CANYON AREA FEASIBILITY STUDY

TECHNICAL MEMORANDUM

Canyon Sewer Solutions – Executive Summary (DRAFT)

DATE: March 5, 2020

FROM: Mace Mangold, PE, LEED AP
Scott Buecker, PE (AE2S)

Executive Summary

The Canyon Area Feasibility Study (FS) provides a preliminary evaluation of wastewater management options for the development corridor adjacent to the Gallatin River near Big Sky, Montana, Gallatin County. Detailed study findings are organized in a series of technical memorandums (TMs) addressing the overall FS scope including:

- District formation recommendations and guidance (TM 1)
- Review of existing and projected wastewater flow rates and associated nitrate loading to the river (TM 2)
- Sewer collection and conveyance (TM 3)
- Treatment alternatives (TM 4)
- Disposal alternatives (TM 5)

This Executive Summary TM presents an overview of findings as they relate to comprehensive wastewater management solutions (i.e. collection-treatment-disposal scenarios).

Conclusions and Recommendation

Based on location and scale of existing and future wastewater load estimates, central collection is recommended to be extended to Service Area 9 (i.e. Ramshorn Subdivision). Two primary treatment scenarios exist, a dedicated Canyon Area Wastewater Reclamation and Reuse Facility (WRRF) or conveyance to the Big Sky County Water and Sewer District (BSCWSD) WRRF. The two treatment plants are referred to as “Canyon WRRF” and “Big Sky WRRF” hereafter. For both scenarios, design effluent quality is assumed to be Class A-1 Reclaimed Water per DEQ-2 standards achieved using enhanced nutrient removal and membrane bioreactor (MBR) technology. This high effluent quality allows for a wide range of disposal and reuse options and provides significant Total Nitrogen (TN) reduction to mitigate existing Gallatin River water quality impacts and reduce risk of future ground water resource impacts as development progresses. Recommended disposal method for both scenarios is groundwater discharge based on several factors including Department of Environmental Quality (DEQ) permit feasibility, nutrient abatement and dilution benefits, existing infrastructure, land space intensity, operation and maintenance (O&M) and public acceptance.

Depiction of infrastructure required for the two scenarios is provided in **Figure 1** (Canyon WRRF) and **Figure 2** (BSCWSD Treatment & Canyon Area Disposal). Component summary and opinions of probable cost for each scenario are presented in **Table 1** and **Table 2.**

TABLE 1 – SCENARIO 1: CANYON WRRF, OPINION OF PROBABLE COST

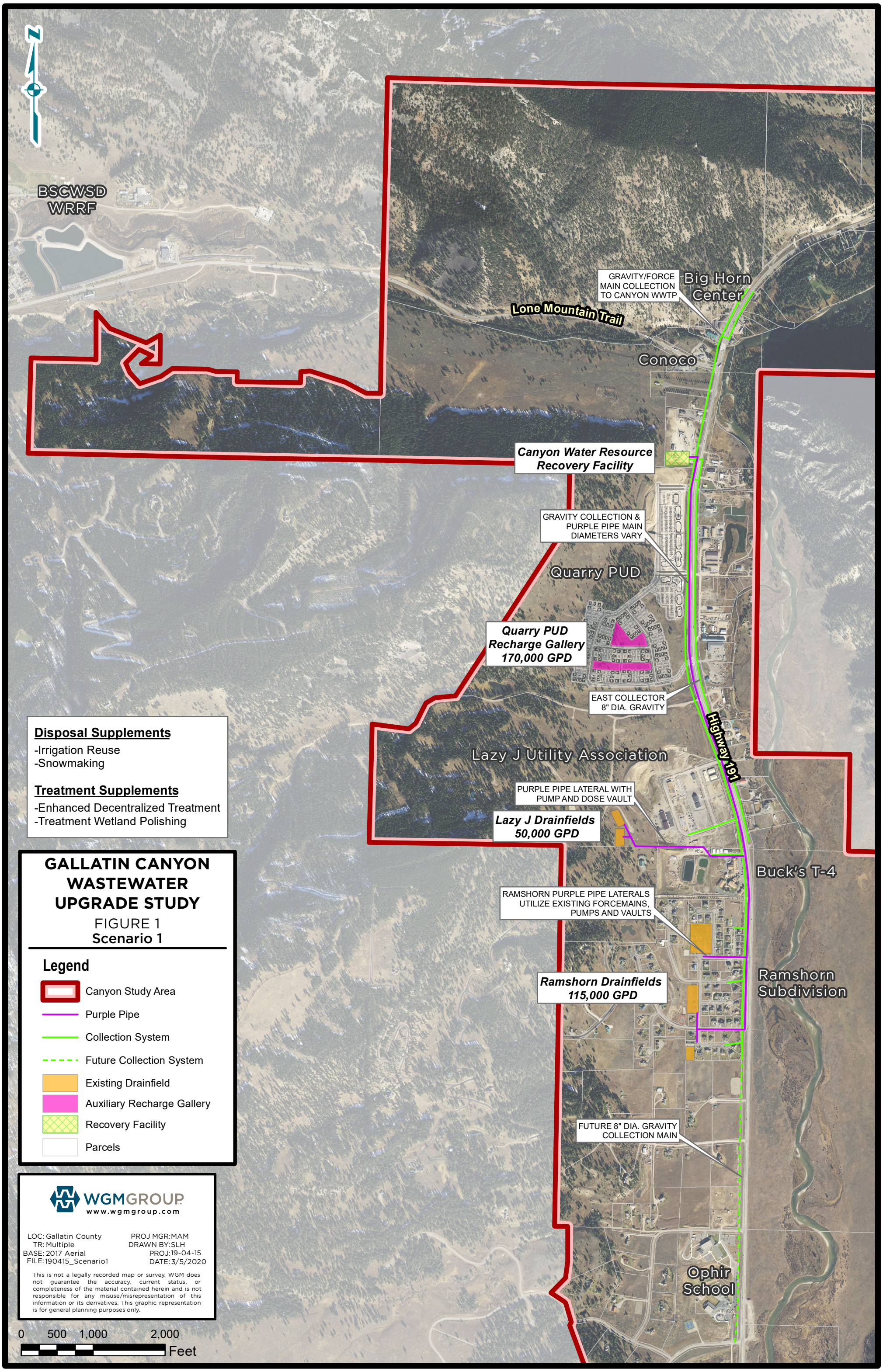
PROJECT COMPONENT	EOPCC (Class IV AACE[i])
Collection System – Bighorn Center to Ramshorn Subdivision	$7.6 Million
MBR WRRF – 305,000 GPD Capacity	$15.6 Million
Disposal – Water Reuse Main & 165,000 GPD Existing Drainfield Capacity ($5.4M), 170,000 GPD Auxiliary Recharge Capacity ($1.1M)	$6.5 Million
Total =	**$29.7 Million**

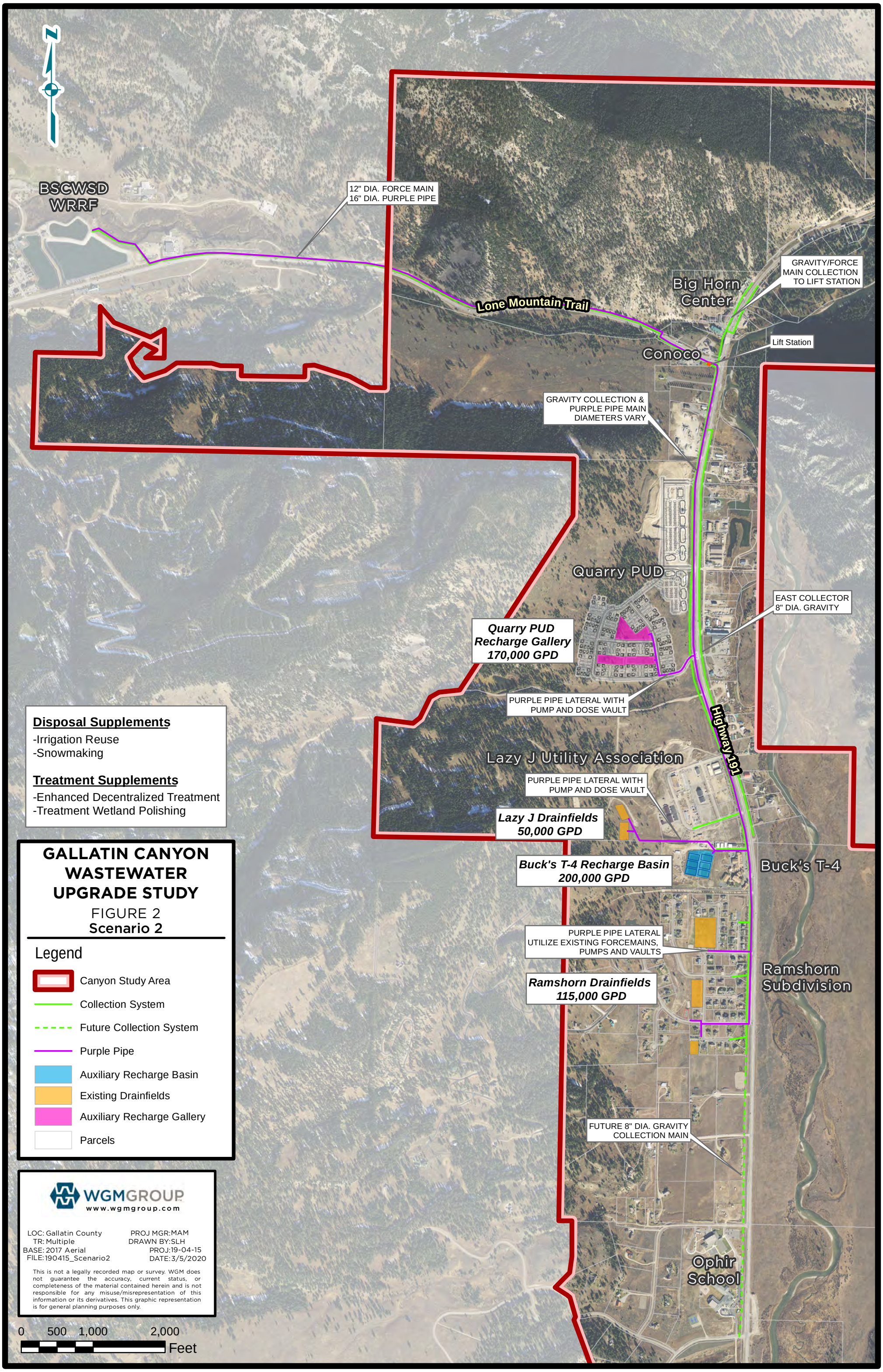
TABLE 2 – SCENARIO 2: BSCWSD TREATMENT & CANYON AREA DISPOSAL, OPINION OF PROBABLE COST

PROJECT COMPONENT	EOPCC (Class IV AACE[i])
Collection System – Bighorn Center to Ramshorn Subdivision	$7.6 Million
Lift Station / Forcemain / Return Water Pipeline	$11.7 Million
Disposal – Water Reuse Main & 165,000 GPD Existing Drainfield Capacity ($5.3M), 370,000 GPD Auxiliary Recharge Capacity ($1.5M)	$6.8 Million
Total =	**$26.1 Million**

The cost opinions presented in **Table 1** and **Table 2** reflect capital costs only. Annual Operations, Maintenance and Replacement (OM&R) costs will vary between the two scenarios. Scenario 2 represents a collaborative solution in which the Canyon Area achieves cost-sharing for planning, design, construction and on-going Operations, Maintenance and Replacement (OM&R) costs, while alleviating disposal challenges for BSCWSD and associated costs. There are substantial economies of scale in centralized water/wastewater treatment facilities. The cost-benefit to each district remains to be mutually evaluated and coordinated to determine connection fee and OM&R obligations. The forthcoming Conceptual Rate Study (TM6) will provide a preliminary financial structure recommendation to serve as a basis for future coordination and assignment of capital and OM&R costs. Findings from TM6 will include conceptual user rates and connection fees based on a preliminary funding package, including Resort Tax Funds allocated in the Additional 1% Resort Tax vote, to provide a better means of comparison for the two scenarios.

[i] The construction cost estimates presented are based on 2020 dollars. The engineer's opinion of probable project costs (EOPCC) was developed based on other, similar projects, budgetary cost proposals from suppliers, engineering judgement and RS Means cost estimating manuals. The EOPCC cost opinions in this report represent a Class 4 Estimate based on the definitions of the Association for Advancement of Cost Engineering (AACE) International. This level of cost opinion is appropriate for planning level evaluations made with incomplete information. The cost opinion at this level of engineering is considered to have an accuracy range of -25/+35 percent.


N
BSCWSD
WRRF
GRAVITY/FORCE
MAIN COLLECTION
TO CANYON WWTP
Big Horn
Center
Lone Mountain Trail
Conoco
Canyon Water Resource
Recovery Facility
GRAVITY COLLECTION &
PURPLE PIPE MAIN
DIAMETERS VARY
Quarry PUD
Quarry PUD
Recharge Gallery
170,000 GPD
EAST COLLECTOR
8" DIA. GRAVITY
Highway 191
Lazy J Utility Association
PURPLE PIPE LATERAL WITH
PUMP AND DOSE VAULT
Lazy J Drainfields
50,000 GPD
Buck's T-4
RAMSHORN PURPLE PIPE LATERALS
UTILIZE EXISTING FORCEMAINS,
PUMPS AND VAULTS
Ramshorn Drainfields
115,000 GPD
Ramshorn
Subdivision
FUTURE 8" DIA. GRAVITY
COLLECTION MAIN
Ophir
School
Disposal Supplements
-Irrigation Reuse
-Snowmaking
Treatment Supplements
-Enhanced Decentralized Treatment
-Treatment Wetland Polishing
GALLATIN CANYON
WASTEWATER
UPGRADE STUDY
FIGURE 1
Scenario 1
Legend
Canyon Study Area
Purple Pipe
Collection System
Future Collection System
Existing Drainfield
Auxiliary Recharge Gallery
Recovery Facility
Parcels
WGMGROUP
www.wgmgroup.com
LOC: Gallatin County
TR: Multiple
BASE: 2017 Aerial
FILE: 190415_Scenario1
PROJ MGR: MAM
DRAWN BY: SLH
PROJ: 19-04-15
DATE: 3/5/2020
This is not a legally recorded map or survey. WGM does not guarantee the accuracy, current status, or completeness of the material contained herein and is not responsible for any misuse/misrepresentation of this information or its derivatives. This graphic representation is for general planning purposes only.
0 500 1,000 2,000
Feet


BSCWSD
WRRF
12" DIA. FORCE MAIN
16" DIA. PURPLE PIPE
Lone Mountain Trail
Big Horn
Center
GRAVITY/FORCE
MAIN COLLECTION
TO LIFT STATION
Lift Station
Conoco
GRAVITY COLLECTION &
PURPLE PIPE MAIN
DIAMETERS VARY
Quarry PUD
EAST COLLECTOR
8" DIA. GRAVITY
Quarry PUD
Recharge Gallery
170,000 GPD
PURPLE PIPE LATERAL WITH
PUMP AND DOSE VAULT
Highway 191
Lazy J Utility Association
PURPLE PIPE LATERAL WITH
PUMP AND DOSE VAULT
Lazy J Drainfields
50,000 GPD
Buck's T-4 Recharge Basin
200,000 GPD
Buck's T-4
PURPLE PIPE LATERAL
UTILIZE EXISTING FORCEMAINS,
PUMPS AND VAULTS
Ramshorn Drainfields
115,000 GPD
Ramshorn
Subdivision
FUTURE 8" DIA. GRAVITY
COLLECTION MAIN
Ophir
School
Disposal Supplements
-Irrigation Reuse
-Snowmaking
Treatment Supplements
-Enhanced Decentralized Treatment
-Treatment Wetland Polishing
GALLATIN CANYON
WASTEWATER
UPGRADE STUDY
FIGURE 2
Scenario 2
Legend
Canyon Study Area
Collection System
Future Collection System
Purple Pipe
Auxiliary Recharge Basin
Existing Drainfields
Auxiliary Recharge Gallery
Parcels
WGMGROUP
www.wgmgroup.com
LOC: Gallatin County
TR: Multiple
BASE: 2017 Aerial
FILE: 190415_Scenario2
PROJ MGR:MAM
DRAWN BY:SLH
PROJ:19-04-15
DATE:3/5/2020
This is not a legally recorded map or survey. WGM does not guarantee the accuracy, current status, or completeness of the material contained herein and is not responsible for any misuse/misrepresentation of this information or its derivatives. This graphic representation is for general planning purposes only.
0 500 1,000 2,000
Feet

Introduction

The Canyon Area Feasibility Study (FS) was funded by the Resort Tax Advisory Board to evaluate wastewater collection, treatment, and disposal solutions for the existing development corridor adjacent to the Gallatin River near Big Sky. The 'purpose and need' for the study is three-fold; protect the Canyon Area's groundwater (drinking water source) quality; mitigate existing and future nutrient loading to the Gallatin River; and establish improved long-term wastewater management to mitigate risk of future water quality impacts as the Canyon Area further develops. Study findings are organized as follows:

TM 1: District Planning and Formation
TM 2: Existing Conditions and Growth Projections
TM 3: Sewer Collection and Conveyance
TM 4: Treatment Alternatives
TM 5: Disposal Alternatives
TM 6: Conceptual Rate Study and Funding

This Executive Summary provides an overview of the contents of TMs 1 through 5, which form the Canyon Area FS Report. The Conceptual Impact Fee and Rate Study (TM6) will incorporate capital costs for recommended alternatives with district phasing, population projections, and potential funding sources to identify preliminary estimates for connection fees and user rates.

TM 1: District Planning and Formation

This TM provides a recommended district boundary along with an overview of district formation logistics including process, authorities created, funding opportunities, and long-term planning benefits.

District formation would serve as a key first step to mitigate existing water resource impacts and protect against future impacts as development progresses. The lack of a sewer district and central sewer collection and wastewater treatment has resulted in general development sprawl in the Canyon Area and apparent elevated nutrient loading to the Gallatin River. The existing septic systems also increase human health risks due to loading to the aquifer, which serves as only the drinking water source for Canyon Area development. Central collection has the potential to reduce nutrient load significantly using a combination of mechanical central treatment and enhanced decentralized treatment.

District formation can be completed in approximately one month following petition submittal to Gallatin Canyon and collection of signatures of all landowners within the district boundary. If collecting 100% of signatures is not possible, district formation would be conducted through a vote process and require an estimated nine to 18 months to adequately inform the voting public and establish broad consent.

District boundary and phasing recommendations are provided to offer expedited formation while encouraging maximum collection of existing loads. Expedited formation offers the greatest potential for identifying 'co-solutions' with BSCWSD (i.e. Scenario 2) as they actively plan and design WRRF expansion. Expedited formation also has advantages of minimizing developer 'sunk' costs on active planned unit development (PUD) projects that otherwise may be available for comprehensive sewer collection, treatment, and disposal solutions. As depicted in **Figure 3**, the Phase 1A boundary encompasses large

landholdings in close proximity to the intersection of Highway 191 and Lone Mountain Trail where centralized collection for treatment or forcemain conveyance to BSCWSD is proposed. This preliminary planning boundary encompasses landowners that have expressed willingness to form a district such that formation could be conducted with collection of signatures in lieu of requiring a vote, which is expected to substantially reduce the district formation timeline.

The Phase 1B boundary encompasses landholdings with notable TN loads that can be tied into the collection main with limited extra collection cost beyond Phase 1A infrastructure. The added complexity associated with numerous landowners is expected to require substantial coordination and additional due-diligence planning to establish necessary voting population approval. This phased approach would allow for the Phase 1A district to begin securing funds and advance planning, and ultimately utilize refined engineering design and cost estimates to inform potential Phase 1B landowners and voting population for district inclusion. Lastly, the presence of the Highway 191 right-of-way (ROW) and ability to extend the sewer collection main down the ROW creates potential for future annexation of non-contiguous landholdings, such as Ophir School depicted as a conceptual Phase 2.

GALLATIN CANYON WASTEWATER UPGRADE STUDY

FIGURE 3

District Boundary Phasing

Legend

- Highway 191 ROW
- Canyon Study Area
- Service Areas
- Public Land

Phase

- Phase 1A
- Phase 1B
- Phase 2

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Conoco
Quarry PUD
Lazy J Utility Association
Buck's T-4
Ramshorn
Ophir School
Corral/Rainbow Lodge

WGMGROUP
www.wgmgroup.com

LOC: Gallatin County
TR: Multiple
BASE: 2017 Aerial
FILE: TM1Fig1_Boundary_Phase

PROJ MGR:M Mangold
DRAWN BY:S Howell
PROJ:19-04-15
DATE:3/5/2020

0 0.25 0.5 1 Miles

TM 2: Existing Conditions and Projected Build-out

Existing development in the Canyon Area is highly variable in regard to density and use (e.g. residential, commercial, etc.). 'Service Areas' are used as a planning tool to organize existing and future load estimates, design capacity development, and aid in communicating potential for incremental implementation (i.e. priority areas and associated collection and/or treatment cost). These areas are delineated based on a range of factors including zoning, existing land use and potential for increased density. Two estimates are developed to establish a range of projected loading. The 'Existing Condition' scenario reflects approximate present-day build-out to serve as basis for estimating existing nutrient loading and projecting future wastewater flow rates. The 'Projected Build-out' scenario serves as a design capacity for collection, treatment and disposal options.

Existing Condition

The Gallatin County Health Department database was utilized to determine total permitted septic systems located within the 2008 Study Area and associated design flows. The database included 75 permitted systems totaling 112,743 GPD design flow. "Ground truthing" was conducted via aerial imagery, review of as-built drawings and permits, and site observations to identify systems and associated design flows not accurately reflected within the database. The resulting present-day total design flow is estimated to be 114,854 GPD. **Figure 4** presents a spatial distribution of permitted flow rates. Note that design flows are generally reflective of maximum day flow rate rather than average day flow rate.

Projected Build-out

In 2008, the Study Area included permitted discharges totaling 76,543 GPD design flow (Dowl, 2008). The resulting annual growth rate based on permitted discharges from 2008 to present day equates to 3.8%. Formation of a district would be expected to facilitate increased growth and corresponding growth rate. The BSCWSD's record of Single-Family Equivalents (SFEs) connections to the sewer system shows an average of approximately 7% annual increase from 2014 to 2019. The average annual flow at the treatment plant has increased approximately 5% on an annual average basis during the same time period. Assuming a 5% growth rate results in a 20-year projected flow rate of 305,000 GPD.

Collection, treatment, and disposal options presented in the FS use the projected flow rate of 305,000 GPD as the basis of design. This design flow rate is generally characterized as a conservative estimate as it is generated based on the design flow rate (e.g. approximate max day) of permitted systems that may not be fully built-out (reserve capacity). However, development factors such as notable near-term growth associated with approved PUDs and commercial influx, such as hotels, has the potential to contribute to growth rates in excess of 5%. Additionally, increased inflow and infiltration (I&I) is expected with the installation of the collection main. As such, 305,000 GPD is viewed as an appropriate basis of design for the feasibility level of analysis and engineer's opinion of probable costs presented in the FS. **Figure 5** presents a spatial distribution of projected flow rates.

GALLATIN CANYON WASTEWATER UPGRADE STUDY

FIGURE 4

Existing Permitted Systems

Legend

- 2008 Study Area
- ServiceAreas
- Parcels
- Public Land

Permitted System GPD

- 50 - 500
- 501 - 2000
- 2001 - 4000
- 4001 - 10000
- 10001 - 20000

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

WGMGROUP
www.wgmgroup.com

LOC: Gallatin County
TR: Multiple
BASE: 2017 Aerial
FILE: 190415_Existing

PROJ MGR: M Mangold
DRAWN BY: S Howell
PROJ: 19-04-15
DATE: 3/5/2020

0 0.25 0.5 1 Miles

GALLATIN CANYON WASTEWATER UPGRADE STUDY

FIGURE 5

Projected Build-Out

Legend

- Canyon Study Area
- Phase 1
- Phase 1A
- Phase 1B
- Phase 2
- Public Land

Service Area

Total Nitrogen (lbs/yr)

- 0 - 250
- 251 - 450
- 451 - 750
- 751 - 1000
- 1001 - 1830

1 80 lb/yr
2 330 lb/yr
3 350 lb/yr
4 1385 lb/yr
5 1830 lb/yr
6 460 lb/yr
7 135 lb/yr
8 510 lb/yr
9 1080 lb/yr
10 345 lb/yr
11 250 lb/yr
12 1690 lb/yr
13 920 lb/yr
14 490 lb/yr
15 1190 lb/yr
16 490 lb/yr
17 0 lb/yr
18 805 lb/yr

WGMGROUP
www.wgmgroup.com

LOC: Gallatin County
TR: Multiple
BASE: 2017 Aerial
FILE: 190415_Projected_v3

PROJ MGR: M Mangold
DRAWN BY: S Howell
PROJ: 19-04-15
DATE: 3/5/2020

0 0.25 0.5 1 Miles

TM 3: Sewer Collection and Conveyance

Currently there is no centralized sewer system in the Canyon Area of Big Sky. A completely new sanitary sewer collection system would be required to collect the raw sewage generated in the Canyon Area and convey it to treatment. Existing septic and Level 2 community treatment systems would be abandoned and properly de-commissioned.

The Canyon Area generally slopes steadily downward from south to north, so the vast majority of the collection system would be a gravity system, with a small lift station north of the confluence of the West Fork of the Gallatin River with the mainstem of the Gallatin River, which would be necessary to provide service to the developments north of Highway 64. Wastewater collected from this area would be pumped either to a newly constructed Canyon WRRF (Scenario 1) or to the existing but soon to be expanded and upgraded Big Sky WRRF (Scenario 2). Based on a preliminary hydraulic model of the Canyon Area main collection system, sewering the Canyon Area will require approximately 24,900 feet of pipe (7,800 ft. of 12", 3,900 ft. of 10", 13,000 ft. of 8", 200 ft. of 4" forcemain under the West Fork). Depiction of collection is presented in **Figure 6**.

Table 3 provides a summary of the opinion of probable "total project cost" (TPC) for a collection system for each service area. TPC is defined as planning, engineering, construction, and construction administration. All costs are in 2020 dollars. Escalation should be applied to the year of construction, but the schedule is unknown at this time.

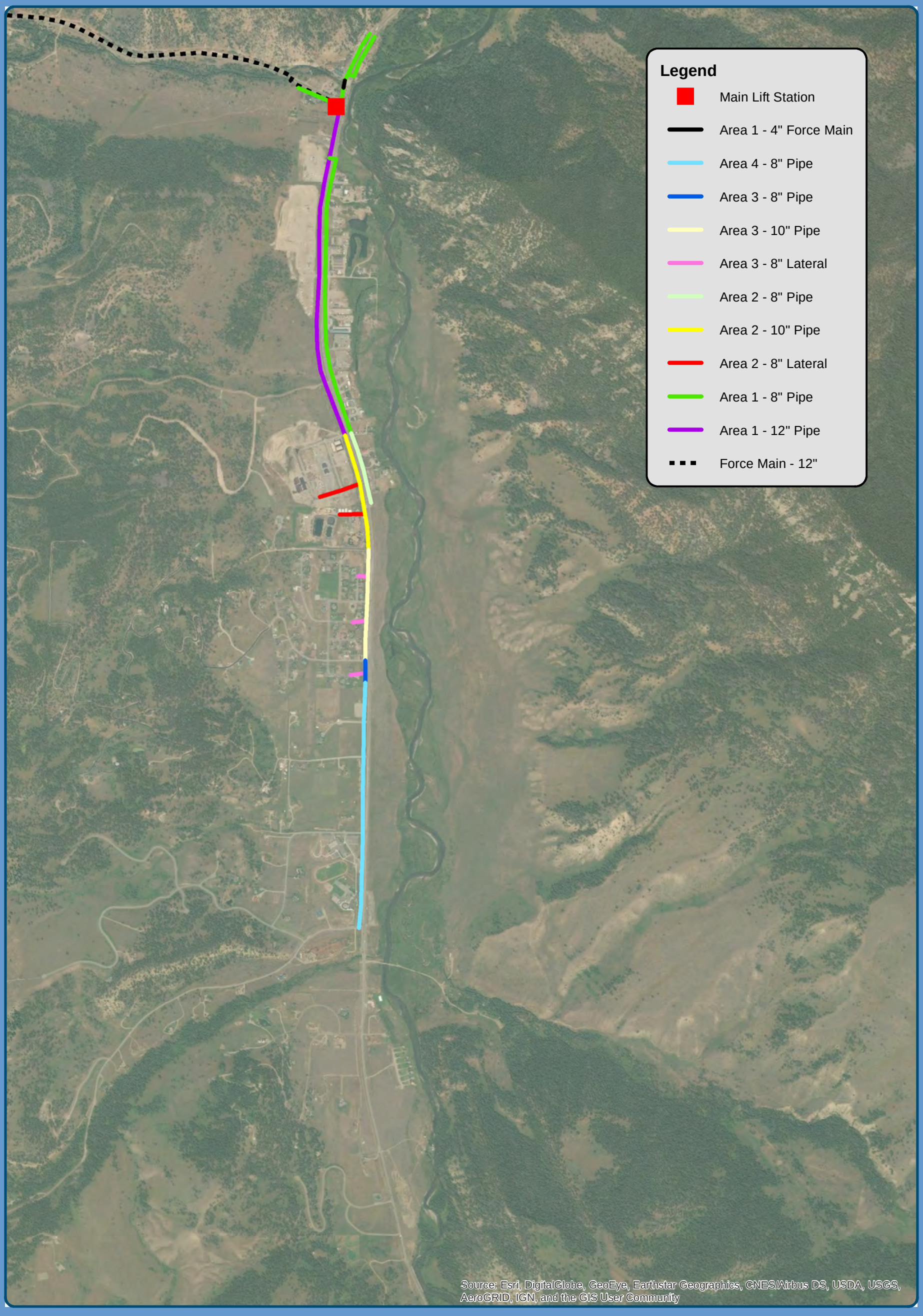
TABLE 3 – COLLECTION SYSTEM, OPINION OF PROBABLE COST

SEWER COLLECTION PROJECT COMPONENT	EOPTPC (Class IV AACE)
Area 1 Collection System	$5.3 Million
Area 2 Collection System	$1.5 Million
Area 3 Collection System	$0.8 Million
Area 4 Collection System (future collection to Ophir School)	$1.0 Million
Total Canyon Area Collection System Cost	$8.6 Million

If raw wastewater is treated in a Canyon Area specific WRRF (Scenario 1, Canyon WRRF), the collection system would be the extent of the collection/conveyance costs for the project. If the Canyon Area wastewater is to be conveyed to the Big Sky WRRF for treatment (Scenario 2), with treated water returned to the Canyon Area for reuse and/or disposal, then the costs for the lift station, raw wastewater forcemain and treated water return along Highway 64 must be included. These cost estimates are listed in **Table 4** below.

TABLE 4 – CANYON AREA LIFT STATION, FORCEMAIN AND TREATED WATER RETURN, OPINION OF PROBABLE COST

CONVEYANCE PROJECT COMPONENT	EOPCC (Class IV AACE)
Canyon Area Lift Station	$3.7 Million
Raw Wastewater Forcemain (12-inch)	$3.0 Million
Treated Water Return Pipeline (16-inch)	$10.0 Million
Total Conveyance System Cost	$16.7 Million



0 0.25 0.5 Miles

Gallatin Canyon Wastewater Upgrade Study
Collection System Service Areas

Figure 6

Advanced Engineering and Environmental Services, Inc.

TM 4: Treatment Alternatives

Alternatives were evaluated for treatment and a Membrane Bioreactor (MBR) based treatment was selected due to its small footprint, high quality effluent, and cost-effectiveness at the small size range of water resource recovery facility needed for the Canyon WRRF. Sequencing Batch Reactor (SBR) technology followed by cloth filtration and UV disinfection was considered, but this treatment approach would have a larger footprint than the MBR alternative with subsequently higher building and site costs, would produce a lower quality of effluent, more waste sludge, and be more challenging to operate than an MBR system. Year-round compliance with Class A-1 treatment requirements for total nitrogen likely would be more challenging than if MBR treatment were utilized.

Scenario 1 – Canyon WRRF

Scenario 1 assumes Canyon WRRF sized for 305,000 gallons per day (GPD) of average annual wastewater flow of medium strength municipal wastewater. The facility would be designed to produce an effluent compliant with Montana DEQ Class A-1 standards for reuse, so the water could be reused in the Canyon Area or be exempt from groundwater discharge permit requirements per ARM 17.30.1022.

The facility would be best located as near as feasible to the intersection of Highway 64 and US 191, but for planning purposes is located in the northeast portion of the Quarry development. For planning purposes, a 2-acre site will be assumed to encompass treatment facilities and vehicle access with traffic flow around the facility. The facility will have a Headworks with screening and grit removal, MBR treatment, UV Disinfection, and Solids Handling equipment and facilities. The equipment would be located indoors, odor control would be provided, and the architecture would be designed to blend the facility in with surrounding development. The engineer's opinion of total project cost for this facility is $15.6M (Class IV estimate by AACE Standards).

There will not be 305,000 of average annual wastewater generation in the Canyon Area until full build-out. WRRFs have issues when substantially less than their rated flow capacity is received for extended periods of time. Therefore, the facility will be set up to accommodate 305,000 GPD of average flow but initially will be started with two smaller skidded MBR packaged treatment systems. Once flows and loads increase due to Canyon Area District development and growth, these skids could be modified to provide aerobic digestion of biosolids generated from the full-scale WRRF.

Scenario 2 – Lift Station & Forcemain to Big Sky WRRF

Scenario 2 assumes a lift station and forcemain would bring Canyon Area wastewater to the Big Sky WRRF for treatment at an upgraded and expanded 1.4 mgd (average annual flow) facility. The facility is being designed and after commissioning it will produce an effluent compliant with Montana DEQ Class A-1 standards for reuse, so the water could be reused or be exempt from groundwater discharge permit requirements per ARM 17.30.1022.

Wastewater will be screened, de-gritted, and then treated through a series of anaerobic/anoxic/aerobic zones to maximize biological nutrient removal. Biosolids will be aerobically digested, dewatered, and composted with sawdust and coarse green waste. Treated water currently is utilized for irrigation. Groundwater discharge, snow-making, and indirect potable reuse are being considered for expansion of reuse and disposal capacity.

The Phase I Expansion and Upgrade is scheduled to be constructed from 2020-2022. The current engineer's opinion of total project cost is $35M (Class IV estimate by AACE Standards).

Supplemental Decentralized Treatment

Decentralized treatment can be implemented in areas that are not cost effective for central collection and provide improved nitrogen removal beyond standard septic systems. Effluent quality is less than that of the proposed MBR central treatment, but very good nitrogen removal performance can be achieved ranging between 60%-90%. Screening of available technologies identified SepticNET based on superior nitrogen removal capacity and Vertical Flow Treatment Wetlands (VFTW) based on good, cost effective nitrogen removal.

SepticNET modular treatment systems were developed in Montana and achieve excellent nitrogen removal. The technology is permitted to produce effluent with less than 7.5 mg/l TN, and analysis of currently installed systems indicate effluent TN levels are consistently below 5 mg/l achieving over 90% TN removal. These modular systems produce excellent water quality and are described as low maintenance. The systems are installed in subsurface modules and are proven Montana's climate. The VFTW system also been proven in Montana and offer a cost-effective onsite treatment alternative. VFTW systems require relatively small amounts of land area for the treatment beds and are planted with local plants resulting in lush habitat that can be incorporated into onsite landscaping. The technology has been shown to reduce incoming TN by 60-80%.

A conceptual 5,000 GPD design scenario is provided to serve as a general comparison between the two decentralized treatment options. Average day flow is assumed to be 3,000 GPD. These design and average day flow assumptions correlate to a group of approximately fourteen 3-bedroom homes or resort style lodging that can accommodate up to 125 people. **Table 5** provides a general cost and performance comparison between the two technologies.

TABLE 5 –DECENTRALIZED TREATMENT

TREATMENT TECHNOLOGY	EOPPC (Class IV AACE)	Annual TN Removal (Pounds)	$/Pound Yearly TN Removal
SepticNET	$295,00	840	$542
Vertical Flow Treatment Wetland	$126,000	610	$318

The engineer's opinion of probable construction costs is limited to treatment structures only. Collection, conveyance, solids handling tanks, and drainfield infrastructure are excluded due to unknowns associated with site specific conditions. Construction overhead and profit (10%) and construction contingency (30%) are included. Engineering and permitting is not included due to site specific variables. Finally, it is noted that financial burden of maintenance and/or failure is distributed across a relatively small population in comparison to central treatment such that OM&R costs should also be considered.

TM 5: Disposal Alternatives

A range of disposal alternatives were evaluated with respect to receiving water impact and implementation considerations such as space constraints, infrastructure costs, and permitting. An overview of discharge alternatives and general findings is presented in **Table 6**. Groundwater discharge is identified as the most feasible method based on environmental benefits of utilizing the aquifer for storage, treatment (phosphorous removal, denitrification processes), and dilution of treated effluent. Additionally, central collection and recommended MBR treatment reduces the annual aquifer TN load by greater than 90%, mitigating existing groundwater impacts and risks to the Gallatin River. Providing net reduction in TN load to the aquifer is expected to receive Montana DEQ support and relatively high likelihood of obtaining necessary regulatory approvals. Finally, based on the net-nutrient reduction, applications of DEQ's nutrient trading policy could be explored to support comprehensive watershed planning projects or regional needs. This policy may serve as a general permitting mechanism for the BSCWSD 'co-solution' scenario (Scenario 2) and should be discussed further with DEQ representatives.

TABLE 6 – DISPOSAL ALTERNATIVE OVERVIEW MATRIX

Alternative	Load Reduction Post-Treatment	Discharge Period	Approximate[1] Space Requirement Per 100k GPD	Approximate Cost[1] Range Per 100k GPD	General Notes
Surface Water Discharge	No additional	Spring runoff	5-15 Acres (Assumes 9-mo Storage)	$2M-$5M	Timed release can eliminate or mitigate base flow loading. No aquifer benefits (treatment, recharge). Permit level: Difficult
Groundwater Recharge Gallery (Subsurface)	Denitrification Phosphorous Adsorption Dilution	Year-round	1-2 Acres	$0.1M-$1.5M	Utilize existing drainfields to reduce cost. Aquifer provides additional nutrient reduction benefits. Source water protection risk and load to river during base flow. Permit level: Feasible
Groundwater Recharge Basin (Above Ground)	Same as above	9-months (potential winter limitations)	0.5-1.5 Acres	$0.1M-1M	Same as above. Potential winter disposal limitations or reductions.
Snowmaking	Denitrification Sublimation Dilution Adsorption Soil/Plant Update	Applied in winter, ideally enters stream in spring runoff Out of system by nutrient season	40 Acres for 5 months of disposal (96 acres for equivalent year-round disposal)	$2M – $5M ($4M-$10M for equivalent year-round disposal)	Snowmelt could be timed to mitigate base flow loading. Reduced load. Reduced water supply demand. Permit level: TBD
Land Application	Plant uptake, denitrification, evapotranspiration	Growing Season	23 acres for 5 months of disposal (55 acres for equivalent year-round disposal)	$0.1M - .5M ($4M-$10M for equivalent year-round disposal)	Load eliminated with proper application rates. Reduced water supply demand. Permit level: Feasible
Class I Deep Injection Wells	Load eliminated	Year-round	0.1 acre	Unknown	Substantial cost with low likelihood of regulatory approval due to complex geology. Permit level: Difficult
Class V Shallow Injection Wells	Dilution Phosphorous Adsorption	Year-round	2-3 wells	$0.2M-$0.5M	Aquifer recharge provided in small footprint. Nutrient reduction benefits are less than the groundwater recharge basin and gallery alternatives. Additional treatment may be required. Permit level: TBD

1 - Disposal infrastructure and quantities are dependent on site specific factors including but not limited to topographic relief, subsurface conditions, infiltration rates and land use constraints. Cost ranges presented are for conceptual planning purposes only and exclude land acquisition and permitting costs.

Scenario 1 – Canyon WRRF

A 'purple-pipe' main will convey treated wastewater to disposal locations. This main is recommended to be installed parallel to the collection main down to Ramshorn Subdivision to facilitate use of existing drainfields. Associated infrastructure is depicted on **Figure 1**. Existing drainfields at Lazy J and Ramshorn have an estimated combined capacity of 165,000 GPD based on review of available design drawings and subsurface information. Supplemental disposal capacity of approximately 170,000 GPD is depicted in Service Area 5 (Quarry PUD) to account for potential near-term infrastructure and additional district capacity needs if initial district formation is limited in extent. Disposal capacity estimates assume Class-A1 reclaimed water, which facilitates increased loading rates in comparison to standard septic or Level 2 effluent and improves drainfield sizing criteria. Lastly, the purple-pipe main also provides opportunity for future land application or additional methods (e.g. snowmaking) and implementation of water conservation measures.

The engineer's opinion of total project cost for Scenario 1 disposal is $6.5 (Class IV estimate by AACE Standards).

Scenario 2 – BSCWSD Treatment & Canyon Area Disposal

The BSCWSD can potentially expand their treatment facilities beyond 0.92 MGD with additional planning, design, and construction, however, the most limiting factor in expansion of the BSCWSD is effluent disposal. Significant, additional irrigation disposal will require additional storage of treated effluent, which is undesired and becoming infeasible due to the land requirements, costs, and difficulties in management.

The BSCWSD is evaluating other methods of effluent disposal and reuse, including snowmaking and groundwater discharge/recharge (the latter potentially for indirect potable reuse). The feasibility of all of these disposal/reuse approaches is limited by the impaired status of the Middle and South Forks of the West Fork of the Gallatin River. Impaired status requires compliance with total maximum daily load (TMDL) limits on these streams, which requires extraordinary measures to avoid discharge of additional nitrogen (or phosphorus) to these streams.

The Canyon Area lies in close proximity to the mainstem of the Gallatin River, which is not currently impaired and does not have a TMDL. Furthermore, the aquifer has greater nutrient abatement and dilution capacity to mitigate nutrient impacts. Therefore, the potential exists for the Canyon Area to provide groundwater discharge for the BSCWSD's treated effluent. Scenario 2 assumes discharge capacity would be provided to BSCWSD in exchange for treatment capacity for Canyon Area wastewater flows and loads while maintaining a net-nutrient reduction to the Gallatin River.

Total discharge capacity depicted on **Figure 2** is 535,000 GPD. This represents approximately 230,000 GPD of capacity beyond the projected Canyon Area build-out flow rates. Similar to Scenario 1, existing drainfield infrastructure is expected to be utilized first, with auxiliary disposal areas and methods to be identified and implemented as development progresses. Auxiliary locations depicted on **Figure 2** have been evaluated for general disposal suitability based on a desk-top level review of available information. Based on the general geology of the Canyon Area, a number of alternate disposal locations likely exist that can be evaluated for increased disposal capacity and/or better suitability for existing and future adjacent land use. Alternate disposal methods, specifically irrigation

reuse and snowmaking, should remain a consideration depending on future land use and DEQ environmental permitting favorability and logistics.

The engineer's opinion of total project cost for Scenario 2 disposal is $6.8 (Class IV estimate by AACE Standards).