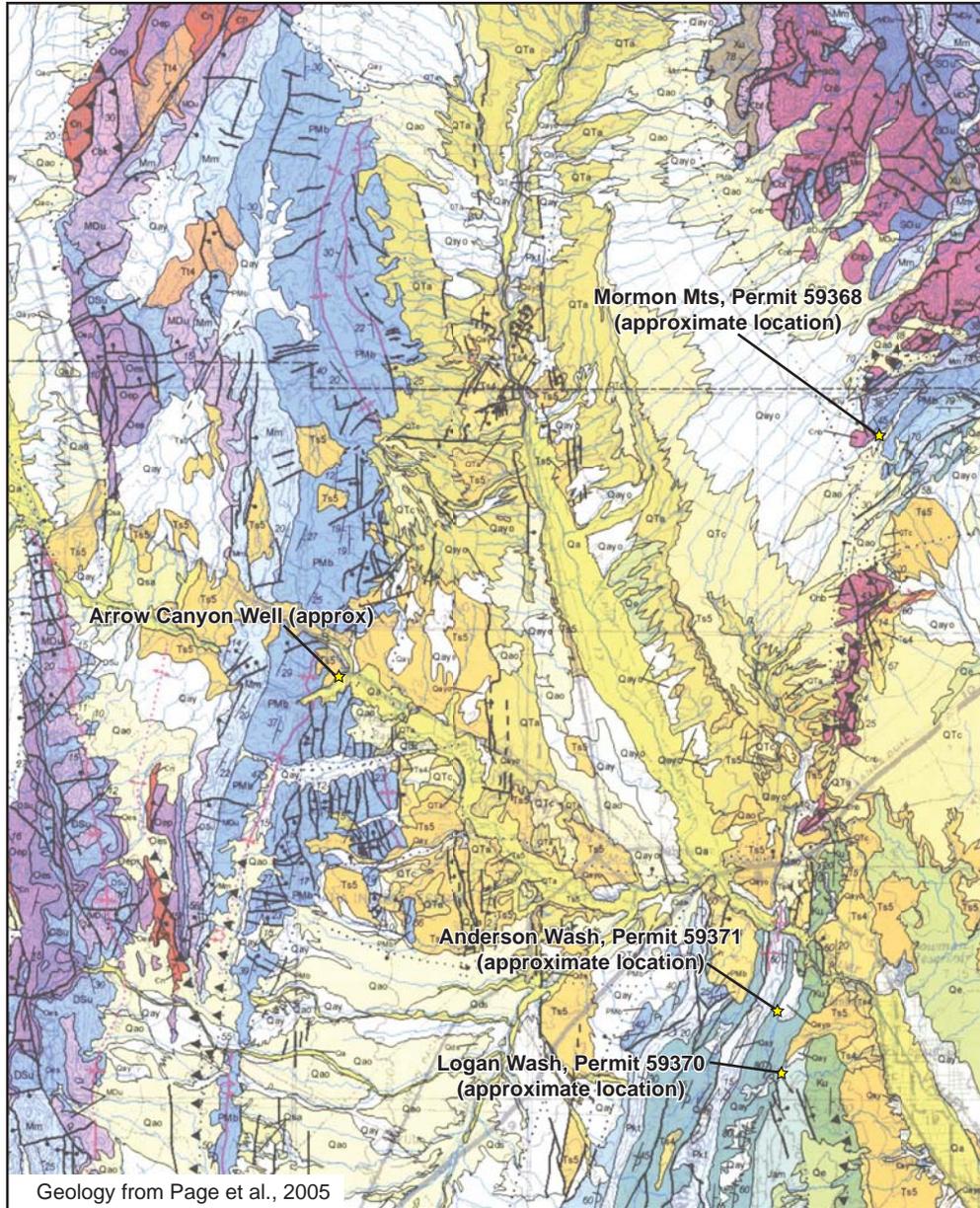


# Hydrogeologic Analysis of Potential Well Sites in Hydrographic Basin 220



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## **Introduction**

At the request of the Moapa Valley Water District (MVWD), Glorieta Geoscience Inc. (GGI) has reviewed geologic and hydrologic data pertinent to three potential future well locations. The locations correspond to applications submitted to the Nevada Division of Water Resources that have been held in abeyance per OSE Order 1169. Order 1169 was issued to curtail additional development in the Regional Carbonate Aquifer (RCA) pending further analysis to determine effects of pumping on water levels in the RCA and flow from springs discharging from the RCA that are the source of water providing habitat for the endangered Moapa Dace. A large scale, long duration (approximately 2-year) pumping test that was conducted in the RCA using well MX-5 concluded in December, 2012. Analysis of water levels and spring discharge data collected during the test suggests that large scale pumping in the RCA results in water level declines in RCA wells and declining flow in selected springs discharging from the RCA.

All of MVWD's existing potable water supply is currently derived from wells and spring sources in Basin 219 that are part of the RCA. If action levels in the springs and monitoring wells in the Muddy Springs area are reached due to pumping in the RCA, pumping may have to be reduced in MVWD's basin 219 wells to ensure sufficient flow to support the endangered Moapa Dace. In the event this occurs, MVWD will be forced to rely on water sources other than the RCA to meet their water supply needs. MVWD has two wells existing wells in Basin 220 that are not completed in the RCA (permit numbers 24007, 72263, and 68524) which are used only as a last resort due to water quality issues – water from these wells must be blended in a 1:4 ratio with water from the RCA sources to achieve drinking water standards. If additional sources of water can be developed in Basin 220, it could become economically viable to construct and operate a treatment facility to allow use of the Basin 220 sources without the need to blend with RCA water.

## **MVWD Basin 220 Permits**

MVWD currently has three applications in hydrographic basin 220 that have been held in abeyance per OSE Order 1169. These applications include permits 59368, 59370, and 59371. Hydrogeologic analyses of these locations, provided below, indicate that they are not part of the Regional Carbonate Aquifer (RCA).

## **Geohydrologic Summary of Permit Locations**

The locations of the MVWD permit applications are shown in Figure 1. All of the locations are within Nevada Hydrographic Basin 220 and are isolated from the RCA in basin 219. Dettinger et al. (1995, p. 57) state that, "The Muddy River Springs, the authors believe, drain all the water flowing in the carbonate-rock aquifer because the carbonate rocks pinch out against geologic barriers to the east and south." These barriers include faults south and east of the springs (Muddy Mountains Thrust of Page et al. [2005]) and thick, relatively impermeable sediments in the Muddy River valley (Dettinger et al., 1995). Further evidence of the isolation of the well sites from the RCA is provided by local geologic and geochemical analyses, as described below.

**Permit Number:** 59368

**Common Name:** Mormon Mountains

**Legal Description:** NW ¼, NW ¼, Sec. 10, T13S, R67E

**Geology:** A well drilled at this location would spud in the Mississippian-Permian age Bird Springs Formation (limestone, dolostone, siltstone, silty limestone, sandstone, and shale) or overlying alluvium (Figure 1). The well completion would target carbonate intervals (limestone or dolostone) within the Bird Springs Formation. The Mormon Mountains, and the area surrounding the well site, have been extensively deformed by faulting and folding and bedding orientations in the vicinity of the well are highly variable. The location is separated from the Muddy Springs area by normal faulting (Meadow Valley Wash Fault) and thick Mesozoic and Cenozoic deposits (Page et al., 2005, 2011). It appears that the well location is in the upper portion of the Bird Springs Formation, although lower in the section than a nearby test well drilled for MVWD in 1997. The test well was drilled to a depth of approximately 860 ft at a location ¾ mile east of the permitted 40 acres, into the middle silty portion of the Bird Springs Formation. Production from this well was estimated at 1 cfs (450 gpm). General chemistry data from the well (Table 1) are markedly different from samples collected from other wells and springs in the Muddy River Springs area that are part of the RCA. This difference in chemistry supports the interpretation from structural data (Page et al., 2005, 2011) that, while a well in this location would be completed into a carbonate unit, it is not in hydrologic communication with the RCA in the Muddy Springs area.

**Permit Number:** 59370

**Common Name:** Logan Wash

**Legal Description:** SW ¼, NW ¼, Sec. 32, T15S, R67E

**Geology:** A well drilled in this location would spud in the Jurassic-Triassic age Aztec Sandstone or the Overton Conglomerate Member of the Cretaceous age Baseline Sandstone and would be completed into the Aztec Sandstone (Figure 2). This location is isolated from the RCA both stratigraphically (the Aztec sandstone is separated from the RCA by the underlying Triassic section) and structurally (by the Muddy Mountain thrust fault/fault zone west of the site [Page et al., 2005]). Pumping from this location would be unlikely to propagate impacts to the RCA across the fault zone and, if any effects are transmitted to the RCA, they would be downgradient of the Muddy Springs area and the Moapa Dace habitat.

**Permit Number:** 59371

**Common Name:** Anderson Wash

**Legal Description:** SE ¼, SE ¼, Sec. 19, T15S, R67E

**Geology:** A well at this location would spud in in sandstone or gypsiferous sandstone of the Triassic Kayenta and Moenave Formations or the overlying alluvium, depending on the exact site selected within the 40 acre permitted area (Figure 2). Beds here are either vertical or overturned with a west-northwest dip, so it is anticipated that production would be from the Kayenta-Moenave or, potentially, the Jurassic-Triassic age Aztec Sandstone. This location is isolated from the RCA both stratigraphically (separated from the RCA by the underlying Triassic section) and structurally (by the Muddy Mountain thrust fault/fault zone west of the site [Page et al., 2005]). Pumping from this location would be unlikely to propagate impacts to the RCA across the fault zone and, if any effects are transmitted to the RCA, they would be downgradient of the Muddy Springs area and the Moapa Dace habitat.

### **Summary and Conclusions**

- MVWD currently obtains 100% of its potable water supply from wells and springs in the RCA in hydrographic Basin 219
- Development of new water sources separate from the RCA in Basin 220 will eliminate MVWD's reliance on the RCA as a sole water supply source.
- MVWD currently has three applications in hydrographic basin 220 that have been held in abeyance per OSE Order 1169.
- Hydrogeologic analyses of the proposed well locations indicate that they are not part of the Regional Carbonate Aquifer (RCA)
- It is critical that MVWD be allowed to pursue development of these water sources in basin 220 that are located in areas where pumping will not affect the RCA and Moapa Dace habitat.

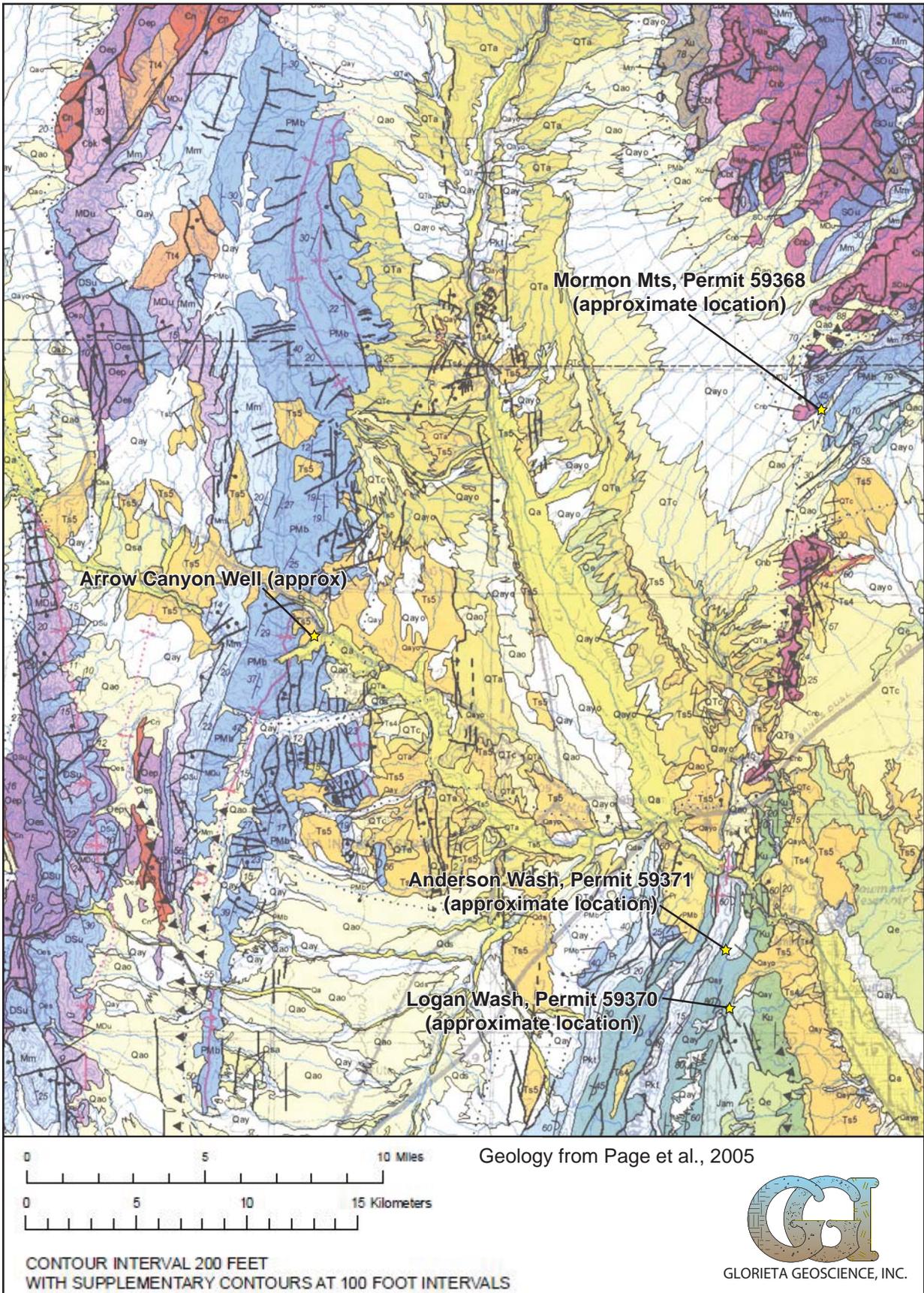
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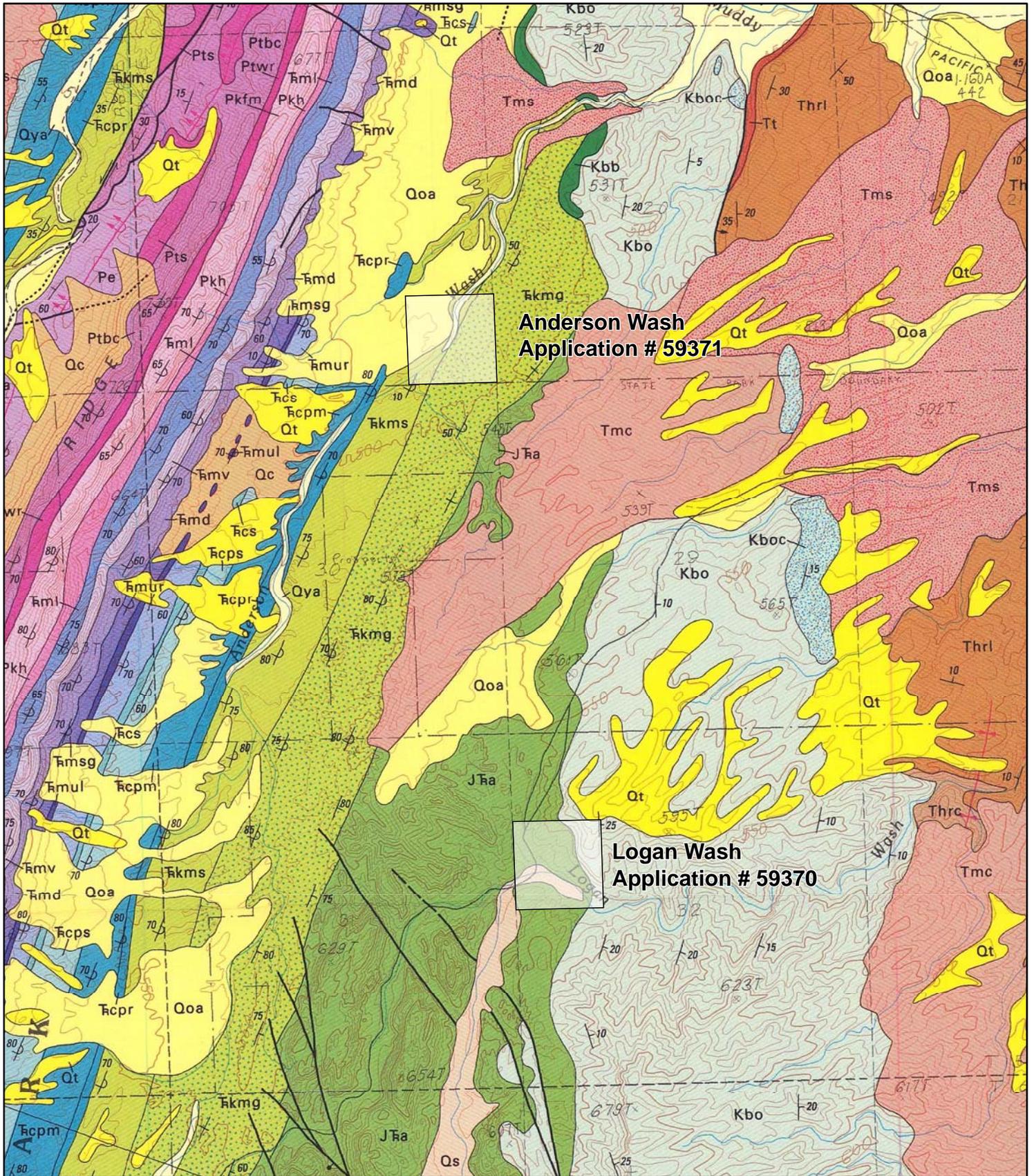
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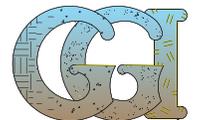
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**Figure 1.** Regional geologic map showing location of MVWD's Basin 20 applications.



Geology from Bohannon, 1992



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Figure 2. Geology of the Anderson Wash and Logan Wash sites.

**Table 1.** Comparison of general chemistry data from the Moapa Peak Test well to other samples collected from the RCA in the Muddy Springs area

Sample	Ca	Mg	Na	K	Cl	SO4	HCO3	TDS
CSV-2	61.3	26.4	101	11.3	61.5	158	262	591
BW-01	60.8	24.4	101	11.0	56.3	195	264	616
CSV-1	40.3	20.3	76.6	11.9	35.8	88.4	286	452
Muddy River Springs 13	64.3	27.8	95.6	10.9	62.5	181.8	260.0	610
Muddy River Springs 14	66.1	28.1	96.6	9.2	62.6	179.4	257.5	617
Muddy spring nr LDS	62.9	27.3	99.5	4.3	64.4	188.0	265.0	608
CE-DT-4	46	19	84	11	35	110	294	599
CE-DT-5	46	20	78	11	34	100	300	589
MVWD CE-DT-6	58	25	87	10	53	160	271	664
Arrow Canyon Well	64	22	97	12	58	153	271	677
CSV-3	51	25	38	10	54	26	300	504
SHV-1	33	30	86	12	64	90	245	560
MX-5	54	22	85	13	38	100	283	595
Pederson	65	29	101	10	61	191	277	734
Big Muddy	65	28	98	12	69	196	270	738
Pipeline Jones	62	27	94	12	66	181	267	709
Baldwin Cut	63	28	96	11	66	184	269	717
CanyonArrow "W" #1	48	26	31		48.6	148	210	563
CanyonArrow "W" #2	47	28	30		47.2	144	190	564
Baldwin "S"	53	28	32		56.2	167	200	615
Jones "S"	51	27	31		54.5	167	190	575
MX-6 "W"	49	26	31		46.8	152	200	551
<b>Moapa Peak Test Well</b>	<b>No data</b>	<b>168</b>	<b>235</b>	<b>13</b>	<b>111</b>	<b>1800</b>	<b>90</b>	<b>2016</b>