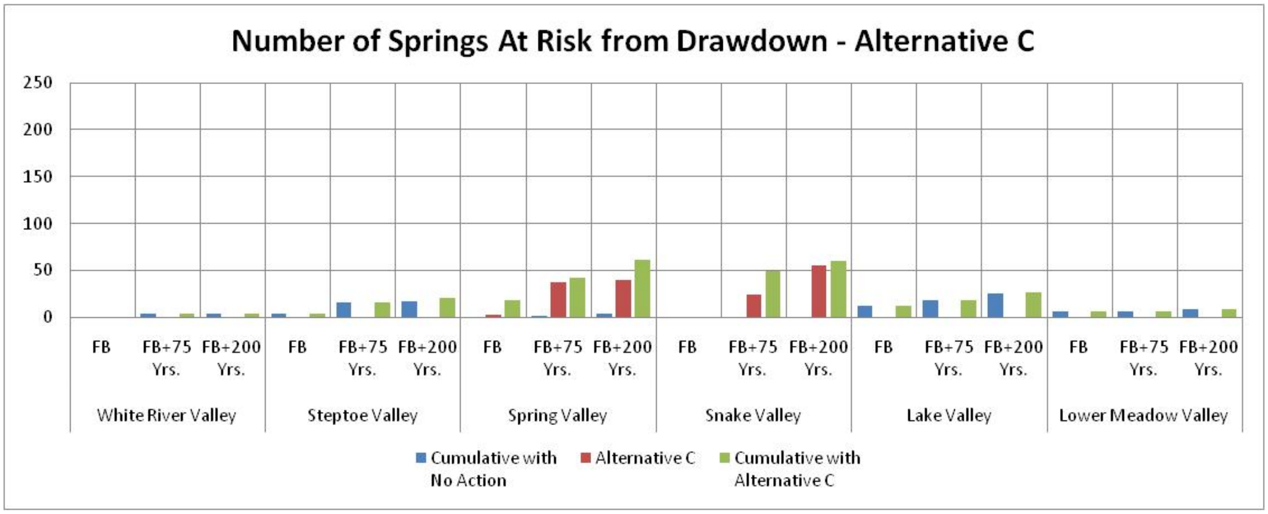


Figure 3.5-25 Number of Springs At Risk from Drawdown, Alternative C

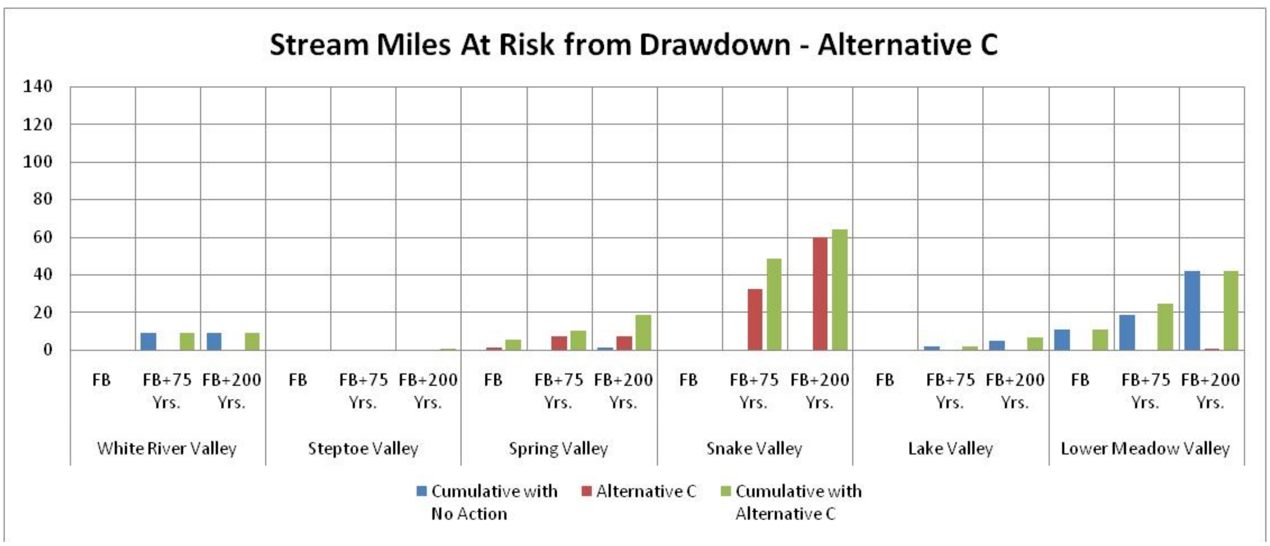


Figure 3.5-26 Stream Miles At Risk from Drawdown, Alternative C

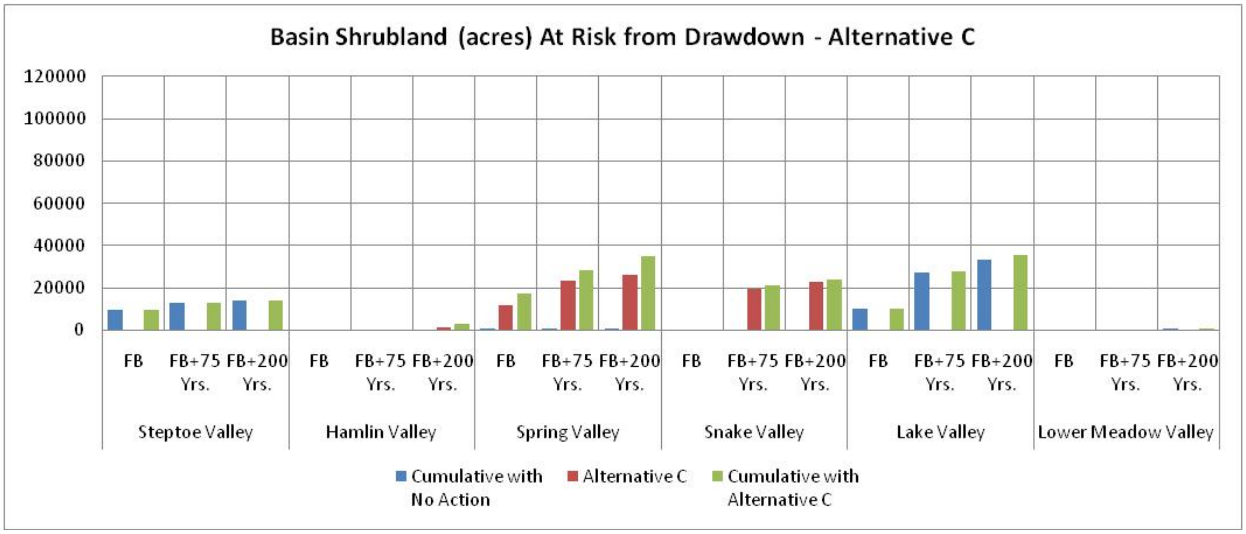


Figure 3.5-27 Basin Shrubland At Risk from Drawdown, Alternative C

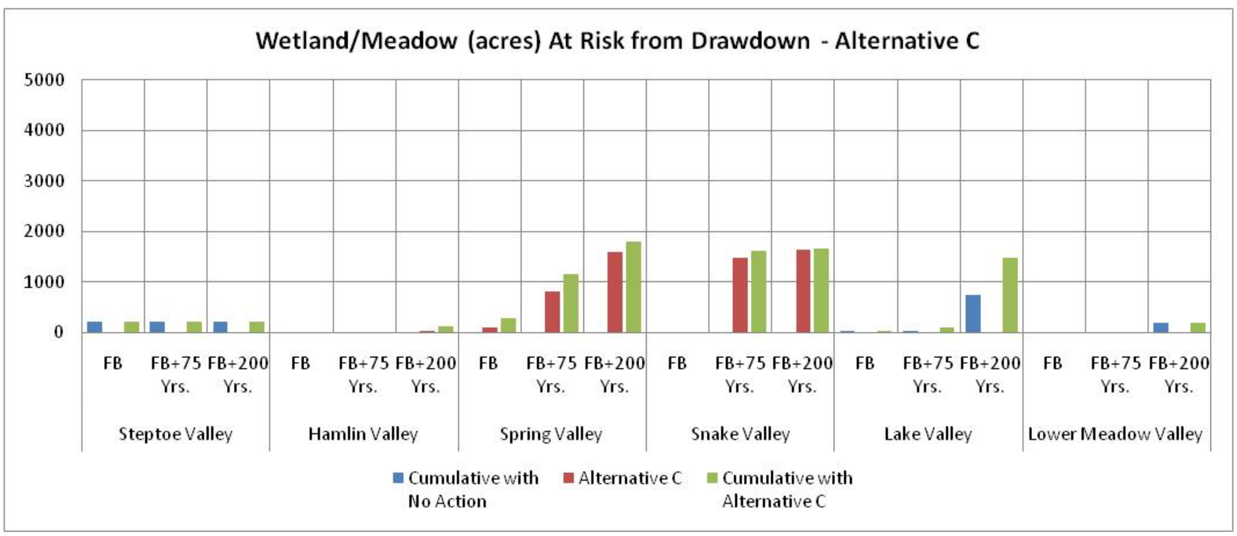


Figure 3.5-28 Wetland/Meadow At Risk from Drawdown, Alternative C

3.5.3.9 Alternative D

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Alternative A.

Groundwater Pumping

Figure F3.5-7 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-29** and **3.5-30** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be at risk by Alternative D groundwater drawdown. Alternative D would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B. This difference is attributed to the concentration of Alternative D pumping in southern Spring Valley, which would not affect streams and streams in northern Spring and Snake Valleys.

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figure 3.5-31** and **Figure 3.5-32**). Alternative D would affect a much smaller ET area acreage as compared to the Proposed Action and Alternative B. This difference is attributed to the concentration of Alternative D pumping in southern Spring Valley, which would reduce the predicted effects in the large ET areas in central and northern Spring Valley.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants in Spring, Snake, and Lake valleys. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long term population viability.

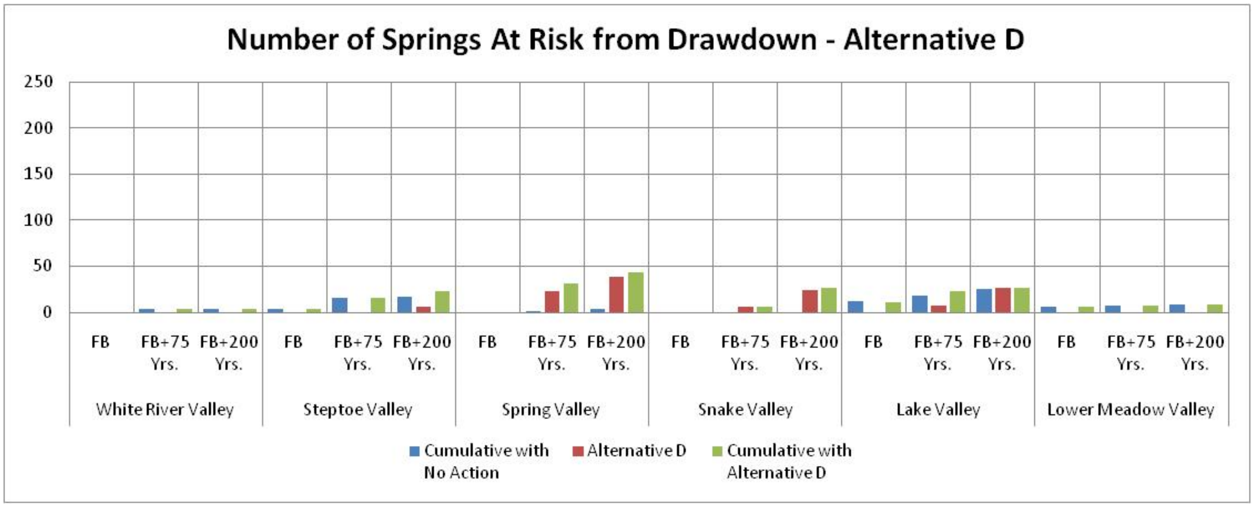


Figure 3.5-29 Number of Springs At Risk from Drawdown, Alternative D

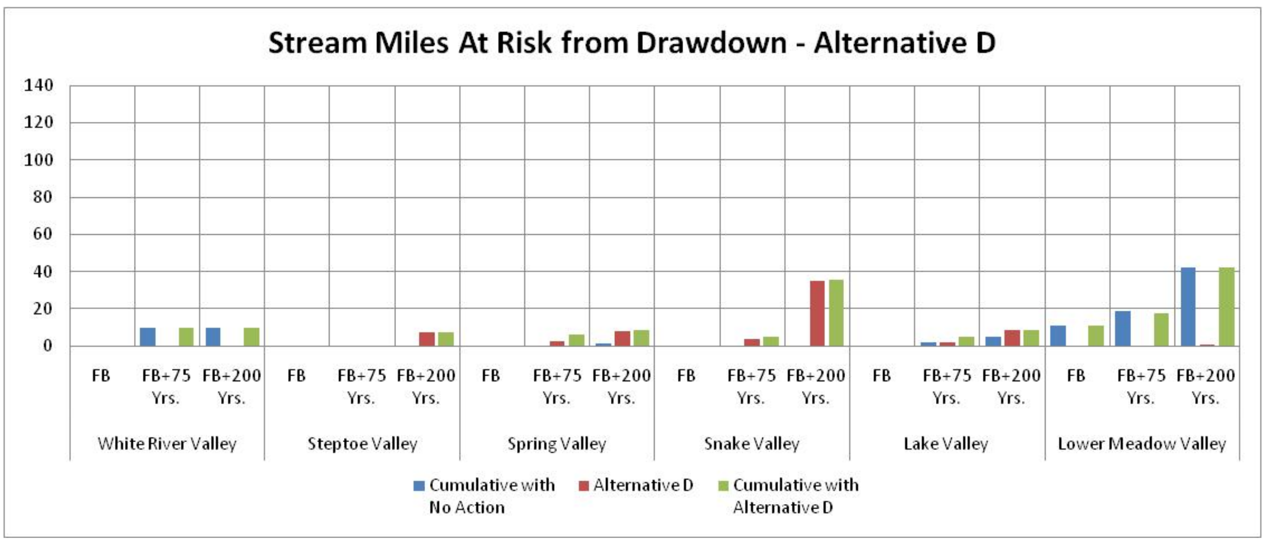


Figure 3.5-30 Stream Miles At Risk from Drawdown, Alternative D

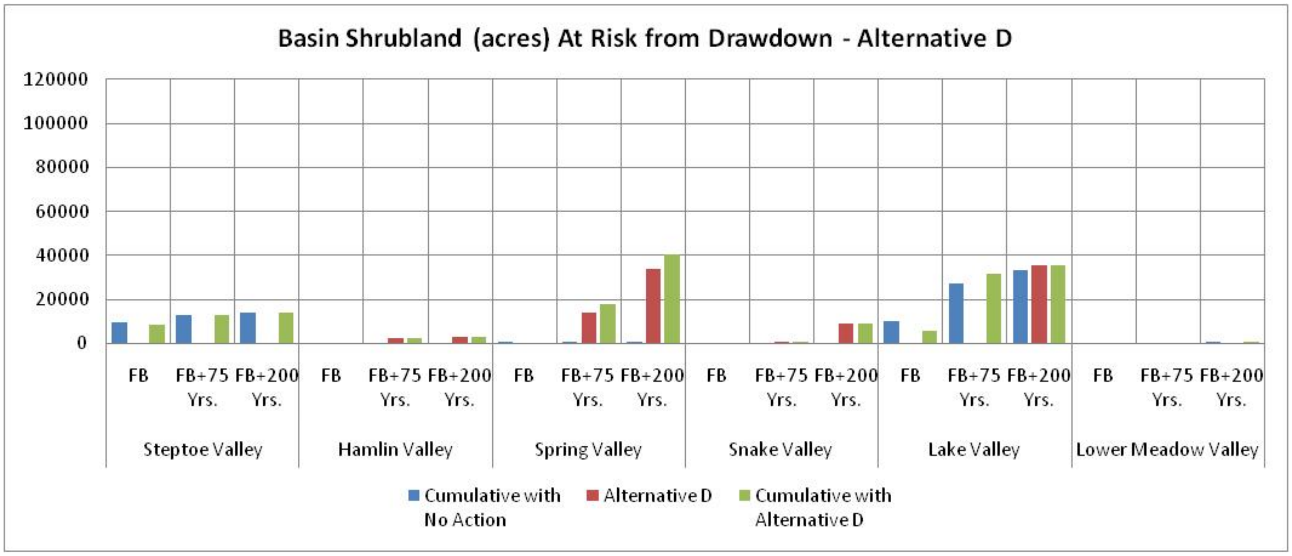


Figure 3.5-31 Basin Shrubland At Risk from Drawdown, Alternative D

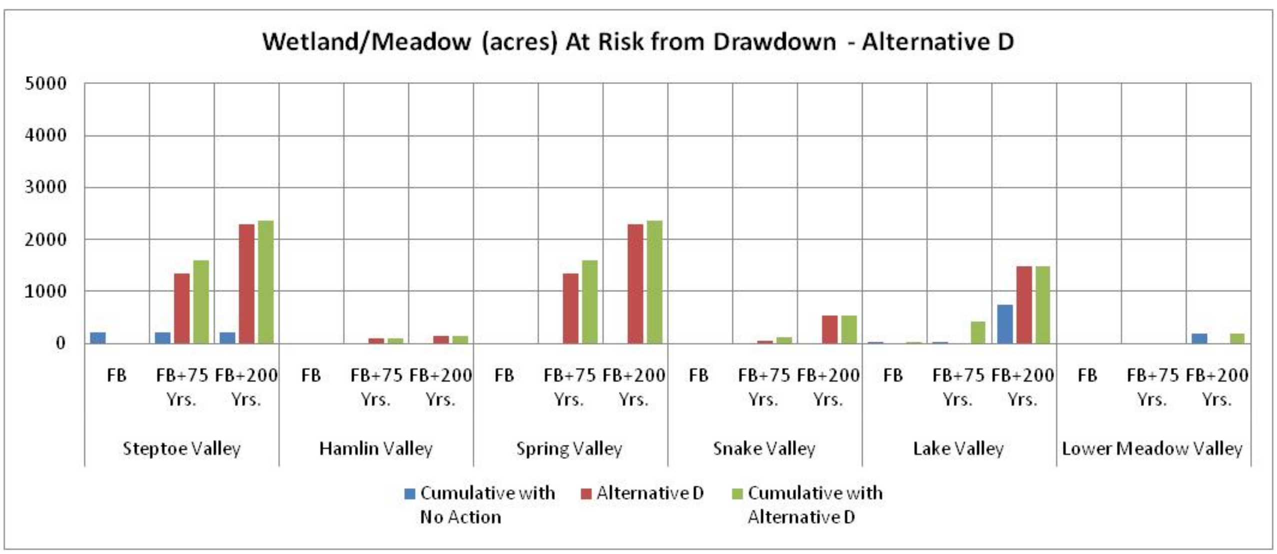


Figure 3.5-32 Wetland/Meadow At Risk from Drawdown, Alternative D

3.5.3.10 Alternative E

Rights-of-way Groundwater Field Development Construction and Operation Maintenance

The GWD Project surface disturbance would intersect with existing road and highway crossings in all hydrologic basins, would parallel approximately 100 miles of a designated utility corridor in Clark and Lincoln counties. Expected cumulative effects to resources would be the same as those described for Proposed Action.

Groundwater Pumping

Figure F3.5-8 illustrates the expansion of the 10-foot drawdown contour in relation to the wetland and phreatophytic cover types, potentially affected springs, and potentially affected perennial stream segments. **Figures 3.5-33** and **3.5-34** illustrate the number of springs and miles of perennial streams by basin, respectively, that would potentially be impacted by the Alternative E. Alternative E would contribute potential drawdown effects to many fewer springs and stream miles as compared to the Proposed Action, and Alternative B, especially in Snake Valley. This difference is attributed to the lack of Alternative E pumping in Snake Valley. However, Alternative E pumping would potentially affect approximately twice as many springs as Alternative D in Spring Valley. This difference is attributed to groundwater development over the entire area of Spring Valley under Alternative E, as compared to only the southern portion of Spring Valley in Lincoln County under Alternative D.

Cumulative acres of potential disturbance due to drawdown for basin shrubland and wetland/meadow ETs have been graphed by hydrologic basin (**Figure 3.5-35** and **Figure 3.5-36**). Alternative E would contribute equivalent effects to ET areas in Spring Valley as Alternative A, because the well development pattern would be the same. No effects on ET areas are predicted in Snake Valley at any time interval.

Successional changes in spring-dependent wetlands and meadows could reduce the availability of Tribal traditional use wetland and riparian plants. Predicted drawdowns in the Panaca Valley affecting up to three springs could affect Ute ladies'-tresses orchid populations occurring in wet meadow habitats in Meadow Valley Wash. There is a risk that soil moisture changes in spring meadows could alter the growth and flowering conditions, which could adversely affect the long-term population viability.

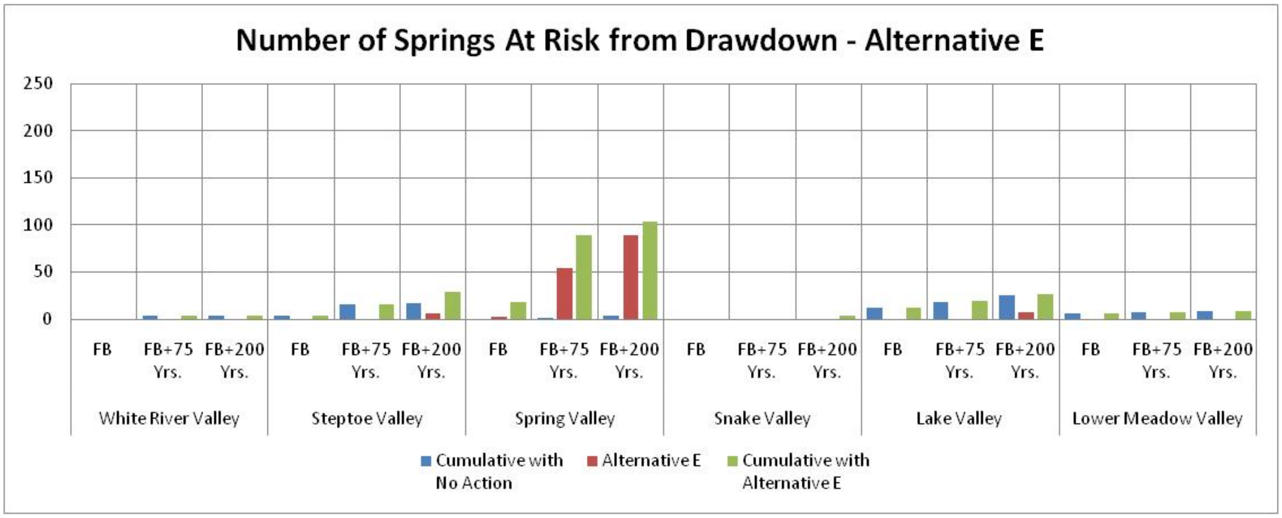


Figure 3.5-33 Number of Springs At Risk from Drawdown, Alternative E

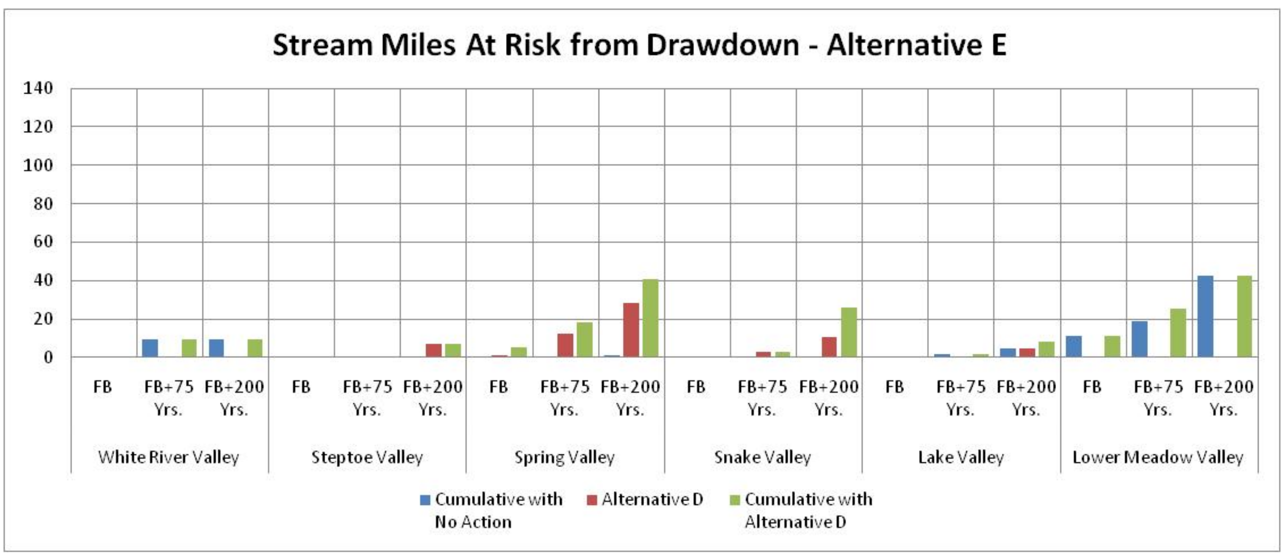


Figure 3.5-34 Stream Miles At Risk from Drawdown, Alternative E

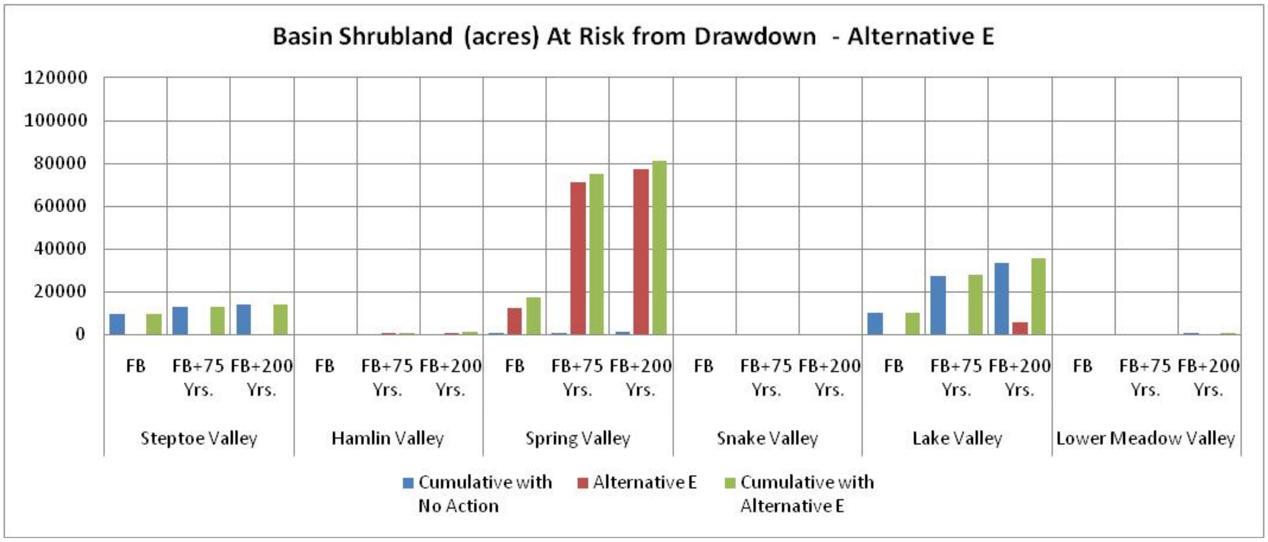


Figure 3.5-35 Basin Shrubland At Risk from Drawdown, Alternative E

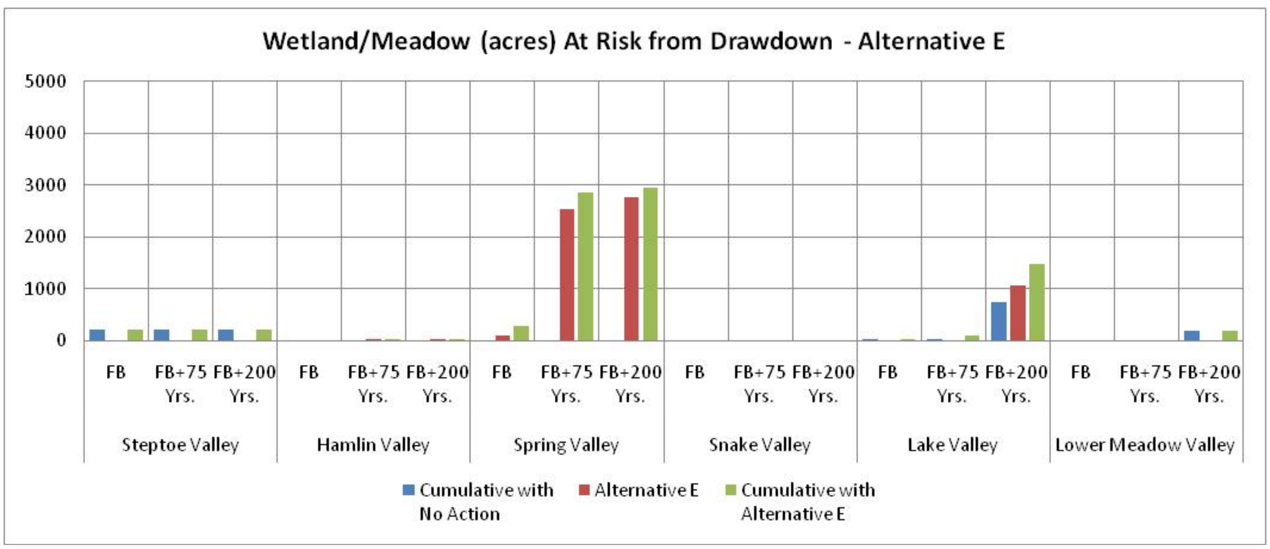


Figure 3.5-36 Wetland/Meadow At Risk from Drawdown, Alternative E