LUMOS & ASSOCIATES

MEMORANDUM

DATE:	11/30/2023
TO:	Ed James
FROM:	Chelsea Cluff, P.E..
CC:	Tim Russell, P.E., WRS; Jonathan Lesperance, P.E.
SUBJECT:	Gardnerville Ranchos General Improvement District Purveyor Data

1.0 Background Information

Lumos & Associates (Lumos) was contracted by the Carson Water Subconservancy District (CWSD) to assist the United States Geological Survey (USGS) with the data collection and analysis of 13 water purveyors within the Carson River Watershed as part of the Carson River Watershed 30-Year Regional Drought and Water Sustainability Plan. The intended purpose of this document is to identify potential deficiencies in water supply (both quantity and/or quality) over a 30-year planning horizon with a focus on existing and future municipal water production, water quality, and water rights for the Gardnerville Ranchos General Improvement District (GRGID). Where deficiencies are noted or anticipated, potential mitigation measures will be provided for future consideration. Existing and future pumping rates and well locations will be provided to USGS for use in modeling groundwater and surface water impacts across the watershed. Tabulated data including monthly production for each well over the current 5-year period of record, will be made available to USGS, CWSD, and the water purveyor.

GRGID manages the operations and maintenance of the water system for the Gardnerville Ranchos community, which is a census designated place within Douglas County, with a population of approximately 11,318 people as per 2022 U.S. Census Data. The GRGID system includes seven (7) existing active municipal supply wells that service 4,704 connections, of which 4,636 are residential. Gardnerville Ranchos is located 20 miles south of Carson City and is approximately 10.3 mi^2 in size.

2.0 Existing and Future Production

2.1 Existing Production

GRGID obtains its municipal water from seven (7) groundwater wells. Monthly total well production from each individual wells varies from 0.7 million gallons per month to 25.6 million gallons per month. Well 1 is the highest producing well with a pumping capacity of 1,181 gallons per minute (gpm) and a max daily production of 1,411,600 gallons per day (gpd). For a breakdown of each well with pumping capacity and max daily production capacity refer to Table 1. The existing locations and associated permit numbers for each well are listed within Table 7 in the supplemental information section.

Table 1: Well Pumping Capacity & Max Daily Production Capacity

Well Name	Well Pumping Capacity (gpm) [1]	Max Daily Production Capacity (gpd) [2]
Well 1	1,181	1,122,500
Well 2	1,765	1,677,500
Well 4	236	224,300
Well 5[3]	1,745	1,658,500
Well 6	600	570,300
Well 8[3]	1,200	1,140,500
Well 9	855	812,600
Total	7,582	7,206,200

Notes:
[1] Well pumping capacity was analyzed using 2023 GRGID Wire-to-Water Analysis
[2] Maximum daily production was estimated by using a sixteen (16) hour pumping cycle. The 16-hour pumping cycle is being used for the purpose of long-term drought and sustainability planning and does not actually reflect well capacity if pumping at 24 hours a day.
[3] Wells 5 and 8 are typically not pumped due to arsenic concentrations above the Federal Maximum Contaminant (MCL) Level. When required, GRGID operates these wells in accordance with the State approved blending protocol to ensure municipal water supplied to service connections is under the MCL and complies with all Federal and state drinking water requirements.

Combined, the seven wells have a total pumping capacity of 7,582 gpm and a max daily production of 7,206,200 gpd assuming a sixteen (16) hour a day pumping cycle. Overall, the production capacity of a system as identified in this report is the summer-time capacity since water demand increases six (6) to ten (10) times compared to winter-time demands. Therefore, the capacity analysis is focused on the high production months. The maximum monthly production for all five (5) years analyzed occurred between June and August with the overall highest production month being July of 2019 at 171.1 million gallons (MG). The average day max month (ADMM) can be calculated by dividing the absolute maximum month for each year throughout the five years of data and dividing by the number of days within that month.

The ADMM was used along with the maximum pumping capacity (based on a sixteen (16) hour a day pumping cycle) to evaluate production deficiencies in the system. On Figure 1 the ADMM for the four (4) summer months is compared to the available production capacity with Well#5 and Well#8 off to account for their current minimal use due to high arsenic levels. Production absent of Well #5 and Well #8 is potentially insufficient for meeting the ADMM. However, this is assuming that Well#5 and #8 aren't used at all which is not reflective of summer usage when adequate blending can be reached. As seen within Figure 1 the current maximum well production exceeds the ADMM for peak summer months in the scenario that Wells #5 and #8 are on. For a breakdown of the production of all the wells through the summer period see Table 2, and for the yearly production of all wells broken down by month, reference Table 8 in the supplemental information section.

Table 2: Historical Total Monthly Well Production

Month	Monthly Well Production (gallons)					
	2018	2019	2020	2021	2022	2018-2022 Average Day Max Month (ADMM)
June	130,692,000	125,657,000	150,245,000	157,087,000	139,196,000	5,236,233
July	166,962,000	171,057,000	157,505,000	148,694,000	156,379,000	5,517,968
August	151,253,000	146,105,000	158,766,000	151,942,000	149,492,000	5,121,484
September	124,102,000	128,691,000	130,251,000	122,843,000	127,078,000	4,341,700

= Maximum Month

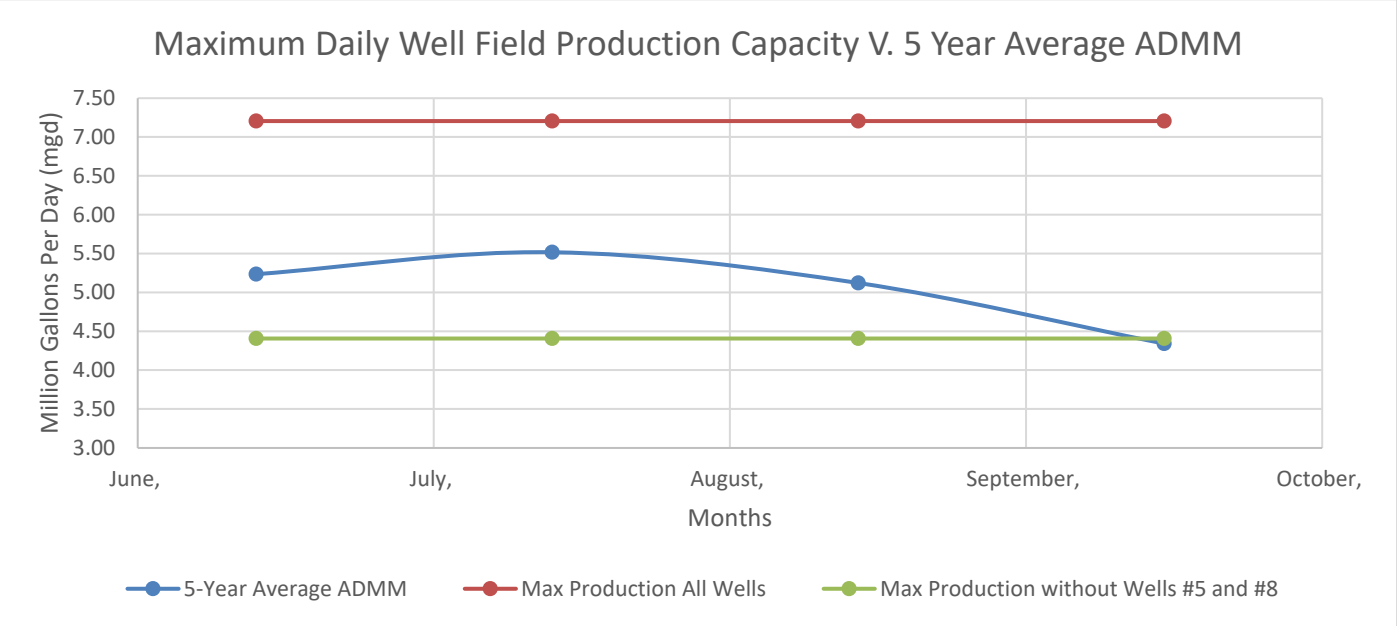


Figure 1: Maximum Well Field Production Capacity

2.2 Growth Projections & Future Required Production

To estimate the growth in water production for GRGID, a planning period from 2021 through 2051 (30 years) was analyzed using a growth rate of 0.54%. The 0.54% growth rate is based on population data from 2010 to the current date and was provided by Douglas County for the whole planning area. Figure 2 illustrates the annual well production required using the Douglas County growth rate over the 30-year planning horizon. Table 9, in the Supplemental Information section, provides an in-depth breakdown of the growth rate and associated estimated population provided by Douglas County over the 30-year planning horizon. It is unknown if developable land (receiving area), planned developments, and land use classifications were taken into consideration in the growth analysis as this is a county provided estimate of production growth.

Figure 2 illustrates the annual well production required using the growth rate from Douglas County over the 30-year planning horizon. Table 9, in the Supplemental Information section, provides and in-depth breakdown of the growth rate and associated estimated population provided by Douglas County over the 30-year planning horizon.

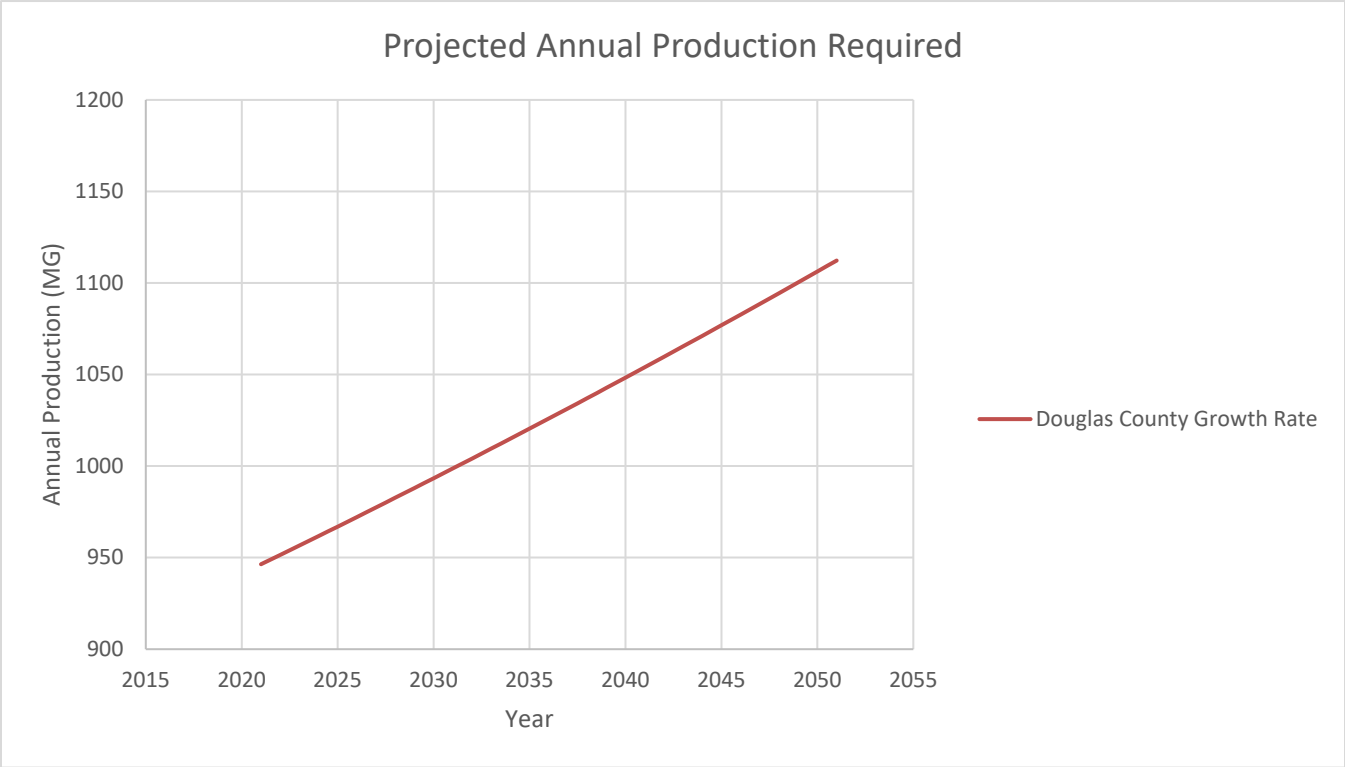


Figure 2: Projected Annual Production

2.3 Estimated Future Demand v. Existing Available Production

To estimate future well production necessary to meet anticipated water demand, the growth projections discussed in Section 2.2 were used to project the maximum daily demand required for GRGID. The calculated demand for GRGID in 2051 was approximately 1,112.3 MG based off Douglas County's growth rate, as described in Section 2.2. On Figure 3, the future estimated ADMM for the Douglas County growth rate is compared against current available production capacity, both with and without Well #5 and Well#8. If all wells are operating, there is insufficient capacity to meet the Douglas County growth rate. If Wells #5 and #8 are offline, there is not enough capacity to meet the future long-term demand estimate. Under the Douglas County growth rate without Well #5 and #8, an additional 1,920 gpm (at 16 hours a day) will be required. Under the Douglas County growth rate with Well #5 and #8, no additional capacity is required. For projected annual total production, see Table 10 in the supplemental information section.

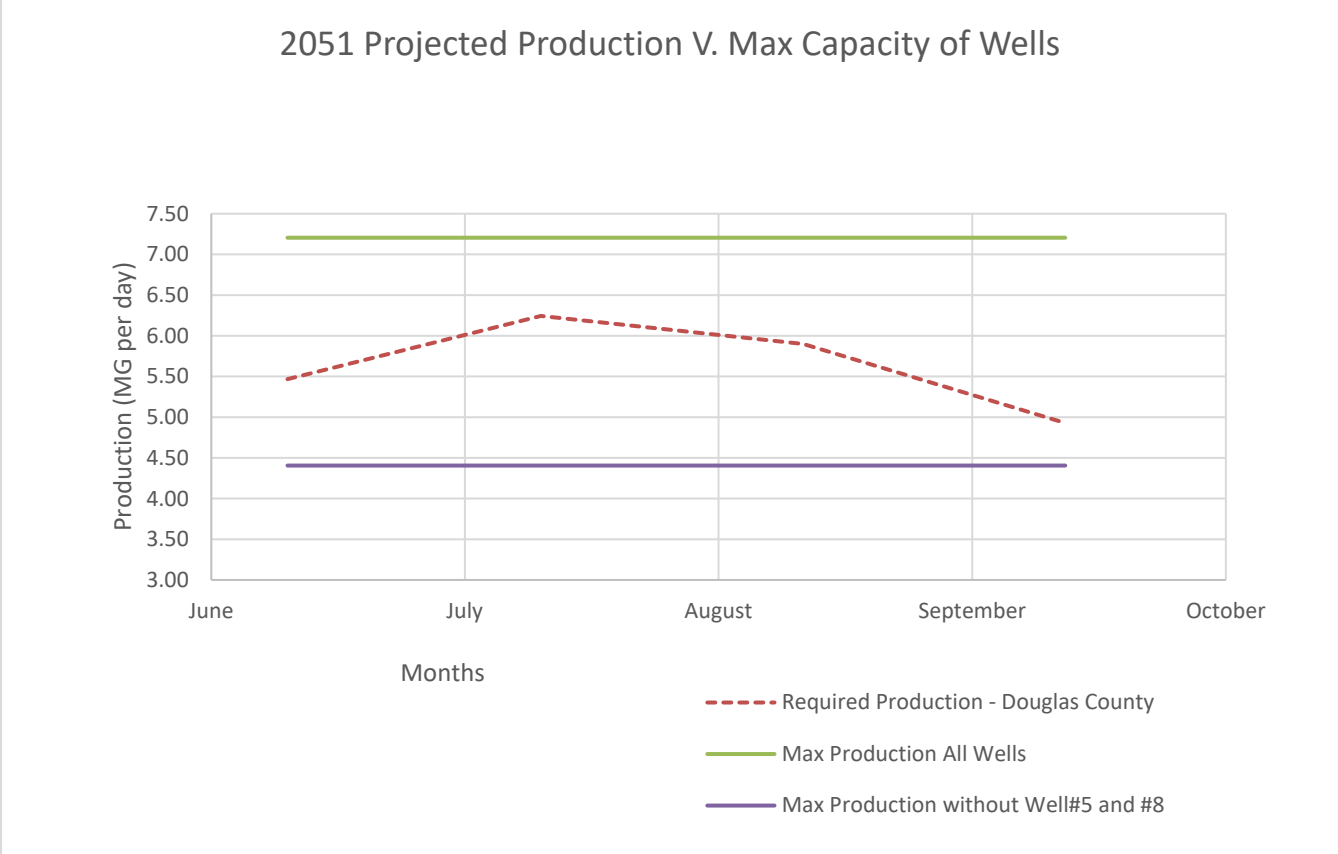


Figure 3: Projected 2051 Production versus Max Capacity of Wells

3.0 Water Quality

Water quality was analyzed using purveyor provided data from 2018 through 2021. The data provided analyzes existing water quality per well for six (6) constituents: Total Dissolved Solids (TDS), Arsenic, Iron, Manganese, Nitrogen, and Alkalinity. Two wells (Well#5 and Well#8) have had spot samples of arsenic concentrations above the maximum concentration limit (MCL) of 10 parts per billions (ppb) and their use has been limited to times of peak demand. During these times of peak demand, water from Wells #5 and #8 requires adequate blending with water from the other GRGID wells to reduce the arsenic level below 10 ppb, in accordance with the State approved blending protocol to ensure water quality compliance. The only other contaminant flagged for being above the limit is a single occurrence of iron in Well #1 with 0.65 parts per million (ppm), which is above the limit of 0.3 ppm. However, iron exceedance at Well #1 does not seem to be a consistent occurrence. Overall, it is recommended to continue the monitoring of Wells #1, #5, and #8, and to begin the preliminary discussions of installing an arsenic treatment system. The remaining GRGID wells have low or non-detectable contaminant levels for the monitored contaminants. The yearly concentrations are shown in Table 3.

Table 3: Contaminants Concentration

	CONTAMINANT	TDS	Arsenic	Iron	Manganese	Nitrogen	Alkalinity
	MCL	1000 (ppm)	10(ppb)	0.3 (ppm)	0.1 (ppm)	10 (ppm)	----
Well 1	2018	180	6	ND	ND	1	110
	2019	----	3	----	----	1	----
	2020	160	----	0.65	----	----	----
	2021	----	----	----	----	0.9	----
	2022	----	5	----	----	1	----
Well 2	2018	210	3	ND	ND	0.8	130
	2019	----	----	----	----	0.68	----
	2020	220	2	ND	ND	0.77	----
	2021	----	----	----	----	0.68	----
	2022	----	----	----	----	----	----
Well 4	2018	<3	----	----	0.8	----	----
	2019	----	3	----	----	1	----
	2020	230	6	ND	ND	0.6	97
	2021	----	----	----	0.6	0.9	----
	2022	----	5	----	----	1	----
Well 5	2018	----	22	----	----	0.2	----
	2019	----	6	----	----	3	----
	2020	230	6	ND	ND	1.6	----
	2021	----	6	----	----	----	----
	2022	----	6	----	----	2.3	----
Well 6	2018	180	4	ND	ND	1.6	97
	2019	----	----	----	----	1.7	----
	2020	150	----	ND	ND	1.8	----
	2021	----	ND	----	----	2.8	----
	2022	----	----	----	----	----	----
Well 8	2018	140	11	ND	ND	0.21	77
	2019	----	7	----	----	0.16	----
	2020	130	7	0.1	ND	ND	----
	2021	----	9	----	----	ND	----

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	CONTAMINANT MCL	TDS 1000 (ppm)	Arsenic 10(ppb)	Iron 0.3 (ppm)	Manganese 0.1 (ppm)	Nitrogen 10 (ppm)	Alkalinity ----
	2022	----	9	----	----	----	----
Well 9	2018	210	7	ND	ND	4.5	130
	2019	200	8	ND	ND	3	----
	2020	----	----	----	----	2.7	----
	2021	----	----	----	----	3.1	----
	2022	----	----	----	----	----	----

4.0 Water Rights

GRGID has 14 certificated and 39 permitted water rights attributed to nine (9) municipal wells. The total combined duty of those water rights is 5,307.92 acre-feet (AF) annually with a combined diversion rate of 19,146 gpm. The current annual production for the base year (2021) is 2,904.23 acre-feet per year (AFA). Projected demand based on 0.54% (Douglas County growth rate) in 2051 is 3,413.5 AFA. Based on this conservative projected future demand, the GRGID system has sufficient water rights over the 30-year planning period.

5.0 Summary

For the beginning of the planning period (2021), GRGID currently has adequate well production capacity (7.21 MG/day with Wells #5 and #8) to meet the demands of its community (5.7 MG/day) and negligible water quality issues impacting their system. Based on the planning horizon of 30-years (2021 to 2051) and the growth rate (0.54%) used in the analysis, GRGID has sufficient water rights (5,307.92 AFA) to account for future growth in 2051 (3,413.5 AFA). As development continues and the population grows within their district, the future required well production capacity will be 6.24 MG/day still well below the current capacity of 7.21 MG/day with Wells #5 and #8 from the seven (7) active wells. However, it is critical to reanalyze future water supply to ensure demands can be met in case growth is higher than 0.54% year over year. For an in-depth look at all considerations and groundwater modeling scenarios, see Section 5.1 and Section 5.2. For a more detailed breakdown of projected well production required capacity and the surplus, see Table 4.

Table 4: Summarized Existing & Future Production

	With Well #5 & Well #8		Without Well #5 & Well #8	
	Mgal/day	Gal/min	Mgal/day	Gal/min
Existing (2021) Water Supply Capacity [1]	7.21	7,500	4.41	4,600
Existing (2021) Water Demand	5.7	5,900	5.7	5,900
Existing (2021) Water Supply Deficit/Surplus [3]	1.51	1,600	-1.29	-1,300
Future (2051) Water Supply Demand [2]	6.24	6,500	6.24	6,500
Future (2051) Water Supply Deficit/Surplus [3]	0.97	1,000	-1.84	-1,900

Notes:
[1] Existing Water Supply capacity includes production from the following wells: Well 1, Well 2, Well 4. Well 5. Well 6, Well 8, and Well 9.
[2] The water demand in 2051 assumes the Douglas County growth rate, as discussed in Section 2.2,
[3] The deficit/surplus calculation assumes no additional well development between 2021 and 2051 to analyze the additional well capacity needed to meet future demands. A negative number represents a water production deficit (and the need for additional water production) and a positive number represents a water production surplus (no additional water production necessary to meet future water demands.

5.1 Future Water Supply Considerations

The current (5.7 MG/day) and future demands in 2051 (6.24 MG/day) are well below the maximum well capacities (7.21 MG/day), as shown in Figure 1 and Figure 3. Based on the current data and methodology used for the analysis, GRGID's current water supply of seven (7) wells is sufficient for the projected growth in the service area and will not require additional wells to meet the projected water demand of 6,500 gpm. It is important to note that population growth in an area is dependent on many different factors that are not always able to be anticipated in a future growth analysis. Therefore, the population and expected community growth should be continually monitored in case an unanticipated population boom drives the water demand to be higher than the capacity of the existing water supply. For this reason, it is encouraged that all purveyors look at the benefits of water conservation.

1. Water Conservation
    - Pros: Reduce overall demand and production needs, inexpensive
    - Cons: Consumer buy in, does not fully accommodate long-term growth, loss of revenue
2. Drill/Equip New Well
    - Pros: Maintains customer level of service, least expensive option (O&M and construction costs)
    - Cons: Expense for 3-4 months of need, finding viable location

From the 2018 GRGID Water Masterplan, ideal locations for new wells were analyzed and identified as north of Riverview Drive and east of Centerville Lane. For a location map showing the existing and potential future wells, see Figure 4 within the supplemental information section.

3. Arsenic Treatment for Well#5 and #8
    - Pros: Uses existing infrastructure, known capacity and production ability
    - Cons: Highest anticipated O&M costs, managing waste by-product
4. Intertie with Adjacent System
    - Pros: Known source of water quality and quantity, reasonable adjacent location to existing system, and anticipated to have the lowest O&M costs
    - Cons: Depending on final alignment and length, this is anticipated to have highest construction cost, and will be subject to negotiation and interlocal agreement

5.2 Modeling Options

The condition that would be recommended for modeling purposes has been summarized below and in Table 5. This is not a recommendation to the purveyor and purely an assumed option for modeling purposes. The condition uses the growth rate that was provided by Douglas County (0.54%). A summary of the projected population growth per year over the 30-year planning horizon can be found in Table 9.

Option 1: Run existing wells at existing capacities and include a new well or two new wells with a total capacity of at least 1,920 gpm at the proposed locations. See Table 6 for approximate location of the wells along with extraction depth.

See Table 5 for the required capacities of each well during each option.

Table 5: Proposed Required Well Capacities in 2051

Options	Well 1 (gpm)	Well 2 (gpm)	Well 4 (gpm)	Well 5 (gpm)	Well 6 (gpm)	Well 8 (gpm)	Well 9 (gpm)	Prop. Well 10 (gpm)	Prop. Well 11 (gpm)	Total (gpm)
Option #1	1,181	1,765	236	0	600	0	855	950	950	6,536

Notes:
[1] Max well production was assumed that wells could run 16 hours of the day during the peak months of June through September
[2] Proposed well capacity is based on a Douglas County provided growth rate of 0.54%

Table 6: Proposed Well Locations for Option #3

Parameter	Prop. Well 10	Prop. Well 11
Nearby Street	Centerville	Riverview
Well Depth (ft)	420	420
Screened Interval from (ft)	140	140
Screened Interval to (ft)	420	420
Latitude	38.92196	38.91553
Longitude	119.7411	119.7183
Elevation (ft)	4782	4828

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6.0 Supplemental Information

Table 7: Existing Well Locations & Depths

Parameter	Well 1	Well 2	Well 4	Well 5	Well 6	Well 8	Well 9
Well Depth (ft)	420	670	375	450	434	500	390
Screened Interval from (ft)	140	270	183	200	210	260	240
Screened Interval to (ft)	420	650	372	450	430	500	390
Latitude	38.909669	38.911528	38.903561	38.895936	38.913939	38.918175	38.912442
Longitude	119.717572	119.722808	119.716125	119.754536	119.743967	119.732978	119.75896
Surface Elevation (ft)	4823	4826	4848	4805	4797	4799	4763

Table 8: Historical Total Monthly Well Production

Month	Monthly Well Production (gallons)					
	2018	2019	2020	2021	2022	2018-2022 Average
January	23,207,000	26,901,000	24,294,000	23,748,000	27,049,000	25,039,800
February	23,030,000	22,276,000	24,709,000	22,206,000	23,729,000	23,190,000
March	24,415,000	22,578,000	27,232,000	28,268,000	40,980,000	28,694,600
April	55,247,000	62,305,000	60,596,000	78,508,000	66,633,000	64,657,800
May	90,547,000	105,249,000	119,268,000	110,470,000	120,230,000	109,152,800
June	130,692,000	125,657,000	150,245,000	157,087,000	139,196,000	140,575,400
July	166,962,000	171,057,000	157,505,000	148,694,000	156,379,000	160,119,400
August	151,253,000	146,105,000	158,766,000	151,942,000	149,492,000	151,511,600
September	124,102,000	128,691,000	130,251,000	122,843,000	127,078,000	126,593,000
October	74,023,000	59,929,000	85,868,000	54,087,000	76,850,000	70,151,400
November	27,901,000	25,898,000	31,557,000	27,842,000	27,372,000	28,114,000
December	21,537,000	27,327,000	25,964,000	20,658,000	29,681,000	25,033,400
Total	912,916,000	923,973,000	996,255,000	946,353,000	984,669,000	952,833,200
Average Day (gpd)	2,501,000	2,531,000	2,722,000	2,593,000	2,698,000	2,610,502
Max Month (gallons)	166,962,000	171,057,000	158,766,000	157,087,000	156,379,000	160,119,400
ADMM (gpd)	5,386,000	5,518,000	5,121,000	5,236,000	5,044,000	5,165,142

= Maximum Month

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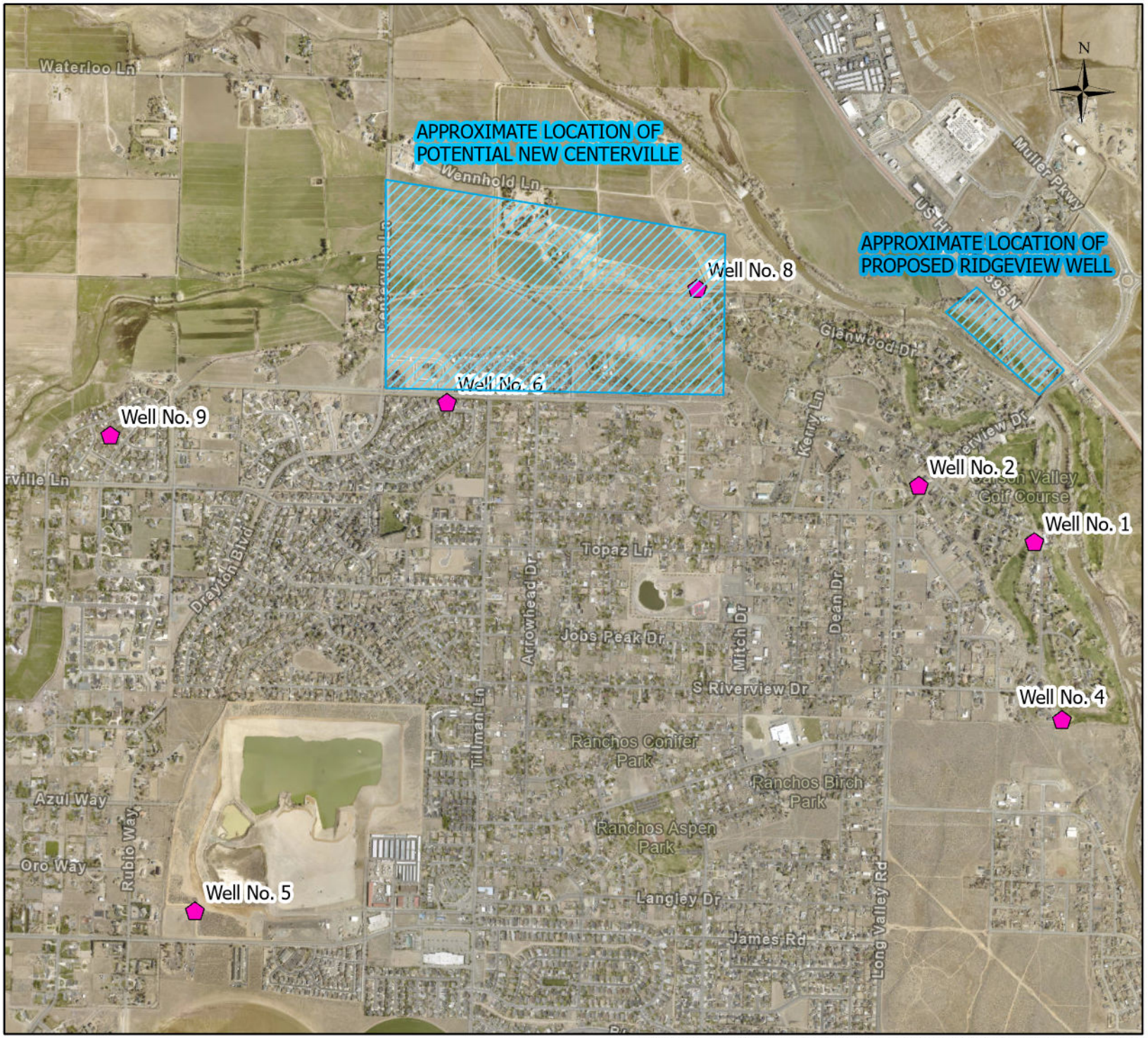
Table 9: Projected Growth Rates & GRGID Consumption

Year	Projected Growth Rates (%)	Consumption based on Douglas County (MG)		
	Douglas County	Residential	Commercial	Schools
2021 (base)		828	52	21
2022	0.54%	832	52	21
2023	0.54%	837	52	21
2024	0.54%	841	53	22
2025	0.54%	846	53	22
2026	0.54%	850	53	22
2027	0.54%	855	54	22
2028	0.54%	860	54	22
2029	0.54%	864	54	22
2030	0.54%	869	54	22
2031	0.54%	874	55	22
2032	0.54%	878	55	23
2033	0.54%	883	55	23
2034	0.54%	888	56	23
2035	0.54%	893	56	23
2036	0.54%	898	56	23
2037	0.54%	902	57	23
2038	0.54%	907	57	23
2039	0.54%	912	57	23
2040	0.54%	917	58	24
2041	0.54%	922	58	24
2042	0.54%	927	58	24
2043	0.54%	932	58	24
2044	0.54%	937	59	24
2045	0.54%	942	59	24
2046	0.54%	947	59	24
2047	0.54%	952	60	24
2048	0.54%	957	60	25
2049	0.54%	963	60	25
2050	0.54%	968	61	25
2051	0.54%	973	61	25

Table 10: Future Well Production

Year	Future Production [1]
2021 (base)	946,353,000
2022	951,463,000
2023	956,601,000
2024	961,767,000
2025	966,961,000
2026	972,183,000
2027	977,433,000
2028	982,711,000
2029	988,018,000
2030	993,353,000
2031	998,717,000
2032	1,004,110,000
2033	1,009,532,000
2034	1,014,983,000
2035	1,020,464,000
2036	1,025,975,000
2037	1,031,515,000
2038	1,037,085,000
2039	1,042,685,000
2040	1,048,315,000
2041	1,053,976,000
2042	1,059,667,000
2043	1,065,389,000
2044	1,071,142,000
2045	1,076,926,000
2046	1,082,741,000
2047	1,088,588,000
2048	1,094,466,000
2049	1,100,376,000
2050	1,106,318,000
2051	1,112,292,000

Notes:
[1] Total Projected Production is based off Douglas County provided growth rate described in Section 2.2 and is the total of all wells in gallons



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WELL LOCATIONS

GRGID

CWSD

30-YEAR REGIONAL DROUGHT PLAN

1 OF 1

LEGEND

- GRGID Wells

* The proposed wells are conceptual and the location, depth, and capacity may vary if taken to design or construction.

Paper Size: 8.5" x 11"

0 — 1,250 — 2,500
Feet

Projection: Transverse Mercator
Grid: NAD 1983 UTM Zone 11N
Datum: North American 1983
Created by: dmarinrios

Date:	11-30-2023
Project #:	10974.000
Revision:	0