Big Sky Community Water Conservation and Drought Management Plan

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1.0 INTRODUCTION

1.1 Background

The Gallatin River Task Force (GRTF) is a nonprofit organization based in Big Sky, Montana whose mission is "*to partner with our greater community to lead conservation and inspire stewardship of the Gallatin River Watershed*." Through this lens of community engagement and stewardship, GRTF has developed a Water Conservation and Drought Management Plan (Plan) to establish a foundation for ongoing water planning in an area with multiple public water providers and private well users, all of which have an impact on the vitality of the Gallatin Watershed.

Water conservation ensures responsible use of a vulnerable resource, helps improve water supply resiliency, and safeguards the community's greatest asset, the Gallatin River. GRTF's Conservation Program includes a water savings rebate program as well as active outreach and engagement with the community to educate the public on water conservation. This Plan discusses past conservation efforts and offers recommendations to continue and expand GRTF's programming and projects with a strong focus on community partnerships.

This Plan also addresses drought; how to address the impacts drought will have on Big Sky's water supply and the Gallatin River. The Plan provides recommendations for short- and long-term strategies to mitigate the impacts from drought; with a focus on demand-oriented measures. Depending on the characteristics and severity of drought, the repercussions can be significant, impacting local economies, disrupting quality of life, and even affecting the health and welfare of a population and its environment[1].

The GRTF has been leading water resources sustainability planning in Big Sky since its inception in 2000. Water conservation and drought management efforts have included:

- Drought resiliency planning as part of the National Drought Resilience Partnership for the Upper Missouri River Basin (2015 to 2017)
- Big Sky Water Conservation Program launched with tracked community water savings (July 2016)
- Big Sky Area Sustainable Watershed Stewardship Plan (*Stewardship Plan*) released with recommendation to extend existing and future water supplies by creating incentives and regulatory methods for adopting water conservation practices and programs (January 2018)
- Draft Upper Gallatin Drought Management Plan (February 2018)
- Trout-Friendly Landscape Pledge launched to promote water-wise landscaping practices (July 2020)

[1] https://www.ncdc.noaa.gov/news/drought-monitoring-economic-environmental-and-social-impacts

To continue in this vein, the GRTF has developed this Water Conservation and Drought Management Plan.

This Plan is not exhaustive and will require periodic updates, so it continues to be useful and is aligned with the current community characteristics (e.g., population projections, water demand trends, development patterns, water supply).

1.2 Plan Need

The Upper Gallatin River Basin has a limited supply of water that could be surpassed as the demand for water increases with community growth and climate variability. Water conservation is the most cost-effective, expedient, and environmentally friendly way to thrive through drought and stretch water supplies while ensuring a high quality of life and healthy rivers. Some of the key factors guiding the need for the Plan include:

- Big Sky's 10-year population growth is currently estimated at 32.5% (population estimates are from the 2020 U.S. Census data).
- No further water rights can be allocated in the Gallatin or Madison watersheds.
- Groundwater withdrawals from individual and community wells can have a significant impact on the availability of fresh water supplies and streamflows in the Big Sky area and downstream.
- A water supply deficit is estimated to first occur within the next few years based on projections from the 2015 Water System Source Capacity Plan Update prepared for the Big Sky County Water and Sewer District (Western Groundwater Solutions).
- With minimal annual precipitation (~20 inches), Big Sky's semi-arid climate relies heavily on snowpack for its water needs. According to the 2017 Montana Climate Assessment, Montana's snowpack has declined since the 1930's and warming temperatures over the next century, especially during spring, are likely to reduce snowpack at mid and low elevations. Further, rising temperatures will likely exacerbate drought and particularly affect rural water systems because of the lack of redundancy and resources.

1.3 Plan Objectives

The Big Sky Resort Area Tax District was used to establish the planning boundary for this effort. ***Figure 1.1*** shows the planning area, the water providers, and private wells. The resort community has fluctuating population with summer and winter peaks and slower shoulder seasons. The transient nature of the area and lack of a single governmental organization make it challenging to create "one-size-fits-all" planning documents that address the needs of the entire community; the intention of this Plan is to provide high-level summaries of water supply and demand and offer recommendations for improving water conservation and drought preparedness.

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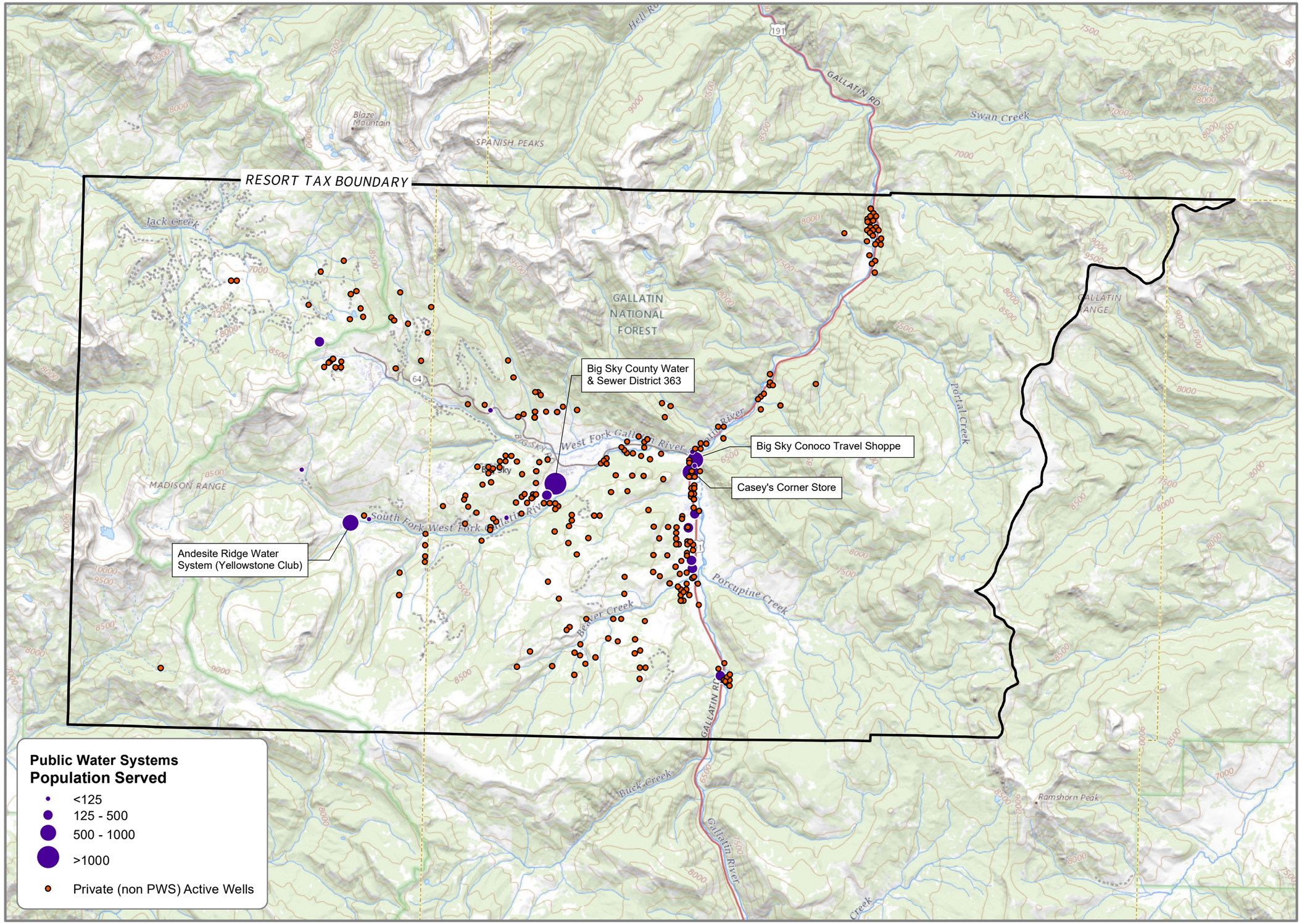


N

0 5,500 11,000

Feet

1 inch = 11,000 feet

Locator Map Not to Scale

Big Sky, MT

Figure 1.1

STUDY AREA OVERVIEW

BIG SKY COMMUNITY WATER CONSERVATION AND DROUGHT MANAGEMENT PLAN

GALLATIN RIVER TASK FORCE

Date: 3/3/2022

Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 StatePlane Montana FIPS 2500 | Edited by: zmagdol | C:\Users\ZMagdol\AE2S\GRTF - Water Conservation Planning - Documents\GIS\GRTF_water conservation_Basemap.mxd

The Big Sky Water Conservation and Drought Management Plan focuses on demand management versus supply management. Demand Management includes methods to encourage **water users** to reduce water demand, whether through change in behavior, the implementation of water-saving technologies, regulatory methods, or through the reduction or elimination of waste. Supply management includes methods by which a **water provider** maximizes the use of available untreated water. The differences between demand-side and supply-side planning lay in the types of strategies and those responsible for implementation. Supply-side plans are typically focused on infrastructure and water source, and it is generally the sole role of the water provider to implement the strategies. Demand-side plans, are focused on how, and why, water is used, and success ultimately lays in the hands of the water user.

Water users, for the purposes of this Plan, includes all human-derived water demand such as individual residences, commercial establishments, resort operations, and golf courses.

Water providers, for the purposes of this Plan, is defined as a public water supplier registered with the Montana Department of Environmental Quality. Water systems in the State of Montana are considered public if they serve at least 25 people. There are over 20 water providers in Big Sky, which is largely the result of fragmented political, management, and ownership boundaries. The planning area is within two counties and is not incorporated.

With demand management at the forefront, the central objectives guiding this planning effort are to:

- Bring community water providers to the same table to discuss conservation and drought management planning
- Identify key conservation measures or projects GRTF can lead to support water providers and the community
- Integrate water conservation and drought planning with the overall community sustainability vision

This Plan was developed over the course of 18 months and included several workshops with Big Sky water providers to understand their needs. The Plan contains the following elements:

- Big Sky Public Water System Operators Drought Survey
- Summary of Water Demand
- Water Conservation Program Expansion
- Drought Vulnerability Summary
- Recommended Drought Monitoring System
- Recommendations for Demand Focused Drought Response Measures

1.4 Summary of Recommendations

Table 1.1 summarizes demand focused recommendations for projects, actions, or initiatives that GRTF can take over the next 5 years to address water conservation and drought management.

As previously noted, the plan and recommendations are not exhaustive and will require periodic updates, so it continues to be useful and is aligned with the current community characteristics and needs.

Table 1.1 Summary of Recommendations

Supply & Demand	1. Complete a watershed-scale water balance to better quantify supplies and demands. 2. Prioritize efforts to reduce summer time/irrigation demand.
Water Conservation Program Strategies	<u>Education & Outreach</u> 1. Expand print/digital marketing opportunities to bolster program participation and expand water conservation messaging. • Develop targeted outreach material and campaigns for specific water user groups (i.e. business, residents, developers, HOA's, etc.). • Share success stories, case studies, and demonstration projects. • Work with HOAs, property managers, and local organizations to help get the word out. 2. Increase engagement by creating more in-person conservation education and outreach opportunities. • Identify opportunities to expand workshops classes, and events. • Identify opportunities to expand water-wise demonstration gardens. 3. Collaborate with local landscaping companies and nonprofit organizations to build capacity, align messaging, and expand education & outreach opportunities. • Trout-Friendly Business Partnerships • Gallatin Invasive Species Alliance & Fire Department • Web-based Landscape Inspiration Hub • Landscape Design Templates <u>Incentives & Technical Assistance</u> 1. Expand rebate eligibility and incentives for outdoor conservation. • Offer indoor rebates to the commercial sector (completed June 2022 • Offer outdoor rebates to the commercial sector (completed June 2022). • Expand outdoor and indoor rebate opportunities (completed June 2022). • Develop a custom rebate option for large commercial businesses who may be upgrading a large number of fixtures. 2. Work with a local organization to develop a Water Conservation Plan for their business (pilot project). 3. Research developer incentives to reduce water demand. <u>Advocacy & Partnerships</u> 1. Formalize and expand partnerships with water providers • Regular contact and information sharing with water providers

	• Explore formation of a "Big Sky Saving Water Partnership" • Research opportunities to support/incentivize/fund strategies led by water providers (i.e. conservation rates, metering, etc.). 2. Encourage adoption of water-wise design and regulations into zoning codes and the development approval process. • Work with SNO on green build toolkit • Develop a Landscape Design Guidebook for HOAs/developers. • Research opportunities for rainwater harvesting & grey water reuse.
Tracking Water Conservation	1. Improve water conservation data tracking and set a community-wide reduction goal. • Work with the Big Sky Water & Sewer District to regularly compute average unit water demand (per capita, per connection, or per single family residence (SFE)). • Work toward aligning water provider data and information used to track annual water demand • Set a community-wide water reduction goal
Drought Management	1. Address the growing threat of more frequent and prolonged drought by monitoring local drought conditions and facilitating community-wide drought response. • Develop the drought monitoring model into an interactive web-based dashboard. • Develop a drought committee (i.e. water providers, fire department, etc.) to monitor drought status and facilitate community drought response. • Develop drought related communication material in coordination with drought committee and distribute to the general public and visitors.
Budget & Funding Sources	1. Diversify available funding sources to support annual program costs and special projects. • Research grant opportunities • Work with water providers, in addition to the Big Sky County Water and Sewer District, to support the program

2.0 WATER SYSTEM PROFILE

2.1 Overview of Big Sky Water System

The Big Sky community includes over twenty water providers and a myriad of private wells serving individual residences and business (see ***Figure 1.1***). The Montana Department of Environmental Quality (MDEQ) categorizes public water systems into three categories:

- Community: a public water supply system which serves at least 15 service connections used by year-round residents or that regularly serves at least 25 year-round residents.
- Transient Non-Community: a public water supply system that is not a community water system and that does not regularly serve at least 25 of the same persons for at least 6 months a year. This system primarily serves a transient population (cafes, bars, campgrounds, motels, etc.).
- Non-Transient Non-Community: a public water supply system that is not a community water system and that regularly serves 25 of the same persons over six months per year. Examples are separate systems serving workers and schools.

Table 2.1 summarizes the water providers and key data. Data were gathered from public sources (MDEQ and DNRC) as well as a water provider survey sponsored by GRTF. Nine water providers completed this survey. ***Appendix A – Water Conservation Survey*** includes the survey questionnaire and summarizes the responses received.

One of the key take-aways from the survey is that there is a wide range of data collection practices among the water suppliers. For instance, Big Sky Water & Sewer District maintains a robust metering and record keeping system which allows them to track and understand water use, while other smaller systems lack the resources to support that level of sophistication. This discrepancy in data and resource availability among the water providers makes it challenging to provide a standardized and all-encompassing conservation and drought management plan; therefore, this Plan aims to provide a range of recommendations.

Another key take-away is that demand-side water conservation strategies being implement by water providers is limited. Several of the larger community water providers have implemented rate structures that encourage conservation. Currently, only GRTF is providing rebates, educational programming, and paid staff to support water conservation efforts. Improvements in water savings can be achieved through a coordinated effort between GRTF and water providers to implement water conservation strategies.

Based on the published MDEQ and Big Sky County Water & Sewer District data, there are a total of 3,323 residential and 537 non-residential connections to public water providers. The total appropriated water to these public systems is over 11,750 acre-feet or 3,830 million gallons per year. Virtually all these water rights are groundwater rights, with the exception of a few spring and surface water rights in the Canyon. In general, groundwater is more resilient to drought than surface water because the groundwater response to drought conditions (e.g., decreased precipitation) are dampened. However, there are vulnerabilities to Big Sky's groundwater supplies, and they are discussed further in ***Section 4***.

There are approximately 300 active private wells within the planning area with a total appropriated water volume of over 860 acre-feet. It is estimated that under 10% of the community uses private wells for water supply with the remaining population being served by Public Water Systems. **Table 2.2** summarizes those wells and total annual legal rights. Water conservation and drought response planning for private well owners have unique challenges and opportunities. In some ways, private well owners have more control over their water and may be able to make meaningful changes to reduce water use; however, they are also limited by economies of scale and likely can't accomplish improvements that result in regional benefits. Private well owners also suffer more acutely from drought or changes in supply availability because lack of resources prevents them from implementing redundancy or developing reserves.

Table 2.1. Big Sky Public Water Providers

Water Provider	DEQ Water System ID	Population Served	Non-Residential Connections	Residential Connections	System Classification[a]	Annual Water Right (ac-ft)[c]
Yellowstone Club	Multiple[1]	1,000		487	C	625
Antler Ridge	MT0004202	50		28	C	98
Big Sky School District #72 (Ophir School)	MT0001281	275	1		NTNC	26
Big Sky County Water and Sewer District	MT0002385	4,132	403	2320	C	4,780
Corral Bar Inc.	MT0001283	195	2		TNC	13
Firelight Meadows	MT0004236	350		216	C	53
Ramshorn View Estates	MT0004035	185		75	C	90
Spanish Peaks Mountain Club	MT0004588	40		173	C	625
Moonlight Basin	MT0004023	350		300[b]	C	583[2]
Big Sky Business Center	MT0003949	49	10		TNC	9
Lone Mountain Guest Ranch	MT0001820	50	24		TNC	5
Big Sky Conoco Travel Shoppe	MT0001832	1,000	1		TNC	N/A
Casey's Corner Store	MT0003839	510	1	2	TNC	N/A
Cinnamon Lodge and Adventures	MT0001546	40	10	8	TNC	5
Bucks T4	MT0001292	270	6	3	TNC	142
320 Ranch	MT0001291	215	45	5	TNC	45
DT Ventures	MT0003963	78	2	5	TNC	2
Rainbow Ranch Lodge	MT0003893	210	4		TNC	N/A
Elkhorn Ranch	MT0001830	65	26	1	TNC	33
Gallatin Riverhouse Grill	MT0001285	50	1		TNC	N/A
Whitewater Inn	MT0004079	125	1		TNC	N/A
TOTAL		**9,239**	**537**	**3,323**		**11,758[c]**

[a] C: Community, TNC: Transient Non-Community, NTNC: Non-Transient Non-Community.

[b] Moonlight Basin connections not categorized – assumed all residential for conservative planning purposes (i.e., greatest water demand)

[c] Total annual water right provided where known – includes only groundwater rights used for domestic and irrigation use

[1] Yellowstone Club Public Water System includes four smaller sub-systems: Andesite Ridge, Encampment Trail, Lower Pioneer Mountain, and Lone View Ridge.

[2] Moonlight Basin annual water right only accounts for groundwater rights

Table 2.2. Summary of Active Private Wells in Resort Tax District

Purpose of Use	Number of Wells	Appropriated Volume (ac-ft)
Commercial	20	136.4
Domestic	249	489.0
Irrigation	7	100.3
Lawn and Garden	19	71.3
Multiple Domestic	5	63.5
Stock	2	1.3

2.2 Supply and Demand

Supply

All the drinking water in the Planning Area is provided by groundwater sources. The Big Sky County Water and Sewer District is the largest water provider in the area, with a capacity of approximately 2,200 gallons per minute (gpm) and 4,780 acre-feet in annual rights. Their 2015 Water System Source Capacity Plan Update (Western Groundwater Services, LLC) provides a comprehensive analysis of groundwater supply and estimated a deficit would occur in the Mountain Village between 2021 and 2022. The District is actively working to develop new supply and improve storage. There are also several surface water diversions in the Planning Area which are used during the growing season for irrigation. A detailed analysis or quantification of supply availability is not within the scope of this Plan.

Demand

Water meter data were requested from the major water providers (large HOAs, resorts, and the Big Sky Water & Sewer District), but detailed records were only provided for the Big Sky County Water and Sewer District (the District) and Firelight Meadows (FLM). Many of the smaller water providers lack the resources to be able to track water use on the scale required to understand demand dynamics and conservation. Combined, these two systems serve nearly 50% of the community and therefore provide a representative profile of water demand across the study area.

Water meter data were analyzed for 2011 through 2020 on a quarterly and connection classification basis (residential and non-residential). Firelight Meadows water meter data were only provided for 2016-2020.

Quarterly data is categorized as follows:

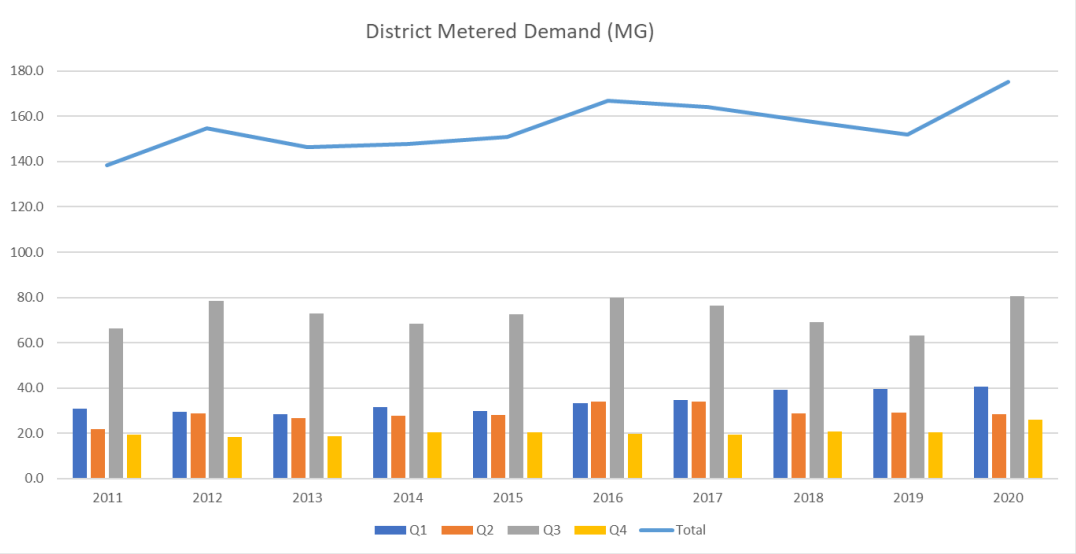
- Quarter 1: January, February, March

- Quarter 2: April, May, June
- Quarter 3: July, August, September
- Quarter 4: October, November December

Non-residential water meter/connection classification encompasses all user classes not considered residential; this includes commercial, hotels, public institutions and services, mixed use development, non-residential landscape irrigation, golf course, and emergency services.

Figure 2.1 shows total quarterly and total annual water demand in million gallons for the District and Firelight Meadows. The key conclusions from these quarterly and annual data include:

- FLM 2019 and 2020 water use is markedly lower than 2016-2018 and does not follow the increasing trend experienced in the District. Water demand in the community is highly variable due to a transient population, tourism peaks and troughs, and the state of the economy. Note that Firelight Meadows entire service area is classified as residential.
- Average per capita Q3 water use in the District is about 160% greater than Q1, Q2, and Q4 demand. This is due to the large irrigation demand during summer months.
- Quarter 1 water use in the District is, on average, 50% greater than Q2 and Q4 use. This increase is from increased population during peak winter tourism season.
- Water use in the District has been generally increasing over the past 10 years – this is consistent with population growth.



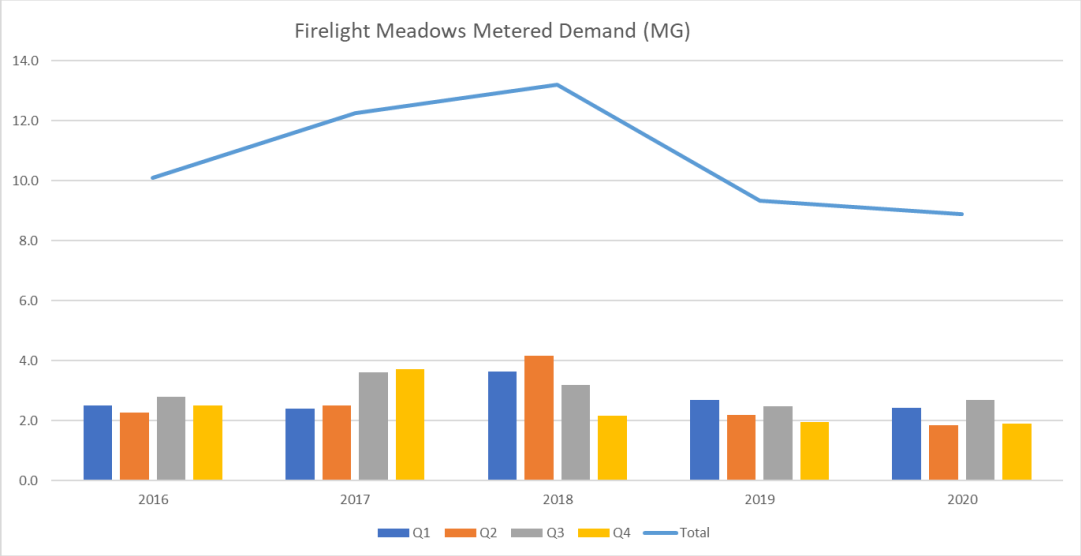


Figure 2.1. Total Quarterly and Annual Metered Demand (million gallons)

Figure 2.2 shows total annual residential and non-residential water use for the District. Non-residential average annual demand has remained relatively consistent over the past 10-years at approximately 60 million gallons per year. Residential demand has generally been increasing with the highest demand in 2020. ***Table 2.3*** summarizes the District's water meter connections and ***Figure 2.3*** plots these data.

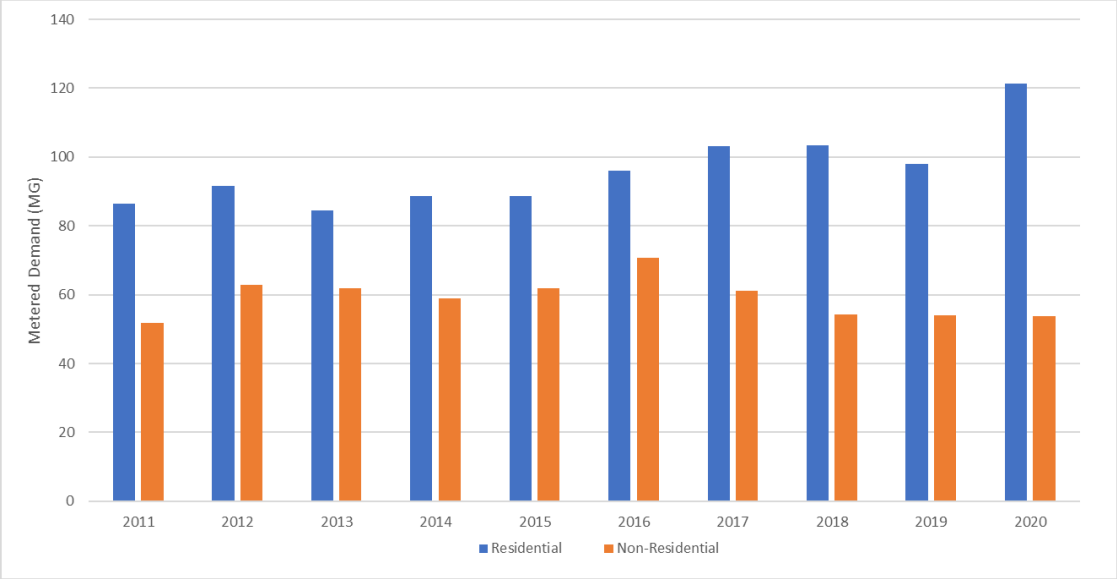


Figure 2.2. District Total Annual Residential and Non-Residential Demand

The number of residential connections to the District's water system is increasing over **6% annually** between 2016 and 2020. This growth is consistent with the increase in residential

annual demand over the same period (~7%). This growth rate is also consistent with trends experienced in the City of Bozeman.

Table 2.3. District Water Meter Connections

Year	Residential Connections	Non-Residential Connections	Total Connections	% Increase
2011	1770	300	2070	-
2012	1771	307	2078	0.4%
2013	1785	311	2096	0.9%
2014	1808	317	2125	1.4%
2015	1813	377	2190	3.1%
2016	1813	336	2149	-1.9%[+]
2017	1987	348	2335	8.7%
2018	2100	368	2468	5.7%
2019	2200	319	2519	2.1%
2020	2320	403	2723	8.1%

[+] District data show decrease in total connections in 2016 - this is likely an artifact of their tracking/billing software. Data should be considered approximate estimates.

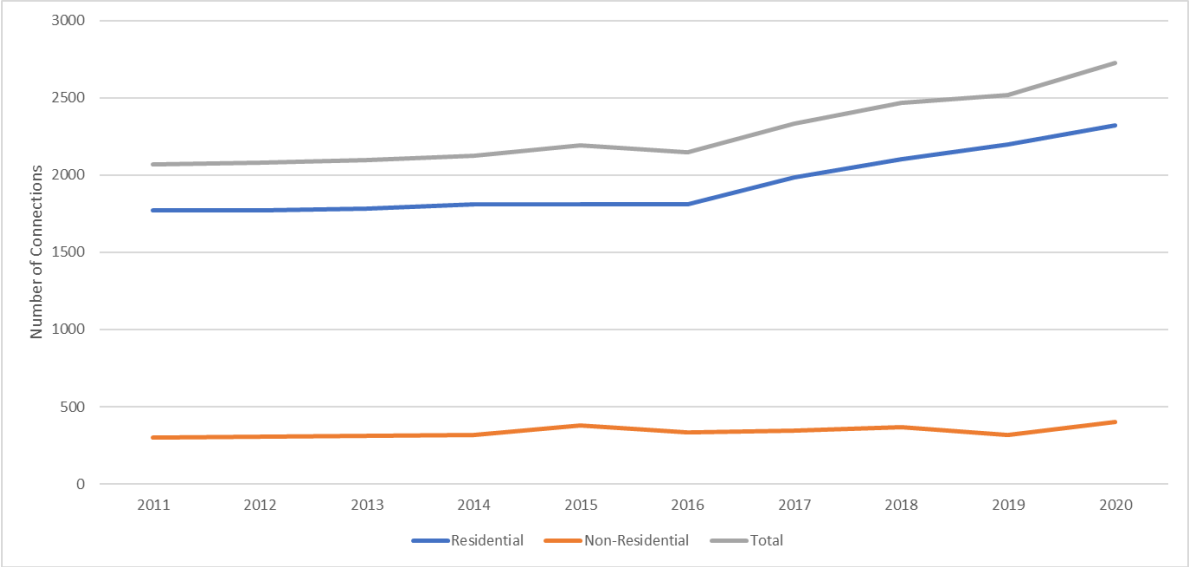


Figure 2.3. District Water Meter Connections

Evaluating water use data on a per person, or in this case, per connection basis, is common practice in water management planning because it provides a standardized way to project future demand, compute conservation savings, and analyze supply/demand gaps. ***Table 2.4*** summarizes metered residential and non-residential average water use per connection for Firelight Meadows and the District.

Table 2.4. Firelight Meadows and District Metered Average Water Use - gallons per day per Connection

	Q1	Q2	Q3	Q4	Average Annual
FLM Residential[1]	140	130	150	130	138
District Residential[2]	133	100	234	77	136
District Non-Residential[2]	341	363	1011	215	483
Recommended Residential Planning Values	**135**	**110**	**234**	**110**	**147**
Recommended Non-Residential Planning Values	**345**	**365**	**1015**	**220**	**486**
Recommended Average Planning Values	**240**	**238**	**625**	**165**	**317**

[1] FLM number of connections not provided, assumed constant for 2016-2020 based on MDEQ data

[2] District water use averaged from 2011-2020

The recommended planning values are based on weighted averages with a higher priority placed on District data due to the additional detail and longer period of record provided. As a comparison to nearby communities, ***Table 2.5*** summarizes the proposed planning values compared to the City of Bozeman's metered demand.

Table 2.5. Water Use Metrics versus City of Bozeman (gallons per Connection per day)

Metric	Big Sky value	Bozeman value[b]
Average Annual (all meter classes)	317	235
Average Winter (all meter classes)	215	165
Average Sumer (all meter classes)	625	391

[b] Bozeman values based on City-wide water use (2016-2020) – **provisional data**

Big Sky water use per connection is higher than Bozeman which is likely reflective of greater landscape irrigation demand and greater number of connections serving hotels and other large multi-unit buildings.

Golf Course & Irrigated Landscape Water Demand

There are over 170 acres of irrigated golf course in the Meadow Village alone and an additional three established golf courses within the planning area. The Meadow Village Golf Course irrigation water is supplied by a combination of reuse water and diverted surface water. Irrigation data for the Meadow Village was reviewed for 2011 through 2021 – this included all irrigation uses, 80% of which is for golf course area. Virtually all of the water used over that period was supplied by reuse water rather than diverted surface water. The average annual water use for Meadow Village irrigated landscape was 368,000 gallons per acre (1.13 acre-ft per acre).

As mentioned above, all of the Meadow Village irrigation water is supplied by reuse water and therefore does not directly negatively impact water supplies. Expanding the reuse distribution system should be a priority for the community to reduce the potable water demand.

Private Wells

There are over 300 private wells within the planning area. The annual demand for each well can be assumed equivalent to their respective water rights. However, there are likely many cases where actual water use is much less than the legal availability. An Integrated Water Resources Plan and Water Balance would better quantify the total legal demands in the area.

Future Demand

Population growth rates over the past five years in Big Sky are estimated to be between 5 and 8 percent based on this analysis and previous wastewater flow analyses for the District. A 6% annual growth rate was used to project future demand for this study. Assuming this growth rate is applicable to residential and non-residential connections the projected annual demand in 2030 will be 1,620 acre-feet. ***Table 2.7*** summarizes projected residential and non-residential demands for the Big Sky community.

Table 2.7. Projected Big Sky Community Annual Water Demands

Year	Connections		Residential Demand		Non-Residential Demand		Total Demand	
	Residential	Non-Residential	MG	ac-ft	MG	ac-ft	MG	ac-ft
2020	3,623	537	194	595	95	292	289	887
2026	5,193	770	279	856	137	420	416	1,277
2030	6,602	978	354	1,086	173	531	527	1,617
2040	12,029	1,783	645	1,980	316	970	961	2,949
2060	39,937	5,919	2,143	6,577	1,050	3,222	3,193	9,799

For comparison, the District's 2015 Source Capacity Plan Update (Western Groundwater Services), predicted that by 2044 the District will require an annual supply volume of 1,970 acre-feet. The 2040 annual demand presented in ***Table 2.7*** includes the entire Big Sky community and assumes that both residential and non-residential growth rates remain consistent. In reality, the large landscape irrigation demand will not increase at the same rate as residential due to planned increases in reuse water, limitations of available suitable space, and economies of scale.

Demand Analysis Conclusion

The key findings from this analysis include:

- Water conservation and management efforts that target reducing summer-time demand will make the biggest impact in optimizing overall water use. Summer per capita demand is over 160% greater than winter demand.
- The community is rapidly growing, and water demand reflects that growth. Legal availability will not be the limiting factor in growth – infrastructure and aquifer capacity will limit available water (40 year planning horizon at annual growth of 6%).
- This analysis did not consider competing water demands such as minimum required streamflow and wildfire risk. Future watershed-scale water balances should be completed to determine a more complete supply-demand profile.

Analysis Limitations

Big Sky's population is seasonal and dominated by tourism, spiking in the winter and summer. The total population served by public water systems, as recorded by MDEQ, is approximately 9,200 people. This includes a large transient / non-permanent population. These population dynamics make it challenging to characterize water use in a standardized method. For the purposes of this study, water demand is analyzed by residential and non-residential connection. This simplified approach allows for easy evaluation of conservation strategies and for drought planning purposes but should not be considered when conducting more detailed planning or infrastructure design.

The data provided is limited to only two sources – there are 18 additional public water systems in the community and therefore the findings presented in this report should not be considered a conclusive or complete and detailed view of water use in Big Sky. Additionally, the data provided by Firelight Meadows was provided in a simplified format already summarized by quarter and year; therefore, it is challenging to confirm the validity of the data. The District's meter data does include meter account details but had some data omissions in 2019 and 2020 due to accounting software changes at the time of this study.

The conclusions drawn from this analysis provide a general understanding of water use characteristics in Big Sky and will help provide a foundation for future water supply and demand studies.

3.0 WATER CONSERVATION

3.1 Background

The Big Sky Water Conservation Program is one of only two programs in Montana that seeks to inspire community members to actively engage in water conservation. Changing the "culture" of water use in the Big Sky area to align with the realities of our semi-arid mountain climate through education and incentives are key components to the program.

Currently, GRTF distributes rebates for indoor and outdoor appliances / fixtures as summarized in ***Tables 3.1 and 3.2***. The indoor rebate program has been in operation since 2016. The outdoor program started in 2017 and has seen less participation than the indoor rebates. In general, GRTF experienced higher interest in the rebate program when first initiated and when outreach efforts increased.

Table 3.1. Current Indoor GRTF Rebate Program

Conservation Strategy	Number Implemented Since 2016	Average Implemented / Year	Rebate Award
Water Efficient Toilets	145	25	$50 - $250[+]
Clothes Washer	30	5	$150
Showerhead installs / swaps	60	11	$20

[+] Rebate award amount varies with exact fixture model and is subject to change

Table 3.2. Current Outdoor GRTF Rebate Program

Conservation Strategy	Number Implemented (2017-2019)	Average Implemented / Year	Rebate Award
Smart Irrigation Controller	58	29	50% off retail
Efficient Sprinkler Heads	12	6	50% off retail
Irrigation / Landscape Audit	4	2	$100

Since its inception, there have been approximately 100 unique individuals / household taking advantage of the rebate program. Assuming the total number of households in the community is 4,010, an estimated 2.5% of homes have participated in the program (0.5% per year). Based on calculations carried out by GRTF, the participation equates to a total cumulative yearly water savings of **8.4 million gallons**.

3.2 Water Conservation Goals

The vision for the Big Sky Water Conservation Program is for everyone in the community to understand the value of our water resources and to participate in water conservation to ensure a reliable, sustainable, resilient water supply and protect the Gallatin River.

The watershed stewardship plan, along with other community planning efforts, including BSRADS's Community Vision & Strategy, has identified interest in further expansion of the Big Sky Water Conservation Program by developing more incentive-based options for water conservation practices that are coupled with education and outreach programming. In addition to incentives for water conservation, developing regulatory requirements for water conservation that limit the extent of lawns, water features, and ponds and minimize or eliminate water usage for non-critical uses may be necessary to sustain the ecological health of the river systems.

Big Sky aspires to set the bar for the highest standard of responsible water use. However, this oftentimes demands moral and cost decisions tied to development. To migrate those issues, the Vision and Strategy serves as testament that protecting and conserving the natural environment is the will of the Big Sky community. The community's development standards should act as an extension of this will by adopting policies and encouraging water conservation and efficiency[2].

The Big Sky Sustainability Network Organization (SNO) is in the process of developing a Climate Action Plan (CAP) for the community. After conducting and publishing a baseline Community Greenhouse Gas (GHG) Inventory of 2018 and 2019 , SNO identified the need for a CAP to detail a strategic framework for measuring, planning, and reducing carbon emissions and increasing resilience to climate change-related impacts. The CAP emphasizes water conservation, understanding that Big Sky is and will continue to face challenges to the availability and resiliency of its water supplies.

In the following section, conservation program categories and conservation measures have been developed to help guide program growth and development over the next 5 years.

3.3 Program Strategies

Water conservation program strategies are specific actions intended to achieve either a behavioral or material change towards reducing consumptive water use in Big Sky. Water conservation program strategies have been grouped into one of three categories as defined below:

- **Education & Outreach:** Strategies that aim to motivate or inspire behavior change.
- **Incentives & Technical Assistance:** Strategies that provide technical assistance or financial motivators either in the form of avoided costs, rebates, or recognition.
- **Advocacy & Partnerships:** Strategies that provide pathways for community water leaders to stretch existing water supplies through partnerships, policies, ordinances, or other activities that incentivize or mandate change in water use.

[2] https://resorttax.org/wp-content/uploads/2022/01/12.02.21_OurBigSky_FinalPlan_ToPrint.pdf

Education & Outreach

Education and outreach strategies inform community members on the ecological and economic benefits of water efficient practices by sharing information through various communication channels. As a growing resort community, there is a continual influx of new community members, many of which may be unfamiliar with the ecological limitations of living in a headwater's community in a mountain semi-arid environment. Ongoing education and outreach to HOAs, developers, and water users will continue to be a key component for the successful implementation of the Big Sky Water Conservation Program. GRTF has been and will continue to be the primary lead for education program measures with support from various partners to help distribute information and collaborate on outreach and education opportunities.

Partners: Homeowners Associations, Water Providers, Big Sky Sustainability Network Organization, Big Sky Chamber of Commerce, Big Sky Community Organization, Gallatin Invasive Species Alliance, landscaping businesses, Big Sky Fire Department.

Key education strategies outlined in the *Stewardship Plan* include:

- Educate homeowners and businesses on the ecological and economic benefits of water efficient landscape design and irrigation systems that reduce summer irrigation demands.
- Educate homeowners and businesses on indoor water conservation measures and the installation of low flow appliances.
- Educate community members on the realities of living in an ecologically sensitive semi-arid mountain environment situated at the headwaters of the Gallatin River and Madison River.

Brochures – GRTF currently utilizes EPA WaterSense "Simple Steps to Save Water" brochure. This brochure is free to GRTF as a WaterSense Partner. In order to address the needs of diverse water users across the community, the brochure inventory could be expanded to include other topics such as:

- Water-wise commercial landscaping
- Demonstration Garden Guides
- Water Conservation for Private Wells
- How to Track Water Use
- Drought Stages and Response Actions

Rack Cards – GRTF currently utilizes a two-sided rack card that provides information on rebate opportunities. This rack card will need to be updated as rebates/incentives are added to the program. Rack cards are designed to be displayed at partner businesses such as local landscaping nurseries, HOA offices, water provider offices, etc.

Demonstration Gardens – Demonstration gardens provide an opportunity to inspire a water conservation ethic through hands-on experiences. GRTF developed a stormwater/raingarden at Ophir School that demonstrates water-wise landscape practices and worked in collaboration with Gallatin Invasive Species Alliance on a water-wise garden at Crail Ranch.

Big Sky Water Wise Landscape Guide – GRTF has developed a landscape guide that provides landscapers, contractors, and homeowners with basic, step-by step recommendations and standards for creating a water wise landscape. The purpose of the guide is to increase water efficiency and reduce water waste through better irrigation design, appropriate plant selection, and placement, turf placement and type, and other techniques. When updating/modifying the guide, it is important to coordinate with other community partners who are advocating for sustainable and geographically appropriate landscaping practices such as the Gallatin Invasive Species Alliance's Grow Wild Program and the Big Sky Fire Departments Fire Adapted Communities Initiative.

Video Segments – Develop a number of short video segments that provide information on various water conservation practices including water-wise landscape design (plant selection, installation, and watering), water-wise irrigation (design, retrofitting, and maintenance), lawn care and watering, container gardening, virtual tours of demonstration gardens, how to fix leaks, how to easily swap out a showerhead, etc.

Water Conservation Best Management Practices – Develop Best Management Practices (BMPs) to provide a menu of options for which water users can choose to implement in order to achieve benchmarks and goals through water conservation. BMPs are voluntary efficiency measures that are intended to save a quantifiable amount of water, either directly or indirectly, and can be implemented within a specified timeframe. BMPs can help provide guidance for delivering a conservation measure or series of measures that is useful, proven, cost-effective, and generally accepted among conservation experts.

Trout-Friendly Landscape Initiative – In 2021, GRTF launched the Trout-Friendly Landscape (TFL) initiative as a part of the Big Sky Water Conservation Program to encourage water-wise practices in lawns, gardens, and outdoor landscapes, which also tie into the ecological protection of our natural resources. Currently, TFL includes a voluntary pledge and engaging local landscaping companies through business partnerships.

- **Trout-Friendly Pledge** – The Trout-Friendly Pledge can be taken by Big Sky residents and businesses to acknowledge their support in implementing water-wise practices in their landscapes. All Big Sky residents and businesses are encouraged to take the pledge, whether they are already implementing water-wise practices, or would like to incorporate more water-wise practices into their landscaping. The pledge is an online form that covers the 7 principles of water-wise landscaping outlined in the Big Sky Water-Wise Landscape Guide. Pledge participants have the option to request a consultation with GRTF for additional resources on water-wise landscaping practices and/or request a TFL lawn sign that can be placed in their landscape to recognize their participation.

- **Trout-Friendly Businesses Partnerships** – Trout-Friendly Business partnerships are intended to engage organizations that are knowledgeable in landscaping practices and doing frequent hands-on work on Big Sky's various landscapes to grow TFL's reach and impact. By partnering with local landscaping and property management businesses, the goal is to provide access to knowledgeable trained landscape and plant experts providing site-specific advice on techniques to improve water efficiencies through irrigation modifications, plant selection and placement, and further get the word out on rebate options. Working directly with landscapers could also offer opportunities for data collection and research into behavioral and technical aspects of landscape preferences and practices; information which could assist in understanding of those practices and beliefs and helping to guide program development in the future.

Landscape Inspiration Hub – Develop a virtual inspiration hub to showcase water-wise gardens throughout the community modeled after the Waterwise Yards.

Water-Wise Plant List – The Big Sky Water Wise Landscape Guide provides a plant list that includes water-wise, drought-tolerant, and native groundcovers, grasses, trees, shrubs, and perennials. The plant list hasl been updated and expanded as part of the expanded outdoor rebates which will include rebates for purchasing drought-tolerant and native plants.

Landscape Templates – Many Big Sky residents and businesses would like to have a water efficient landscape but do not know where to begin or are not allowed to have a water efficient landscape due to their homeowner's association requirements. Providing simple templates for commercial and residential landscapes could provide the added guidance needed by demonstrating visually how a landscape can be attractive, useable, maintainable, and water-efficient.

Workshops, Classes, and Events – GRTF currently provides in person outreach via tabling opportunities at the summer Farmers Market and in front of the post office. Provide regular

and on-going opportunities for residents and businesses to expand their knowledge of water conservation techniques and behaviors. Workshops could include lectures, demonstrations, hands-on experiences, etc. Subject matter would include both indoor and outdoor strategies, and be targeted to a variety of audiences. Subject experts could be utilized to help expand perspective and subject content.

Rebates & Incentives

Rebates and incentives provide financial motivators either in the form of avoided costs, rebates, or recognition. Rebates are defined as financial incentives for buying a particular product or for actions (e.g. removing lawn or planting certain types of plants) that improve water efficiency. Incentives are defined as a reward or benefit for a specific action (e.g. awards, certifications, etc.). Interest and participation in rebates and incentives is largely dependent on a strong education and outreach campaign.

Partners: EPA WaterSense Program, Big Sky Sustainability Network Organization, local businesses.

Indoor Rebates – GRTF offers rebates to Big Sky businesses and residents who install EPA WaterSense and EnergyStar labeled products that are independently certified to meet rigorous criteria for both performance and efficiency.

Rebates offered from 2016-2022

- WaterSense labeled toilet (1.28 gallons per flush or less)
- WaterSense labeled showerhead (1.75 gallons per flush or less)
- Energy Star labeled clothes washer (CEE Tier rated 1, 2, or 3)

Additional rebates added summer 2022:

- WaterSense labeled flush-o-meter toilet (1.28 gallons per flush or less)
- WaterSense labeled urinals (.0125 gallons per flush or less)
- WaterSense labeled bathroom faucet (1.2 gallons per flush or less)

Outdoor Rebates – GRTF offers rebates to Big Sky businesses and residents who install EPA WaterSense labeled irrigation products, irrigation audits, water-wise plants, drip irrigation, and turf conversions.

Rebates offered from 2017-2022

- Irrigation audit
- WaterSense labeled Weather-based irrigation controller
- Rain sensor
- WaterSense labeled sprinkler spray bodies
- MSMT/rotary nozzles (approved brands)

Additional rebates added summer 2022:

- Drip irrigation
- Turf conversion
- Drought tolerant plants

Custom Rebates – Develop a custom rebate option by working with businesses to find innovative solutions to reduce water use. The traditional way of running commercial conservation programs is to create a "menu" of rebate options that a business can choose from. However, the water-saving technology available to a restaurant may not be the same as is available to a school. Custom rebates rely on the expertise of the customer to identify the water-saving technology that is most appropriate for their business. Because custom rebates provide incentives based on water savings not equipment type, it is easily adaptable to any proposed retrofit project. The custom rebate is appropriate when a "one size fits all" rebate won't work and/or for larger scale retrofit projects.

Free Products – GRTF offers free water saving products to Big Sky residents and businesses including showerheads and faucet aerators. Additional free products to consider offering include pre-rinse spray values for commercial kitchens.

Sustainability Certification – Develop and implement a voluntary certification program for the commercial sector. The certification process may include: indoor and outdoor audits; identification and adoption of industry-specific Best Management Practices; Green Building Toolkits, adoption and implementation of a Water Conservation Plan; and support and promotion of sustainability measures. Certified businesses would be identified and receive recognition across multiple community platforms (i.e. print ads, dedicated website page, community events, etc.)

This measure has linkages with other community wide initiatives related to sustainability and natural resource management, therefore, the recommendation is to coordinate with Big Sky SNO to develop a holistic sustainability certification that includes all areas of sustainability and water conservation (i.e. energy efficiency, stormwater management, river stewardship, etc.). Criteria for certification should support and encourage LEED and other similar standards.

Business/Commercial Water Conservation Plan – Invite businesses to develop and implement Water Conservation Plans. Program details may include: plan templates, conservation goals; monitoring, reporting; water-use reductions tabulated, etc. The intent is to demonstrate to the public the commitment of the business community to act as a partner in achieving long-term conservation goals. Water Conservation Plans could be stand alone or utilized as part of a broader sustainability certification process.

Program Management & Partnerships

In order to support community leaders, GRTF, will utilize research, reports, presentations, and one-on-one work with water providers and other key decision-makers to help move toward a more sustainable water supply future.

An outdated approach to meeting new water demands is to pull water from already-stressed river systems and aquifers, imposing significant financial and environmental costs. Water efficiency and conservation strategies help improve the fiscal health and economic performance of Big Sky through reduced development costs, reduce infrastructure investments, reduced operating costs, and preservation of Big Sky's tourism economy.

Water conservation is faster and cheaper to implement than large structural projects, therefore, GRTF advocates that community water leaders explore cost-effective water conservation strategies through the adoption of water conservation policies, ordinances, regulations, and green building practices. It is much easier to maintain a home and/or landscape in a manner supportive of a conservation ethic when the home and/or landscape was designed and constructed with water conservation in mind, therefore, it is critical to consider the incorporation of water conservation into zoning codes and procedures and development approval processes.

Partners: Homeowners Associations, Water Providers, Gallatin and Madison County Planning Departments, Big Sky Planning & Zoning Committee.

Water Providers

Water providers can adopt industry best practices for water efficiency, and new strategies that adjust for changes in water quantity and quality. Improving water efficiency reduces operating costs (e.g., pumping and treatment) and reduces the need to develop new supplies and expand water infrastructure. More and more utilities are using water efficiency and consumer conservation programs to increase the sustainability of their supplies[3].

Supply-side strategies involve accounting for water:

- Metering
    - Universal metering and meter replacement
    - Irrigation meters
- Leak detection & repair
- Water loss audits

Demand-side strategies reduce consumer demand for water:

- Conservation rate structure

[3] https://www.epa.gov/sustainable-water-infrastructure/water-efficiency-water-suppliers

- Volumetric sewer charge
- Water connection charges

Water availability strategies leverage innovative technologies and alternative water supplies:

- Water reuse projects
- Aquifer storage and recovery
- Desalination
- Stormwater management

Several strategies that can be explored in partnership with water providers are highlighted below:

Metering – Installing meters and billing according to usage is the most effective water conservation measure a water utility can initiate. While many water providers are fully metered, there are a number of water providers with unmetered customers who are being charged flat rates. New metering technology such as "Smart" meters can be read remotely and more frequently, providing instant access to water consumption information for both customers and water utilities. A dedicated irrigation meter exclusively meters water used for outdoor watering and irrigation. It has become common practice to install a separate meter for outdoor uses at many large sites with a significant irrigation demand[4].

Conservation Oriented Pricing Structure – Water providers can incentivize water conservation through conservation-oriented pricing structures (also known as monthly billing fees or water rates) that reflect the true value and cost of water. Conservation-oriented pricing structures are typically implemented as inclining block rate structures that include a variable component (where the fee assessed is a function of the water used) and where charges increase steeply by price tier with increased usage. Monthly billing is the primary lever by which utilities can recoup the ongoing cost of treating and distributing water. Monthly billing charges can also be used to fund conservation programs, watershed protection and restoration activities, and education and awareness programs.

Conservation-Oriented Water System Development Charges (SDC) – A growing number of communities have crafted ways to reduce the water demands of new development by redesigning their water system development charges (also known as connection or tap fees) to incentivize highly water efficient homes and developments[5]. System development charges can also be used in some cases to fund conservation programs, watershed protection and restoration activities, and education and awareness programs. SDC fee structures can be designed to recoup the cost of providing water services to new developments, including the

[4] https://www.allianceforwaterefficiency.org/search/site/metering
[5] https://3hzk7prqhr33icsww1y4geu6-wpengine.netdna-ssl.com/wp-content/uploads/2018/07/WRA_Guide-to-Conservation-Oriented-SDCs_web.pdf

costs of water rights, treatment capacity and operations, and storage and distribution infrastructure. At minimum, SDC fee structures can be developed as voluntary programs offering discounted connection fees in exchange for defined water conservation measures.

Drought Surcharges – Drought surcharges are often used on an emergency and temporary basis to pay for costs associated with purchasing emergency water supplies during a severe drought or to support drought restrictions. When drought conditions result in the need to purchase emergency supplies, a surcharge is a logical and simple way to pass along the additional temporary cost of acquiring these high-cost water resources to the current users who require the water supply. Often, surcharges used during drought conditions are also intended to provide a price incentive for customers to reduce water demand. In both of these cases, the surcharge can be in place while the drought exists and can be removed once the drought has ended[6].

Developers/HOA's

Homeowners associations (HOA) have governing documents that establish rules and regulations for their community's safety and structure. These documents provide an opportunity to establish best management practices and actions that conserve water. In the early stages of a subdivision, the developer is in control of maintenance and enforcement. After a certain number of lots/homes/businesses have been sold, the developer typically transfers the management authority to the HOA.

- Declaration of Covenants, Conditions and Restrictions (CC&Rs) dictate the rules or restrictions the owners of the land/home/condo/business must follow and provide the outline for how the community is run. In general, CC&Rs are intended to contribute to a well-integrated, high-quality development; preserve property values, desirability, and attractiveness; and provide for adequate maintenance of common areas and improvements.
- Architectural/Design Review Committee is responsible for ensuring that new construction or changes to the exterior of homeowners conform to the standards set by the governing documents. Many HOA's have architectural and landscape design guidelines to guide decision making.
- Landscaping Contracts – Many HOA's hire a landscaping company to manage their common open space. These contracts are opportunities to integrate water-wise landscaping practices and encourage HOA's to participate in the rebate program.

[6] https://www.awwa.org/portals/0/files/publications/documents/samples/M1WaterRates-ChV3.pdf

Planning, Zoning, & Subdivision Regulations

For a secure water future, water conservation and efficiency must be integrated into all phases of community planning and development[7]. Taking this action requires collaborative engagement between planners who lead the way on community land use, water providers who supply water, and organizations like GRTF who implement community water conservation programs.

Efforts to integrate land use and water planning include:

- Sharing key planning information and data between local and regional organizations
- Providing input and feedback on long-term plans and development proposals
- Adopting codes, regulations, or fee structures to promote water efficiency, alternative water supplies, and water conservation priorities

Green Building Practices

Green building encourages innovative water-saving strategies that help projects use water wisely. Developers and builders can reduce water demand and utilize alternative water supplies utilizing the following strategies:

- Rainwater Harvesting
- Greywater recycling
- Pressure reduction
- Cooling towers
- Install efficient plumbing fixtures
- Install submeters
- Choose locally adapted plants
- Use water-wise (xeriscaping) landscaping practices
- Select efficient irrigation technologies

Partnership Programs

Water conservation program partnerships can take many forms, but usually involve two or more utilities or organizations that share a common goal and/or common service territory. There are many motivations to form a partnership including: reducing program costs;

[7] https://westernresourceadvocates.org/healthy-rivers-lakes/reducing-water-demand/land-use-planning-for-water-efficiency/

providing consistency in functions across adjacent service territories; shared conservation goals; eliminating duplicative efforts; purchasing at volume discounts; enhanced offerings to customers; and cost-sharing. Partnerships usually require more initial effort to form the needed agreements, but can yield great benefits over time[8].

To improve water conservation tracking and program delivery, a partnership model with GRTF, water providers, and other community leaders could be explored. An example partnership model is the Sonoma-Marin Saving Water Partnership[9], representing 13 water utilizes that have joined together to provide regional solutions for water use efficiency. The partnership was formed to identify and recommend implementation of water use efficiency projects, and maximize the cost effectiveness of water-use efficiency programs. This model could be adopted on a smaller, more localized scale for Big Sky and could help show a community-wide commitment to water conservation.

3.4 Tracking Water Conservation

This Plan seeks to establish a way to track and report water savings so that GRTF can gauge the success of each individual measure and the overall program. This will help the community set goals and understand progress.

Since there is no single water provider or regulatory authority, GRTF lacks the ability to develop an enterprise-scale metering program and truly quantify water use and savings over time. This Plan recommends using the Big Sky County Water and Sewer District meter data to evaluate water demand annually. GRTF will compute overall average annual demand per connection every year so they can help the community track progress. Additionally, GRTF will continue to use water savings "book values" for each conservation measure to compute overall volume reduction. ***Table 3.3*** summarizes the assumed water savings for various conservation measures.

Table 3.3 Water Savings by Conservation Measure

Conservation Strategy	Description / Assumptions	Annual Water Savings Per Unit
Toilets	Uses less than 1.28 gallon per flush (gpf)	13,000 gal/yr
Showerhead	Uses less than 1.75 gallon per minute (gpm)	5,100 gal/yr
Washing Machine	EnergyStar Certified	7,000 gal/yr
Showerhead Swap	1.5 gpm	7,000 gal/yr
Kitchen Fixture Swap	Uses less than 1.5 gpm	3,200 gal/yr
Bathroom Fixture Swap	Uses less than 1 gpm	3,300 gal/yr
Water Meter	Typically saves 20% of baseline demand	20% reduction
Smart Sensor	Typically saves 20% of baseline demand	20% reduction
Commercial Toilet	Uses less than 1.6 gpf	10,950 gal/yr
Waterless Urinal	Uses 0 gpf	520 gal/yr

[8] https://www.allianceforwaterefficiency.org/resources/topic/partnership-programs
[9] https://www.savingwaterpartnership.org/about/

Smart Irrigation Controller	Saves 7600 gallons per year	7,600 gal/yr
Sprinkler Head	30% water savings	30% reduction
Irrigation System Audit	10% water savings	10% reduction
Drought Tolerant Plants (retrofit)	20% water savings	20% reduction
Drip Irrigation (retrofit)	35% water savings	35% reduction
Xeriscape (retrofit)	Up to 60% outdoor use savings	50% reduction

The following process shall be conducted annually to track water use and evaluate conservation efforts:

1) Every January, GRTF shall request District annual meter data. Data will be provided via an Excel spreadsheet and at a minimum include quarterly water use for all meters and meter classification.
    a. Screen data for outliers that may not be representative of overall water use trends.
2) Compute/summarize total annual and quarterly water use and total by each meter classification.
3) Compute/summarize number of connections.
4) Compute/summarize water use per connection (total and by meter classification).
5) Summarize previous summer average climate (total precipitation, average June-August daily temperature).
6) Enter all data into Water Use Summary Table provided in Appendix B.

Ultimately the goal of the conservation program is to reduce water consumption. Completing Appendix B annually will enable the community to understand and see progress. The goal is to see a reducing in overall water use per connection.

4.0 DROUGHT MANAGEMENT

Many western U.S. municipalities and water suppliers develop Drought Management Plans so that they have a clearly defined emergency response action plan during times of water shortage and a long-term capital improvement plan to reduce the impact of future drought. Because the Big Sky Water Conservation and Drought Management Plan is not limited to a single water provider or governmental entity, its drought plan offers recommendations for establishing drought stages and demand driven response actions.

While drought is a widely used term, there is no single universally accepted definition of drought. From a meteorological perspective, drought is defined as an extended period of below average precipitation for a given region. However, most definitions recognize drought as causing a water shortage to a particular human activity or environmental function (e.g. water supply, agriculture, stream fisheries, and forest health). Thus, drought is most commonly thought of as an interplay between climate and water-dependent processes. Often, drought is more defined by its effects than its causes.

- Meteorological - An extended period of below-normal precipitation. “Extended period” is a relative term. In areas with relatively steady year-round precipitation, such as tropical rainforests and humid mid-latitude climates, significant droughts can occur in as little as a few weeks. In semi-arid areas with seasonal precipitation patterns and where extended periods of no precipitation are a common occurrence (such as Eastern Montana) droughts tend to be defined in terms of seasons or years.

- Hydrological – A drought that reduces stream flows, reservoirs, lakes and groundwater to below-normal levels. While hydrologic droughts are caused by extended periods of abnormally low precipitation, they tend to lag behind the onset of low precipitation because of the buffering effects of soil moisture, groundwater, permanent snowfields and glaciers, etc. Hydrological droughts often extend far downstream from the areas experiencing unusually low precipitation. It can take several months of above-average precipitation to relieve hydrologic drought conditions. Typically stream flows and reservoir levels recover first, followed by groundwater conditions. Droughts are discussed from this perspective when water shortages begin to impact people and their lives in terms of water supply, loss of hydropower production, loss of fisheries, agricultural production losses and food shortages.

- Economic – Economic impacts that could occur due to drought include 1) reduced agricultural production and potential loss of agricultural jobs, 2) the loss of landscaping, trees and turf. These losses could also trigger reduced tourism, and reduced revenue and economic activity due to a reduction in sporting events and other outdoor activities that

may be curtailed during drought conditions (e.g., fireworks). A financial study could be conducted to better understand the economic implications of drought in Big Sky.

Since the 1900s, droughts have occurred in the southeast Montana and are of particular concern for Big Sky, especially as the community has experienced rapid growth in recent decades. The impact of drought on Big Sky is further compounded by its location in the headwaters of the Gallatin watershed and very limited water storage.

4.1 Vulnerability Assessment

A drought Vulnerability Assessment reveals specific vulnerabilities of a community to drought, in order to show stakeholders why drought planning is important, and to provide the basis for subsequent drought mitigation and response planning. Based on previous studies, we have listed general water supply vulnerabilities in Big Sky below.

- Southwestern Montana has experienced severe drought in its recorded history (1930-1941, 1999-2006) and is located in a region that appears to be relatively prone to drought conditions according to historical Palmer Drought Severity Index data.
- Developing new groundwater supplies is challenging in Big Sky because of the fractured nature of the aquifers and water quality concerns (e.g., arsenic, iron, manganese).
- Climate change models predict warming in the region, which could reduce snowfall and result in earlier melting of the snowpack.[10] Climate change may result in greater precipitation in the Big Sky area but it will come in the form of more rain rather than snow shifting the hydrograph to peak earlier in the water year and potentially having adverse effects on groundwater supplies by reducing snowmelt recharge.
- Climate change models are also predicting increased wildfire frequency and longer wildfire duration.[11,12] As witnessed in the interior Northwest in the fire season of 2015, wildfire risk tends to follow drought conditions. Regionally, wildfire has already been occurring with what appears to be increasing frequency. A warming climate leads to increased evapotranspiration, resulting in drier fuels in the late summer and fall months.
- The combination of a rapidly growing population and subsequent high water usage increases vulnerability to drought. The District's Water System Source Water Capacity Plan Update revealed that a supply deficit will likely begin in the year 2022 or 2023.
- Based on the demand analysis, over the last several years Big Sky's average water usage is approximately 320 gallons per connection per day, for all water users and uses. The State of Montana's average per connection water use is 275 gallons per day.[5]
- As a result of irrigation, water usage significantly increases during the dryer months of June, July, and August. The peak summer demands for lawn watering are nearly 160% of

[10] Barnett, T. P., Adam, J. C., & Lettenmaier, D. P. (2005). Potential impacts of a warming climate on water availability in snow-dominated regions. *Nature*, *438*(7066), 303-309.

[11] https://www3.epa.gov/climatechange/impacts/forests.html

[12] An, H., Gan, J., & Cho, S. J. (2015). Assessing climate change impacts on wildfire risk in the United States. *Forests*, *6*(9), 3197-3211.

[5] State calculation assumes 115 gpcd (2015 average) and 2.39 people per household (2020 US Census)

the average winter demand. During drought, lawns become drier, prompting greater irrigation, rather than less.

4.2 Drought Monitoring

Drought monitoring is a process for monitoring near and long-term water availability, with the goal of providing a framework for predicting future drought probability or confirming the intensity of an existing drought. A robust monitoring plan is critical to recognize and respond as soon as possible to the onset of a drought event.

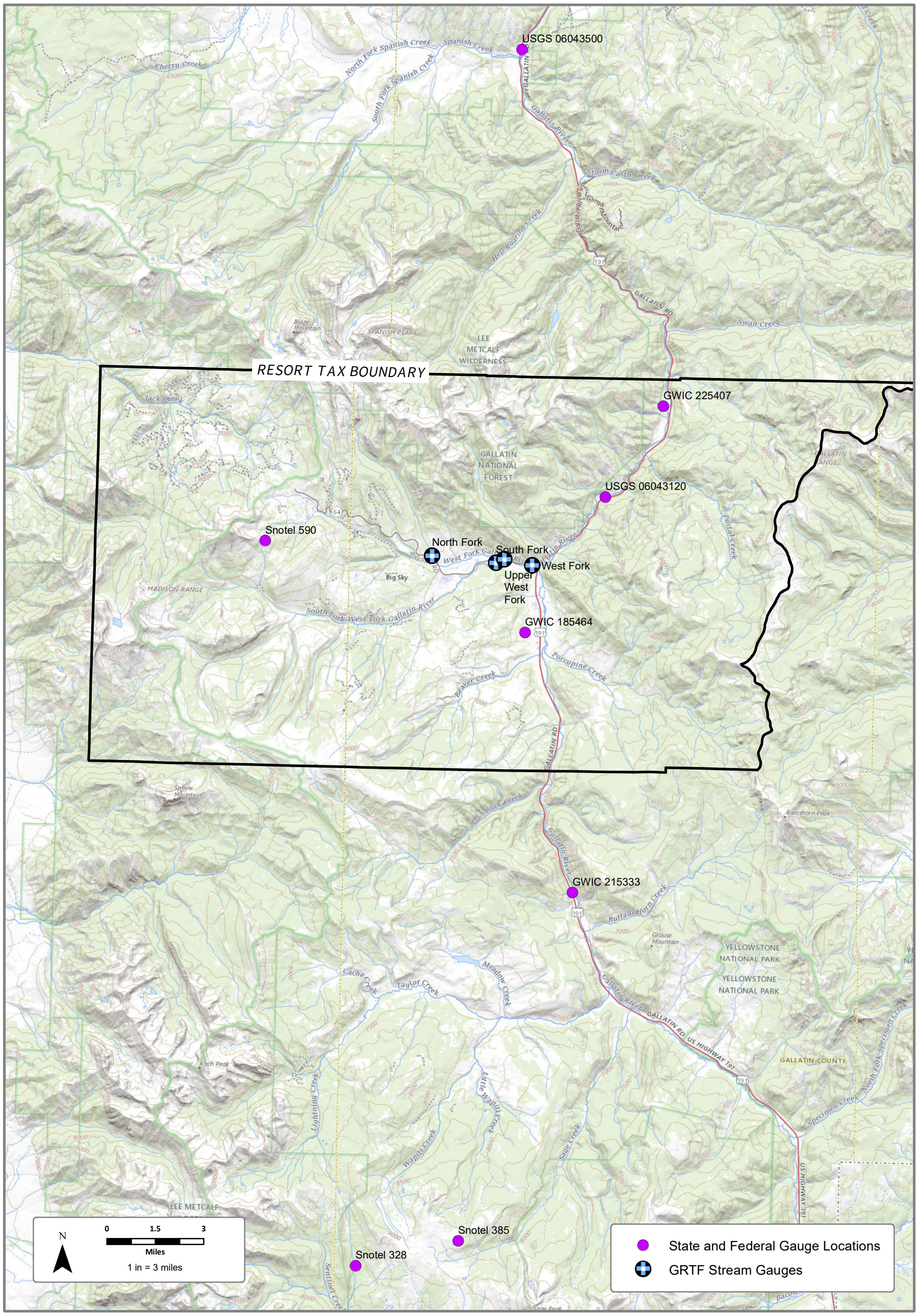
Drought Monitoring Model

The drought monitoring model uses a combination of local parameters and national drought indices to assess current drought conditions and quantify an overall current drought stage assessment.

Streamflow, snow water equivalent (SWE), precipitation, and groundwater static water level (SWL) data were gathered throughout the Big Sky area to develop a drought tracking model. Data availability ranged from 1889-present as shown in ***Table 4.1***. Gauge locations are shown in ***Figure 4.1***.

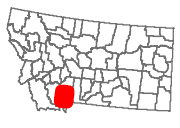
Table 4.1: Local Hydrologic Indicators Considered for Drought Tracking

Monitoring Location ID	Description	Period of Record Included
USGS 06043120	Gallatin River near Big Sky	05/2019 – Present
USGS 06043500	Gallatin River near Gallatin Gateway	08/1889 – Present
Lower West Fork Gallatin	Provided by GRTF	04/2006 – 12/2020
North Fork Gallatin	Provided by GRTF	04/2006 – 10/2020
South Fork Gallatin	Provided by GRTF	04/2006 – 10/2020
Middle (Upper West) Fork Gallatin	Provided by GRTF	05/2006 – 10/2020
NRCS590	Lone Mountain	10/1988 – Present
NRCS385	Carrot Basin	10/1966 – Present
NRCS328	Beaver Creek	10/1966 – Present
GWIC 185464	Hammond, Scott	07/2001 – Present
GWIC 187230	Conrad, Paul and Suzan	08/2011 – Present
GWIC 215333	Altman, Parker	07/2010 – Present
GWIC 225407	Richter, Mike	04/2007 – Present
GWIC 234783	Yellowstone Club LLC * Sewage	08/2014 – Present
GWIC 259697	Gallatin National Forest Red Cliff C.G.	11/2011 – Present
PDSI	South Central and Southwestern climate divisions	01/1897 – Present
SPI	South Central and Southwestern climate divisions	01/1897 – Present



Information depicted may include data unverified by AE2S. Any reliance upon such data is at the user's own risk. AE2S does not warrant this map or its features are either spatially or temporally accurate.

Coordinate System: NAD 1983 StatePlane Montana FIPS 2500 | Edited by: zmagdol | C:\Users\ZMagdol\AE2S\GRTF - Water Conservation Planning - Documents\GIS\Figure 4.1 Hydrologic Indicators Gauge Locations.mxd



Locator Map Not to Scale

Figure 4.1

DROUGHT MONITORING GAUGE LOCATIONS

BIG SKY COMMUNITY WATER CONSERVATION AND DROUGHT MANAGEMENT PLAN

Date: 7/20/2022

These data were compiled into a GIS-based dataframe that leverages python to stream live data from the following publicly available sources:

- USGS National Water Information System
- NRCS SNOTEL Sites
- NOAA Weather Service API

GWIC data and GRTF gauge readings were added to the dataframe, though they are not updated by the python script as they do not have an API. Historical soil moisture data collected by NASA satellites (GLDAS) will be incorporated into the tracking tool as well but has a much courser resolution and will not provide the local detail needed to accurately predict drought conditions.

In addition to the local hydrologic indicators, national drought indices have been incorporated into the drought tracking tool including the Palmer Drought Severity Index (PDSI), U.S. Drought

Monitor (USDM), and the Standard Precipitation Index (SPI). ***Table 4.2*** summarizes the advantages and disadvantages to each national index.

Table 4.2. National Drought Indices Advantages and Disadvantages

Drought Index	Parameters Included	Advantages	Disadvantages
Palmer Drought Severity Index (PDSI)	Rainfall Temperature Evapotranspiration Soil Recharge Runoff Moisture Loss	Monitors long-term (several month) drought conditions Based on water balance equation	Does not respond to quick weather changes Excludes snowfall/snow cover
US Drought Monitor Index (USDM)	Precipitation Temperature Evapotranspiration Soil Recharge Runoff Moisture Loss Snow Water Content	Included multiple parameters Provides consistent drought conditions	Broad coverage area (lacks local detail)
Standard Precipitation Index (SPI)	Precipitation	Computed for various time scales	Only accounts for precipitation

The drought monitoring model is an excel spreadsheet-based tool that compiles the selected drought monitoring data, assign a drought score to the data, and multiply the drought score for each data source by a weighting factor to calculate an overall numerical drought stage score, ranging from 0 to 4. Future efforts will transfer the spreadsheet model to a more interactive and web-based dashboard.

Each hydrologic indicator and national index are assigned a weighting factor based its qualitative impact on water supply availability from both an environmental and human demand standpoint. These weighting factors are highly subjective and should be modified as needed so that the drought model results are representative of the severity of a given drought.

Four drought stages are established based on varying response levels from each indicator. Drought stages are defined as:

Stage 1: Drought Watch
Stage 2: Drought Advisory
Stage 3: Drought Warning
Stage 4: Drought Emergency

These response levels can also be adjusted in the future so that model results are aligned with ground-truthed observations and/or perceived drought severity. ***Table 4.3*** summarizes the hydrologic indicators used to develop the initial drought model and their respective weighting factors and response levels at each stage. The drought model computes monthly drought score.

Table 4.3. Drought Monitoring Selected Indicators, Weights, and Stages

Indicator	Weighting Factor	Response Level (percentile or score)			
		Stage 1	Stage 2	Stage 3	Stage 4
Gallatin River Streamflow @ Gallatin Gateway	0.3	0.75	0.8	0.85	0.9
North Fork Streamflow	0.05	0.75	0.8	0.85	0.9
SNOTEL	0.3	0.75	0.8	0.85	0.9
GWIC	0.05	0.75	0.8	0.85	0.9
PDSI	0.1	-1	-1.5	-2	-2.5
USDM	0.1	1.5	2	2.5	3
SPI	0.1	-0.5	-1	-1.5	-2

Streamflow: Minimum average daily flow for each month
SNOTEL: Maximum monthly snow-water-equivalents (SWE) (average value of Carrot Basin, Lone Mountain, and Beaver Creek)
GWIC: Maximum monthly median daily value as an estimate of lowest groundwater level (average of 3 wells, 215333, 225407, 18546)
PDSI: Monthly value derived from daily averages
USDM: Monthly value derived from weekly averages
SPI: Monthly value derived from daily averages for 3-month and 12-month (averaged)

Based on the recommended weighting and response factors presented in ***Table 4.3***, a matrix summarizing past drought scores was produced to visualize results and better understand how the model functions. ***Table 4.4*** shows the monthly drought scores for the past 20 years. The 2021 drought was estimated to be a Stage 3 drought. ***Figure 4.2*** shows the 2021 Gallatin Gateway

streamflow against the historic exceedance curves based on data from 1890 through 2020. In June and July 2021 streamflow dipped below the 95th percentile.

The drought model results are assumed relatively representative and are intended to provide the community with a gauge of the overall hydrologic condition in the watershed. Future efforts will transition the drought model to a web-based dashboard to help inform and engage the public.

Table 4.4. Previous 20-Year Drought Scores based on Recommended Weights and Response Levels

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	1	1	2	2	2	2	3	3	3	2	2	2
2002	2	2	2	2	2	1	2	3	2	2	2	3
2003	3	3	2	1	0	1	3	3	4	4	3	2
2004	2	1	2	1	1	1	2	1	1	0	1	1
2005	1	3	2	2	1	1	0	0	1	0	0	1
2006	0	1	1	0	0	0	1	1	1	1	1	0
2007	1	0	1	1	1	2	3	3	3	0	1	0
2008	1	0	1	1	0	0	0	0	0	1	0	0
2009	0	0	0	1	0	0	0	0	0	0	0	2
2010	0	1	1	2	0	0	0	0	0	0	1	0
2011	0	1	0	0	1	0	0	0	0	1	0	0
2012	1	1	0	0	0	1	1	1	1	1	1	1
2013	0	1	1	1	1	1	1	1	1	1	0	0
2014	0	0	0	0	0	0	0	0	0	1	1	1
2015	0	1	1	1	1	2	1	1	1	2	1	0
2016	0	0	0	0	0	2	2	2	1	1	1	1
2017	1	0	0	0	0	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0	0	0	1	0	0
2019	0	0	0	0	0	0	0	0	0	0	0	0
2020	0	0	0	0	0	0	0	0	0	1	1	1
2021	1	0	1	0	1	2	3	2	3	1	1	No data

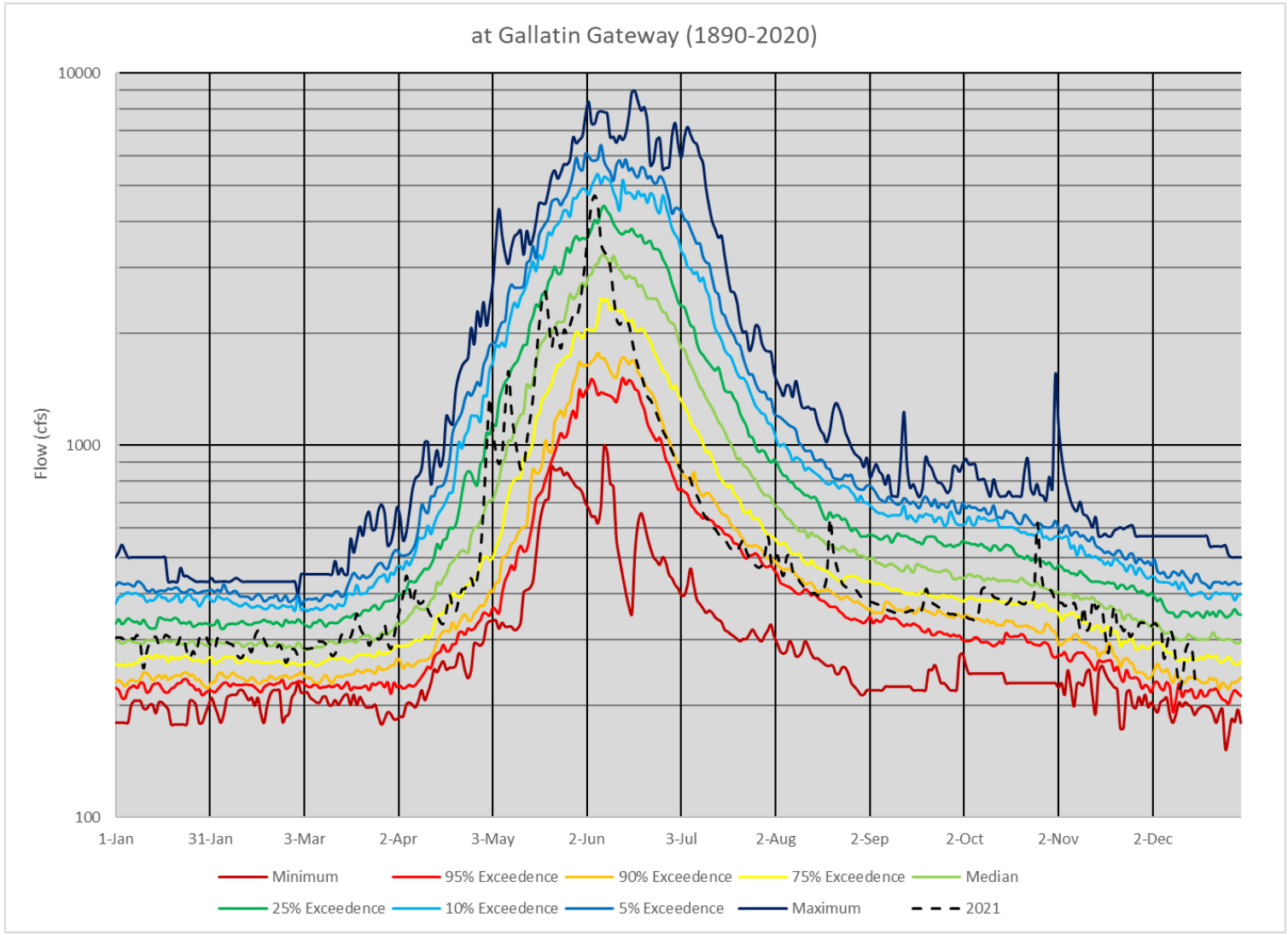


Figure 4.2. Gallatin River Streamflow at Gallatin Gateway, 2021 vs Historic Probabilities

4.3 Drought Response

The drought response framework will help guide GRTF and the community on strategies that should be implemented during drought. The drought tracking model will be integrated into the GRTF's webpage so that water users and water providers can see current drought status and the recommended respective actions.

Responses are recommended for each successive stage of drought, which are based on the monitoring of parameters described previously. Research has shown that voluntary actions can result in water use reductions of up to 23% but that is dependent on the public's trust that the water provider's qualification of the drought stage is reasonable and on the level of education they have received on water use reduction[13]. If demand does not decrease or drought conditions worsen, subsequent stages would trigger progressively greater water use restrictions. The summer 2021 drought in Bozeman resulted in an official drought declaration and imposing mandatory water use restrictions. During this time, the City experienced a 25% reduction in water use – a very successful result of drought response actions.

Table 4.5 on the following page summarizes the recommended drought response actions. This table was adopted from the Bozeman Drought Management plan and modified to reflect the unique characteristics of the Big Sky community (e.g., higher tourism and seasonally impacted water use). The response measures are recommendations rather than mandatory actions – not all measures will be applicable to all users within the Big Sky community. A generic list of suggested actions is provided below for residential and non-residential water users.

- Limit filling swimming pools and hot tubs
- Limit use (duration and times) of potable water for landscape irrigation
- Promote outdoor water audits
- Limit the installation of new sod, seed or landscaping
- Limit washing of vehicles, driveways, and sidewalks
- Promote indoor water audits
- Promote installation of high efficiency fixtures
- Promote installation of high efficiency fixtures at the time of house sale or remodel
- Promote reduction in water cooled air conditioning
- Limit use of construction water
- Turn off indoor and outdoor fountains and splash pads
- Promote buildings with water-cooled air conditioning to raise temperatures

[13] Alliance for Water Efficiency, "An Assessment of Increasing Water-Use Efficiency on Demand Hardening." July 2015.

- Promote grey water reuse
- Promote water service at restaurants only upon request
- Promote reduction in linen and towel washing in lodging establishments
- Promote implementation of drought surcharge rates

Table 4.5. Recommended Drought Response Actions

Category	Stage 1 Drought Watch	Stage 2 Drought Advisory	Stage 3 Drought Warning	Stage 4 Drought Emergency
	Suggested Response Actions			
Residential	• Voluntary outdoor potable water use restrictions. • Recommend limit watering days per week.	• Encourage outdoor potable water use restrictions. • No watering between 10am-6pm. • Eliminate lawn and garden watering that results in excess runoff. • Limit re-filling of swimming pools and hot tubs	• Limit potable outdoor water use to 1-day per week and no watering between hours of 10am-6pm • Eliminate vehicle, driveway, and sidewalk washing • Eliminate decorative fountains and filling of swimming pools and hot tubs • Encourage grey water reuse • Reduce use of water-cooled air conditioning	• Eliminate non-essential outdoor use of potable water • Encourage indoor water audits • Encourage limiting clothes & dish washing
Non-residential	• Voluntary outdoor water restrictions. • Recommend limit watering days per week.	• Encourage outdoor landscape potable watering restrictions. • Eliminate runoff from landscape irrigation • Limit installation of new sod and/or other landscaping	• Limit use of construction water. • Turn off indoor and outdoor ornamental fountains. • Limit re-filling of swimming pools and hot tubs • Reduce linen and towel washing in lodging establishments • Reduce use of water-cooled air conditioning	• Promote indoor and outdoor water audits where applicable. • Eliminate unnecessary linen and towel washing in lodging establishments • Eliminate hot tub refilling
GRTF Efforts	• Continued general public outreach via website and social media (e.g., free water saving products, rebates, etc.)	• Outreach via other public media outlets (e.g., Explore Big Sky and Lone Peak Lookout)	• Outreach directly to large water users by providing communication material • Facilitate monthly meetings with water providers	• Continued frequent and focused outreach • Facilitate weekly drought response meetings with large water providers and community stakeholders

5.0 BUDGET AND FUNDING SOURCES

5.1 Budget

The Big Sky Water Conservation Program annual budget, ***Table 5.1***, is set on an annual basis. The budget typically remains relatively consistent with the exception of annual cost of living increases for payroll and benefits and special projects, which vary from year to year.

Table 5.1 Annual Budget

Line Item	Cost Estimate	Notes
Marketing & Communications	$8,000.00	Includes print materials, digital marketing, outreach events, etc.
Materials & Supplies	$1,000.00	Includes free water conservation products and program supplies
Payroll & Benefits	$98,536.00	Includes two GRTF Staff
Financial Assistance - Rebates	$10,000.00	Includes indoor and outdoor rebates
Data Management	$5,000.00	Annual Drought Tracker and Water Use Summary Table
Special Projects (see table)	TBD	Varies year to year. See table 5.2 below.
Total	**$137,536.00**	

Table 5.2 Special Projects

Line Item	Cost Estimate
Drought Dashboard Development	$20,000.00
Drought Communications Campaign	$50,000.00-100,000.00

5.2 Funding Sources

Implementation of the Water Conservation & Drought Management Plan ultimately depends on funding availability. Potential funding for annual programming and projects includes federal, state, local, and private sources.

Federal

Water and Energy Efficiency Grants: The Bureau of Reclamation through WaterSMART provides 50/50 cost share funding to irrigation and water districts, tribes, states and other entities with water or power delivery authority. Projects conserve and use water more efficiently; increase the production of hydropower; mitigate conflict risk in areas at a high risk of future water conflict; and accomplish other benefits that contribute to water supply reliability in the western United States. Projects are selected through a competitive process and the focus is on projects that can be completed within two or three years. Project funded have included: rebate programs for irrigation measures, advanced metering infrastructure, rebate program to replace turfgrass with water efficient landscaping, direct install programs for turf replacement and smart timer installation, etc. Annual funding. Last closing date for applications was November 3, 2021. Award ceiling is $15,000,000.

Small-Scale Water Efficiency Projects: The Bureau of Reclamation through WaterSMART provides 50/50 cost share funding to irrigation and water districts, tribes, states and other entities with water or power delivery authority for small water efficiency improvements that have been identified through previous planning efforts. Projects eligible for funding include installation of flow measurement or automation in a specific part of a water delivery system, lining of a section of a canal to address seepage, or other similar projects that are limited in scope. Up to $75K per applicant. Total project costs should generally be $200K or less.

Drought Response Program: The Bureau of Reclamation's Drought Response Program supports a proactive approach to drought by providing assistance to water managers to: develop and update comprehensive drought plans, and implement projects that will build long-term resiliency to drought. Program areas with associate grant funding include: contingency planning, resiliency projects, and emergency response actions.

WaterSMART Eligibility: Organizations with water delivery authority. Nonprofit conservation organizations acting in partnership with an organization with water delivery authority.

State

Watershed Management Grant: The Montana Department of Natural Resources and Conservation (DNRC) provides financial support for the development and implementation of locally led watershed related planning and capacity building activities that conserve, develop, improve or preserve state natural resources. Eligible applicants include local governments, non-

profit entities with a local government sponsorship, or non-profits with a 1:1 match. Funding limits up to $35K. GRTF received a WMG in 2020 to develop this planning document.

Local & Private

Big Sky Resort Tax: Projects and programs located within the boundaries of the Big Sky Resort Area District that provide for the public health, safety, and welfare of the greater Big Sky community are eligible for funding. The Water Conservation & Drought Management Plan align with the *Our Big Sky Community Vision and Strategy* goals related to the natural environment. Historically, approximately 50% of funding for the Big Sky Water Conservation Program has come from Resort Tax.

Private Funding: As a nonprofit organization, the Task Force has the ability to raise private funding from memberships, donations, capital campaigns and grants from private foundations to support implementation of the Water Conservation & Drought Management Plan. Historically, approximately 50% of funding for the Big Sky Water Conservation Program has come from the private sector.

Water Provider Funding: Water Conservation Programs are traditionally offered by the water provider because the primary savings anticipated from water conservation result from avoided capital and operational costs in the areas of source development and treatment. Ratepayers also benefit when conservation strategies lower costs for the service and can help build public support for conservation programs. GRTF should work with the larger water providers to identify opportunities to support the program financially. There could be an opportunity to explore adding a small water-efficiency charge to customers water bills. The money raised from the charge could be utilized to support the Big Sky Water Conservation Program and provide a wide range of services, incentives, trainings, and information that help residents and businesses manage water use and related costs.

Upper Gallatin River Basin Water System Survey

The goal of this initiative is to develop a better understanding of the current and projected water supplies and demands within the Upper Gallatin River Basin. The data collected in this effort will be used by the Gallatin River Task Force to develop water conservation plans that lead to a more resilient community.

1.Water System Name:

2.Contact Name, Title:

3.Contact Email Address:

4.Contact Address:

5.Contact Phone Number:

6.Current Water Sources (check all that apply):

- ☐ Groundwater
- ☐ Surface Water
- ☐ Combined
- ☐ Purchased from another water system
- ☐

7.Water System Population Served:

8.Number of Current Water Services/Connections:

9.Are you considering new connection points to your water system? If so, where and when?

10.Current annual permitted allocation and percentage used in a typical year:

11.List locations and capacities of wells/intakes:

12.Do you provide any treatment aside from disinfection?

13.List locations and volumes of any water storage facilities you maintain:

14.Does your system have any of the following components?

- [ ] SCADA system (instrumentation & controls)
- [ ] GIS database (pipe size & layout, meter locations)
- [ ] Water meter usage records
- [ ] Pump and storage information (e.g., pump and storage tank sizes, operation records)

15.If you maintain a SCADA system, may Gallatin River Task Force have access to download water use data?

- [ ] Yes
- [ ] No
- [ ] Maybe

16.If you don't maintain a SCADA system, do you maintain water use records by a different means?

17.If you maintain water meters, what percentage of your users are metered?

18.Current Potable Water Demands (2019): a) Average annual flow b) Average monthly flow c) Peak day flow - If unknown, provide estimate -

19.Non-Potable Water Demands (2019): - If unknown, provide estimate -

20.Projected population and/or projected number of services in 2040:

21.Do you know the average percent water loss your system experiences? If so, how much? - If unknown, provide estimate -

22.Existing Water System Challenges:

- [ ] Regulatory Issues
- [ ] Aging Infrastructure
- [ ] Water Supply - Quantity
- [ ] Water Supply - Quality
- [ ] Staffing
- [ ] Funding
- [ ]

23.What's your biggest challenge and how are you approaching it?

24.Are you considering supplemental or replacement water supply? If so, please describe:

25.What type of Conservation Strategies has your system implemented?

- [ ] Leak detection and repair
- [ ] Low-flow shower heads
- [ ] Toilet exchange rebates
- [ ] Washing machine exchange rebates
- [ ] Paid staff to support water conservation efforts
- [ ] Consumer education programs
- [ ] Technical assistance to help consumers detect leaks
- [ ] Metering all billed and unbilled water use
- [ ] Periodic water audits
- [ ] Ordinances / enforcement
- [ ] Conservation water rates / surcharging
- [ ] Turf and drought resistant vegetation initiatives

26.If you have implemented Conservation Strategies, please describe your experience and the effectiveness of the strategies:

ANTLER RIDGE COMMUNITY PUBLIC WATER SYSTEM

CURRENT WATER SOURCE
Groundwater

POPULATION SERVED
~30 - 200
Varies seasonally

2
WELLS

1
STORAGE FACILITY

UNKNOWNS

- Current annual water right and percentage used in a typical year
- Current potable demands (average annual flow, average monthly flow, and peak day flow)
- Non-potable / irrigation demands
- Average percent water loss

INFRASTRUCTURE

TREATMENT
None

WELLS
Currently use two wells:
1. Well south of the junction of Fourpoint Road and Antler Ridge Road
2. Well to the northeast of the water storage tank

WATER STORAGE
300,000 gallon above ground storage tank

SYSTEM CHALLENGES
1. Aging infrastructure
2. Lack of sampling points outside of residences

CONTACT

Peter Manka, Water System Operator
Alpine Water
PO Box 161603
Big Sky, MT 59716
406-599-0333
mail@alpinewater.net

CURRENT WATER CONSERVATION STRATEGIES

None

BIG SKY SCHOOL DISTRICT #72 - OPHIR SCHOOL PUBLIC WATER SYSTEM

CURRENT WATER SOURCE
Groundwater

POPULATION SERVED
~200

1
WELL

1
STORAGE FACILITY

2019 POTABLE WATER DEMANDS

Average annual flow:
350 gal/day

Average monthly flow:
10,500 gal/month

Peak day flow:
500 gal/day

INFRASTRUCTURE

TREATMENT
None

WELLS
Groundwater well is located east of the school building

WATER STORAGE
3,000 gallon underground concrete storage tank

SYSTEM CHALLENGES
Underground storage tank system was poorly constructed and creates a potential contamination vector

UNKNOWNS

- Current annual water right and percentage used in a typical year
- Non-potable / irrigation demands
- Average percent water loss

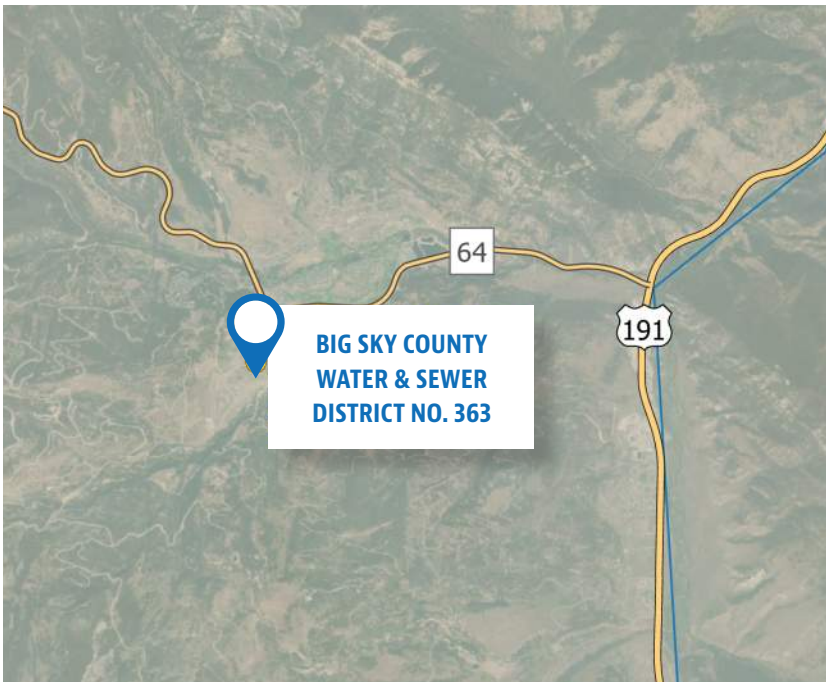
CONTACT

Peter Manka, Water System Operator
Alpine Water
PO Box 161603
Big Sky, MT 59716
406-599-0333
mail@alpinewater.net

CURRENT WATER CONSERVATION STRATEGIES

None

BIG SKY COUNTY WATER & SEWER DISTRICT NO. 363 PUBLIC WATER SYSTEM



CURRENT WATER SOURCE
Groundwater

POPULATION SERVED
~2,500

PROJECTED CONNECTIONS IN 2040
~3,500

7
STORAGE FACILITIES

- ✔ SCADA System
- ✔ GIS Database (pipe size and layout, meter locations)
- ✔ Water Meter Usage Records
- ✔ Pump & Storage Information

ALL USERS ARE METERED

INFRASTRUCTURE

TREATMENT	Ultraviolet sterilization in the Meadow when Wells #4 and #5 are running
WELLS	Number and location not provided
WATER STORAGE	Sweetgrass Hills Upper Tank (50,000 gallons), Sweetgrass Hills Tank (250,000 gallons), Hidden Village Tank (1M gallons), Aspen Groves Tank (240,000 gallons), Lone Moose Tank (450,000 gallons), Mountain Village Tank (500,000 gallons), and Cascade Tank (1.5M gallons)
SYSTEM CHALLENGES	Finding a high-quality water source with sufficient capacity to serve Big Sky's future residents. Currently drilling for water in search of water sources

DATA NOT PROVIDED

- Current annual water right and percentage used in a typical year
- Current potable water demands
- Non-potable / irrigation demands
- Average percent water loss

CONTACT

Vince Palafox, Water System Operator
Big Sky Water & Sewer District No. 363
PO Box 160670
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406-283-1394
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CURRENT WATER CONSERVATION STRATEGIES

- Water restrictions on irrigation
- Leak detection and repair
- Source metering and monitoring

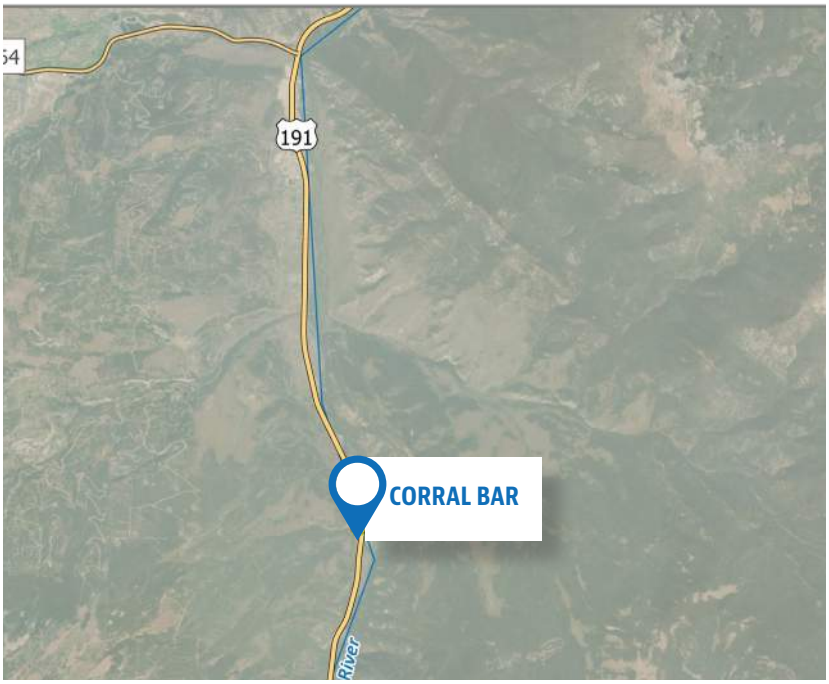
CORRAL BAR PUBLIC WATER SYSTEM

CURRENT WATER SOURCE
Groundwater

POPULATION SERVED
Varies seasonally

1
WELL

1
STORAGE FACILITY



UNKNOWNS

- Current annual water right and percentage used in a typical year
- Current potable demands (average annual flow, average monthly flow, and peak day flow)
- Non-potable / irrigation demands
- Average percent water loss

INFRASTRUCTURE

TREATMENT
Softener and reverse osmosis

WELLS
One 15 gpm groundwater well

WATER STORAGE
2,500 gallon cistern

SYSTEM CHALLENGES
Effluent disposal

CONTACT

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42895 Gallatin
Big Sky, MT 59716
406-995-4249
corral@3rivers.net

CURRENT WATER CONSERVATION STRATEGIES

None

FIRELIGHT MEADOWS PUBLIC WATER SYSTEM

CURRENT WATER SOURCE
Groundwater

POPULATION SERVED
~500

ANNUAL WATER RIGHT
52.98 acre feet

3
WELLS

2019 POTABLE WATER DEMANDS
Average annual flow: 8,960,901 gallons
Average monthly flow: 747,783 gal/month
Peak day flow: ~60,000 gal/day

ALL USERS ARE METERED

INFRASTRUCTURE

TREATMENT
Orthophosphate injection (corrosion control) and chlorination

WELLS
Two wells, plus one back-up (redundant) well on the Firelight Meadows campus. Each well produces approximately 20 gpm, with a max flow rate of 40 gpm

WATER STORAGE
One 350,000 gallon tank on the Firelight Meadows campus

SYSTEM CHALLENGES
Dealing with high demand/usage was the greatest challenge prior to installing individual meters. No major system challenges now.

OTHER

- Approximate water loss is 10-15% when comparing water production versus measured wastewater flow
- Data on non-potable irrigation demands was not provided as the irrigation system is separate and owned/operated by the Firelight Meadows HOA

CONTACT

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CURRENT WATER CONSERVATION STRATEGIES

Recently moved from a flat rate to a usage-based billing system to reduce consumption and encourage conservation

RAMSHORN VIEW ESTATES PUBLIC WATER SYSTEM

CURRENT WATER SOURCE
Groundwater

ANNUAL WATER RIGHT
90 acre feet
use ~75% of water right

POPULATION SERVED
~150

2
WELLS

2019 POTABLE WATER DEMANDS
Average annual flow: 17,000,000 gallons
Average monthly flow: 46,000 gal/month
Peak day flow: 200,000 gal/day

~5%
WATER LOSS

INFRASTRUCTURE

TREATMENT
None

WELLS
Two wells are located within the subdivision boundary

WATER STORAGE
One 350,000 gallon tank at the top of the system

SYSTEM CHALLENGES
Quality water supply

OTHER

- Summer irrigation demand is approximately 300% of winter daily use
- The water is of excellent quality other than it contains hydrogen sulfide and although safe to drink, it can cause an objectionable odor. The HOA opted not to go with a central treatment system but rather leaves it up to homeowners to purchase their own point-of-use treatment system to remove the hydrogen sulfide.

CONTACT

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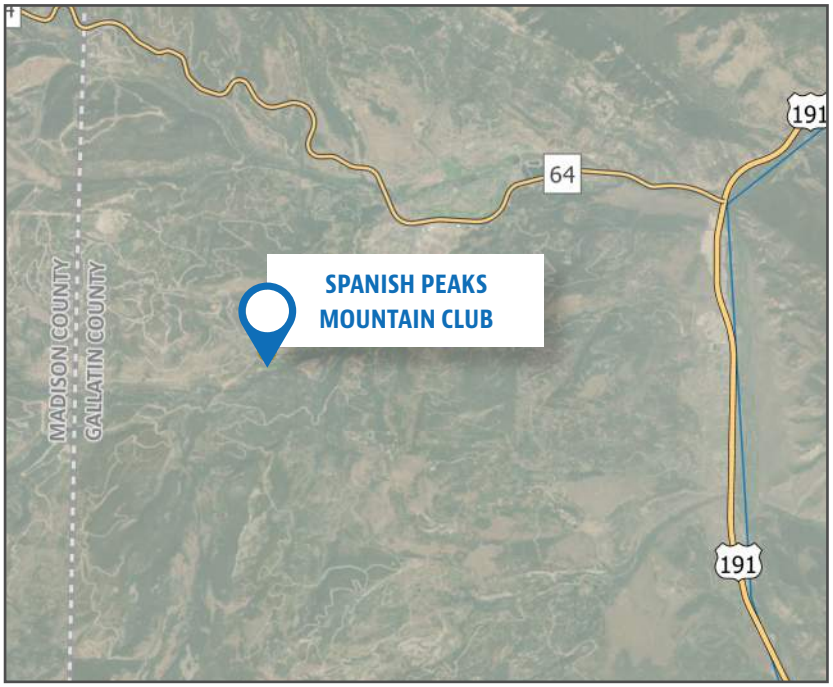
CURRENT WATER CONSERVATION STRATEGIES

None

SPANISH PEAKS MOUNTAIN CLUB PUBLIC WATER SYSTEM



CURRENT WATER SOURCE
Groundwater

ACTIVE CONNECTIONS
150
650 connections projected in 2040

ANNUAL WATER RIGHT
625 acre feet
used ~25% of water right in 2020

4
WELLS

2019 POTABLE WATER DEMANDS
Average annual flow: 41,000,000 gallons
Average monthly flow: 3,500,000 gal/month
Peak day flow: unknown

ALL USERS ARE METERED

INFRASTRUCTURE

TREATMENT
Iron removal and chlorine injection

WELLS
Currently use four wells:
- Well 1 - 210 gpm
- Well 2 - 210 gpm
- Well 3 - 175 gpm
- Well 4 - 80 gpm

WATER STORAGE
One 860,000 gallon concrete reservoir located on Elk Meadow Trail

SYSTEM CHALLENGES
No major issues

OTHER

- Recently drilled two additional well on Lot 1 of Gallatin Preserve. These wells will connect to the Spanish Peaks Mountain Club system in 2021
- Maintains a SCADA system
- Current non-potable/irrigation water demand data was not provided
- Assumed minimal average percent water loss in the system
- Considering effluent for golf course irrigation, hoping for future snowmaking

CONTACT

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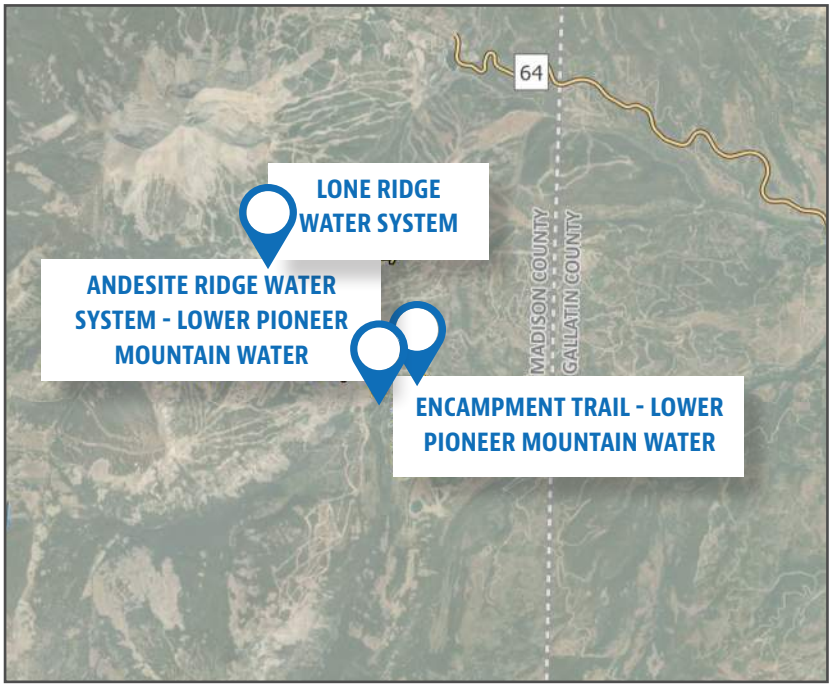
CURRENT WATER CONSERVATION STRATEGIES

Conservation water rates / surcharging

YELLOWSTONE MOUNTAIN CLUB PUBLIC WATER SYSTEMS



CURRENT WATER SOURCE
Groundwater

POPULATION SERVED
1,000
480 connections

ANNUAL WATER RIGHT
625 acre feet
used ~25% of water right in 2020

3-5% WATER LOSS

2019 POTABLE WATER DEMANDS
Average annual flow: not provided
Average monthly flow: not provided
Peak day flow: not provided

80-85% OF USERS ARE METERED

INFRASTRUCTURE

TREATMENT
Currently chlorinate on one of the four Public Water Systems

WELLS
Number and location not provided

WATER STORAGE
Seven storage facilities, varying capacity from 240,000 to 600,000 gallons

SYSTEM CHALLENGES
Water conservation is the biggest challenge. Have increased residential metering, increased emphasis placed on lead detection and repairs, and have initiated a tiered fee schedule.

OTHER

- New system connection points are currently underway and parallel the growth rate of the development
- Currently have four Public Water Systems, which have varying water rights supporting them. Not at full build out to date and operate near 65% of water right.
- Current non-potable/irrigation water demand data was not provided
- Increasing effort toward utilizing reclaimed wastewater to offset current irrigation and snowmaking demands

CONTACT

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CURRENT WATER CONSERVATION STRATEGIES

Through leak detection and repairs, have recovered over 20,000,000 gallons of water per year since 2018

Appendix B- Water Use Summary Table

To Be Updated Annually with District Water Meter Data

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
	Total Connections	2468	2519	2723								
	Residential Connections	2100	2200	2320								
	Non-Residential Connections	368	319	403								
Annual	Total Water Used (MG)	157.84	151.99	175.25								
	Residential (MG)	103.46	97.89	121.40								
	Non-Residential (MG)	54.38	54.10	53.86								
	Average Water Use (gallons per connection per day)	175	165	176								
	Avg Residential Use (gallons per connection per day)	135	122	143								
	Avg Non-Residential (gallons per connection per day)	405	465	366								
Q1 (Jan-Mar)	Total Water Used (MG)	39.14	39.43	40.54								
	Residential (MG)	28.52	28.00	30.28								
	Non-Residential (MG)	10.63	11.43	10.26								
	Average Water Use (gallons per connection per day)	43	43	41								
	Avg Residential Use (gallons per connection per day)	37	35	36								
	Avg Non-Residential (gallons per connection per day)	79	98	70								
Q2 (Apr-June)	Total Water Used (MG)	28.59	29.01	28.21								
	Residential (MG)	19.50	17.54	19.95								
	Non-Residential (MG)	9.09	11.48	8.26								
	Average Water Use (gallons per connection per day)	32	32	28								
	Avg Residential Use (gallons per connection per day)	25	22	24								
	Avg Non-Residential (gallons per connection per day)	68	99	56								
Q3 (Jul-Sep)	Total Water Used (MG)	69.22	63.26	80.53								
	Residential (MG)	40.50	38.43	51.46								
	Non-Residential (MG)	28.72	24.83	29.06								
	Average Water Use (gallons per connection per day)	77	69	81								
	Avg Residential Use (gallons per connection per day)	53	48	61								
	Avg Non-Residential (gallons per connection per day)	214	213	198								
Q4 (Oct-Dec)	Total Water Used (MG)	20.89	20.30	25.98								
	Residential (MG)	14.95	13.93	19.70								
	Non-Residential (MG)	5.95	6.37	6.28								
	Average Water Use (gallons per connection per day)	23	22	26								
	Avg Residential Use (gallons per connection per day)	19	17	23								
	Avg Non-Residential (gallons per connection per day)	44	55	43								
	Total Summer (June-Aug) Precipitation (inches)	4.55	4.23	4.43								
	Average Summer (June-Aug) Daily High Temperature (F)	79.2	78.9	79.6								