Mighty Argo Upper Landing
Wastewater Reclamation Facility
Site Application and Engineering Report
June 2023

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Mighty Argo Upper Landing
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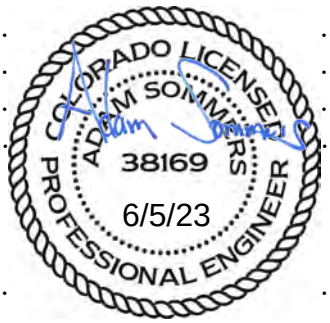

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ABBREVIATIONS

(Not all may be included in this report)

ATS	Automatic Transfer Switch
AWDBO	AquaWorks DBO, Inc.
BDL	below detection level
BNR	Biological Nutrient Reduction
BOD	biological oxygen demand
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
cf	cubic feet
cy	cubic yards
DMR	discharge monitoring report
EQR	equivalent residential
ft	feet
g	gram
GPD	gallons per day
GPM	gallons per minute
HMI	human-machine interface
Hp	horsepower
I&I	inflow and infiltration
kw	kilowatt
kwh	kilowatt hour
LS	lump sum
MBR	membrane bioreactor
MCL	maximum contaminate level
MLSS	mixed liquor suspended solids
MG	million gallons
MGD	million gallons per day
mg/L	milligrams per liter
min	minutes
N/A	not applicable
NaOCl	sodium hypochlorite
NRBP	National Blue Ribbon Commission
O&M	operation and maintenance
ORP	oxygen reduction potential
PER	Preliminary Engineering Report
PEL	Preliminary Effluent Limits

PLC	programming logic controller
PPD	pounds per day
ppm	parts per million
RAS	return activated sludge
SBR	sequencing batch reactor
SCADA	supervisory control and data acquisition
SCFM	standard cubic feet per minute
SRF	State Revolving Fund
SRT	solids retention time
RTU	remote telemetry unit
TDS	total dissolved solids
TSS	total suspended solids
WWTP	wastewater treatment plant
WQCD	Water Quality Control Division
WAS	waste activated sludge

EXECUTIVE SUMMARY

Mighty Argo Upper Landing is proposing an outdoor recreational and heritage tourism development in Idaho Springs, Colorado. The project includes a new gondola that will take visitors to a new development 1.25 miles above the city. At the top of the gondola, the upper landing site will be home to an amphitheater, food services, restrooms, and other non-residential uses. This application is for a wastewater reclamation facility at that location. Approximately 3 years ago, Mighty Argo previously began the site location and design review process to construct the wastewater treatment plant project with CDPHE. The treatment facility achieved site location approval in 2020; however, progress on the project stopped unexpectedly and the site location approval expired. This site application restarts the Regulation 22 review and approval process for the proposed wastewater treatment facility. There are no substantive changes between this application and the previously approved site application approval.

The treatment facility design remains unchanged relative to the expired site approval and is sized to treat 20,000 GPD (30-day average) and 95 pounds per day of BOD. The proposed site location, on top of the hillside, does not include access to surface water features for either a drinking water source or for discharging treated wastewater. Therefore, the project is designed to produce category 3 reclaim water under Regulation 84 and discharge a portion of effluent to groundwater. Reclaimed water will be used for Regulation 84-compliant reuse activities, including toilet/urinal flushing, and landscaping irrigation. Reclaim water use will be maximized, and most of the excess will be discharged to groundwater. Some wastewater will also be hauled to Idaho Springs WWTP.

The treatment alternatives evaluated in this report include taking no action, consolidating with another facility, and installing the membrane bioreactor or sequencing bioreactor treatment technology. The membrane bioreactor was selected as the preferred alternative because of its filtration capabilities required in Regulation 84, small footprint, ease of installation, modularity, and the ability to produce high-quality effluent. The biological and membrane treatment included in the MBR will be supplemented with both UV disinfection and chlorine disinfection to meet log inactivation requirements in Regulation 84 as well as reverse osmosis for TDS treatment.

Improvements are planned for completion by fall 2024.

SITE APPLICATION REPORT ELEMENTS

1 Site Application Forms

The Site Application forms are provided in the Appendix.

2 System Legal Ownership

The system is a privately owned entity. The legal contact information for the Applicant is:

Mary Jane Loevlie
Argo Development Partner
1431 Miner Street
Idaho Springs, CO 80452

3 Service Area Definition

Mighty Argo Upper Landing is proposing a new outdoor recreational and heritage tourism development near Idaho Springs, Colorado, including a new gondola that will transport visitors from the base near Argo Gold Mill in Idaho Springs to the new development. The gondola will traverse the hillside and drop passengers 1.25 miles above Idaho Springs. At the top of the gondola, the upper landing development will be home to an amphitheater, food services, restrooms, and other non-residential uses.

Overall, the upper landing service area will consist of the following:

- 10,000 ft^2 sun decks, event space, food & beverage, flexible programming, shade/shelter
- 15,000 ft^2 pedestrian promenade, food truck hookups, emergency vehicle access
- 20,000 ft^2 of mountain top park, terraced picnic area, natural playscapes
- 5,000 ft^2 of restrooms, control center, concessions counter
- Interpretive nature and history trails
- Gateway to Virginia Canyon Mountain Park trails
- 18-20 miles of mountain biking and hiking trails

New water and wastewater treatment facilities are required for the proposed development. The site is currently undeveloped and is remote. Additionally, the site does not have access to consistent surface water sources. Groundwater in the area is expected to be unreliable and of low quality; therefore, potable water will be trucked in from Idaho Springs. Wastewater treatment will be

provided on-site. To reduce the quantity of trucked water, wastewater will be treated and reused for toilet flushing and landscape irrigation.

Figure 1: Planning Area Map

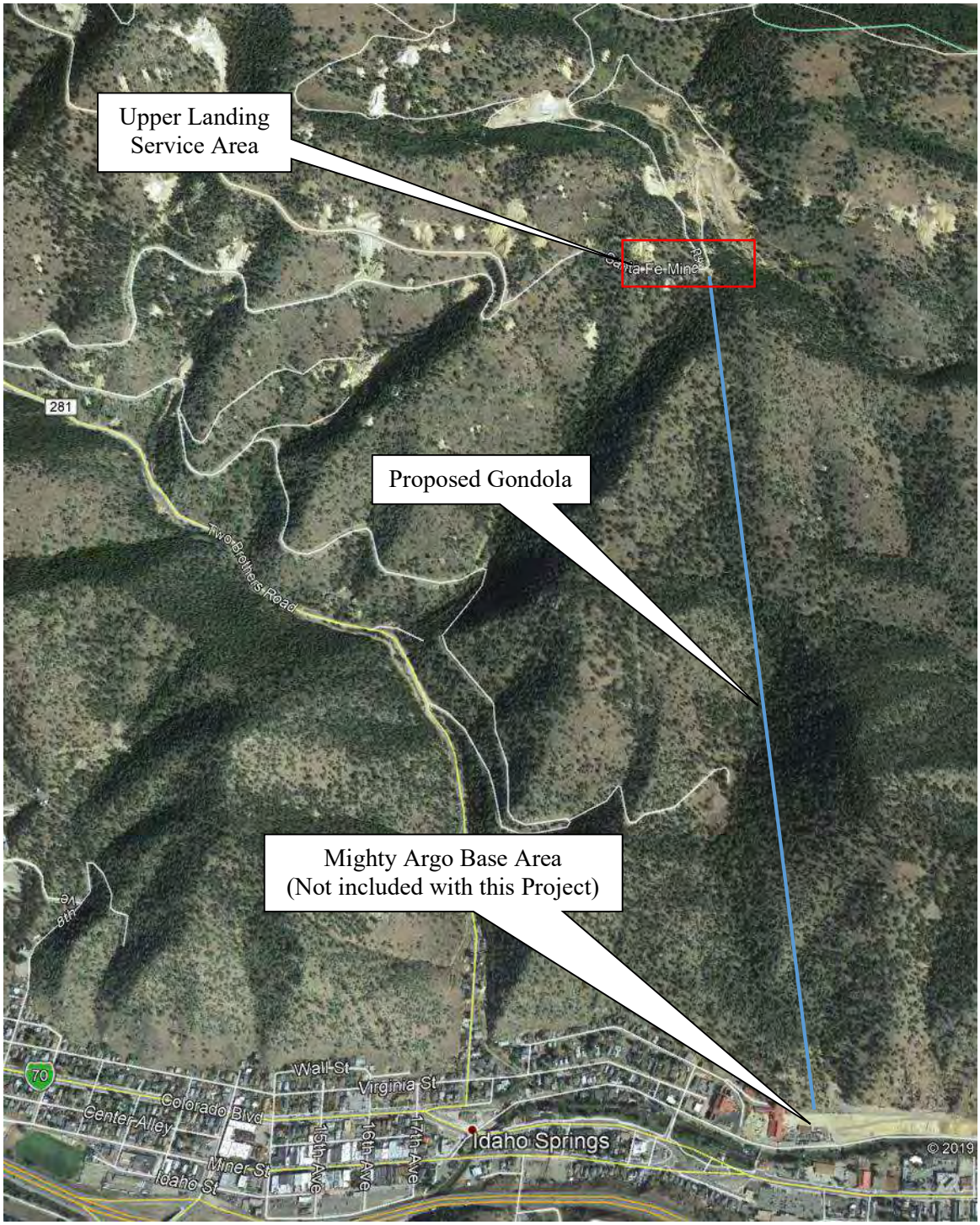


Figure 2: Upper Landing Area Proposed Structures

3.1 Existing and Projected Population

There is no existing population as the site is currently not developed. The new development will include recreational and food service components but no residential aspects. Therefore, the proposed population is quantified by use and not EQRs. The facility will generally be open through the evening but is not intended to be open 24-7. The projected populations are included in Table 1.

3.2 Staging or Phasing

The hydraulic and organic loading proposed for this project are for the ultimate build-out of the

upper landing site as proposed. The entire development will be constructed in one phase.

3.3 Flow and Loading Projections

Since the site is currently undeveloped, no empirical data is available to estimate flow and loading. Therefore, Regulation #43, On-Site Wastewater Treatment, was used to estimate the flowrate the plant will need to treat. The types of land uses specified in Regulation #43 most like the proposed development were chosen to determine the following:

Table 1: Wastewater Flow Forecasts

Reclamation Facility Flow & Loading Projections (Regulation #43 - On-Site Wastewater Treatment)					
Use	**Number of Units**	**Unit**	**Value**	**Unit**	**Flow (GPD)**
Facilities w/Short-Term Transient Visitors	2,000	visitors	5	GPD/visitor	10,000
Office Building	20	employees	15	GPD/employee	300
Food Trucks (Paper Service)	75	seats	25	GPD/seat	1,875
Bar	60	seats	30	GPD/seat	1,800
Retail	4,000	ft^2	0.1	GPD/ft^2	400

Calculated 30-Day Flow (GPD):	14,375
Rounded 30 Day Design Flow (GPD):	20,000
Average 30-Day Flow (GPM):	14
Peak Day Factor	2
Peak Day (GPD)	40,000
Peak Day Flow (GPM)	28
Peak Hour Factor	4
Peak Hour Flow (GPM)	56

The influent characteristics anticipated for this project will be higher than typical household wastewater. The site's wastewater will consist primarily of toilet waste and will not have the benefit of dilution from showers and laundry. Further, all site piping will be new, and building plumbing will include new, water-saving fixtures. Installing low-flow fixtures will result in higher concentrations of wastewater constituents.

AquaWorks DBO has recently worked on rest area replacement projects for the Colorado Department of Transportation. The Mighty Argo Upper Landing will likely have similar wastewater properties to the rest area projects, including the Vail Pass Rest Area WWTP. This Vail Pass facility only treats toilet waste—there are no showers or other services at the site. Therefore, depending upon the parameter, the influent concentrations for the Vail Pass facility,

which are 2-3 times higher than standard household waste, will likely be comparable to the Mighty Argo Upper Landing project. The concentrations in Table 2 are the historical averages for the Vail Pass WWTP. Loading projections for the Mighty Argo Upper Landing reclamation facility were calculated by multiplying the Vail Pass WWTP empirical data by the full capacity of the proposed Mighty Argo Upper Landing project, 20,000 GPD.

Table 2: Wasteload Forecasts

Item	Concentration		Loading per Day	
BOD_5	569	mg/L	94.9	Pounds
TSS	750	mg/L	125.1	Pounds
TKN	290	mg/L	48.4	Pounds
TP	15	mg/L	2.5	Pounds

The following is a summary of the design conditions for the proposed facility:

Table 3: Design Capacity Summary Table

Item	Design Standard
Influent Temperature	10 °C
Site Elevation	9,000 Feet ASL
Average Daily Flow	20,000 GPD
Max Daily Flow	40,000 GPD
Peak Instantaneous Flow	56 GPM
BOD Loading	95 lb/day
TSS Loading	125 lb/day
TKN Loading	48.4 lb/day
TP Loading	2.5 lb/day

3.4 Relationship to Other Water and Wastewater Treatment Works

The one-mile and five-mile radius maps are included below. Only limited information about drinking water and wastewater systems in the area is available. Access to the locations of drinking water and wastewater facilities is restricted because of security concerns. Roads, water bodies, and municipal boundaries are included on the maps.

Figure 3: 1-Mile Radius Map

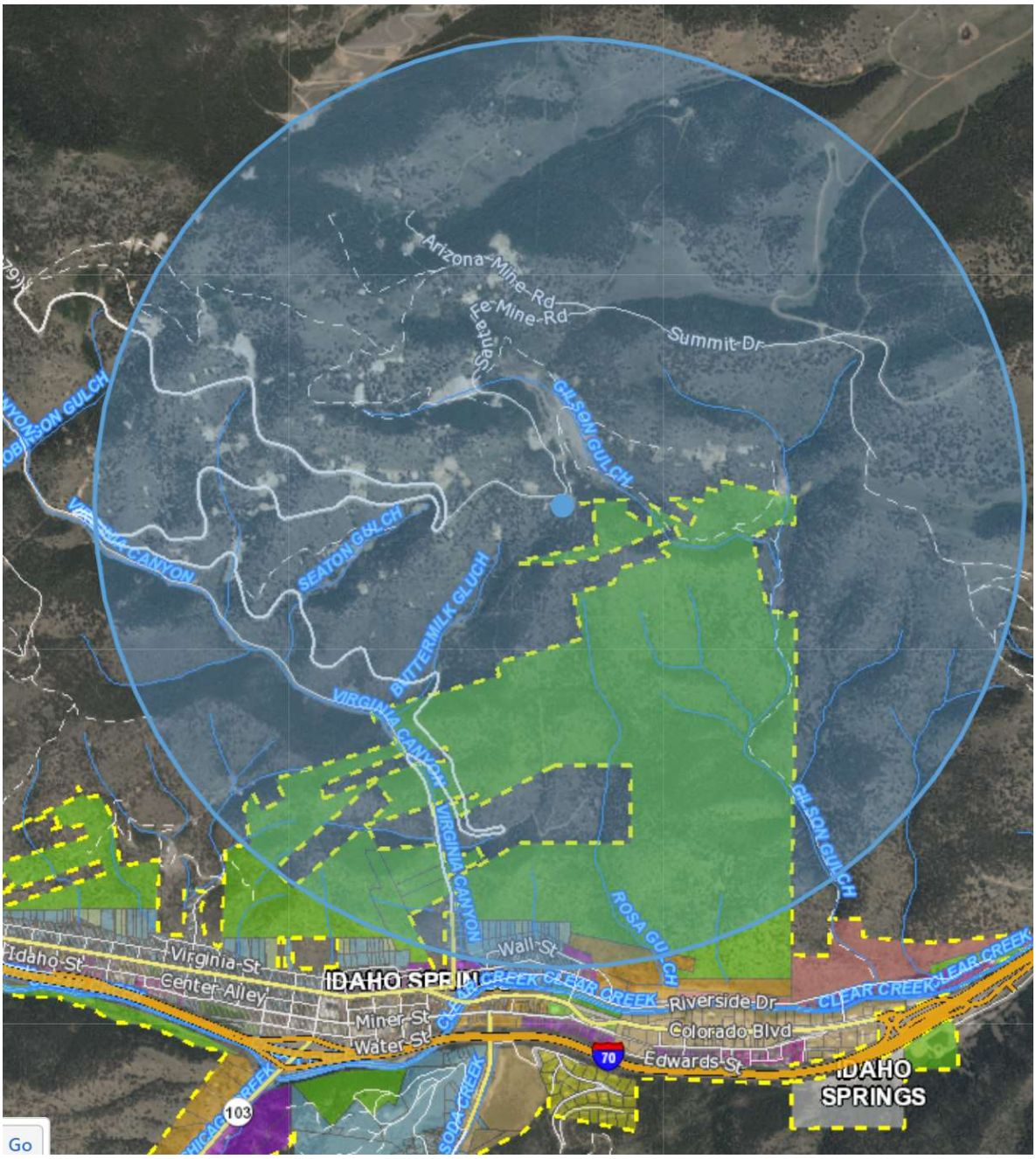
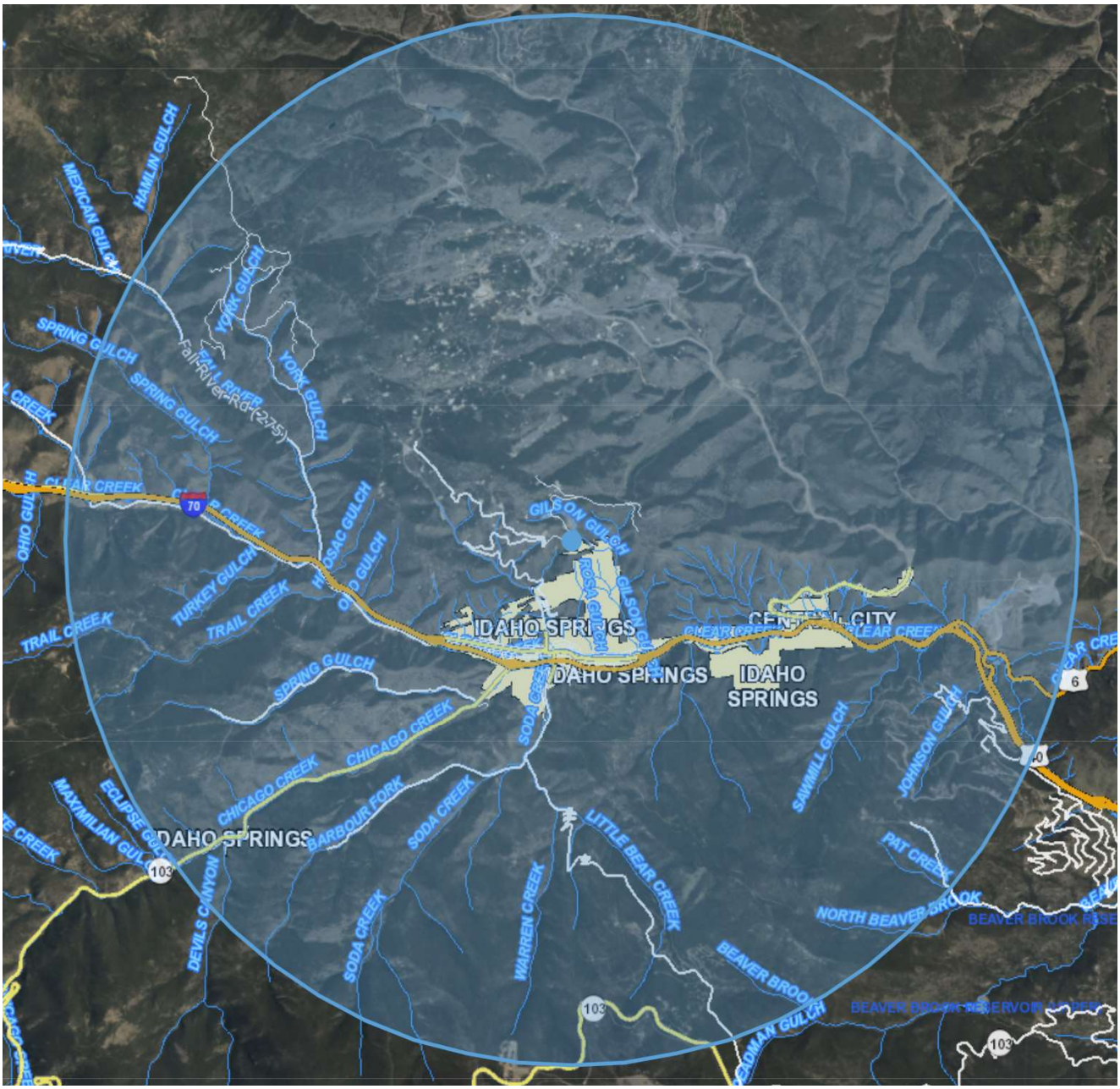


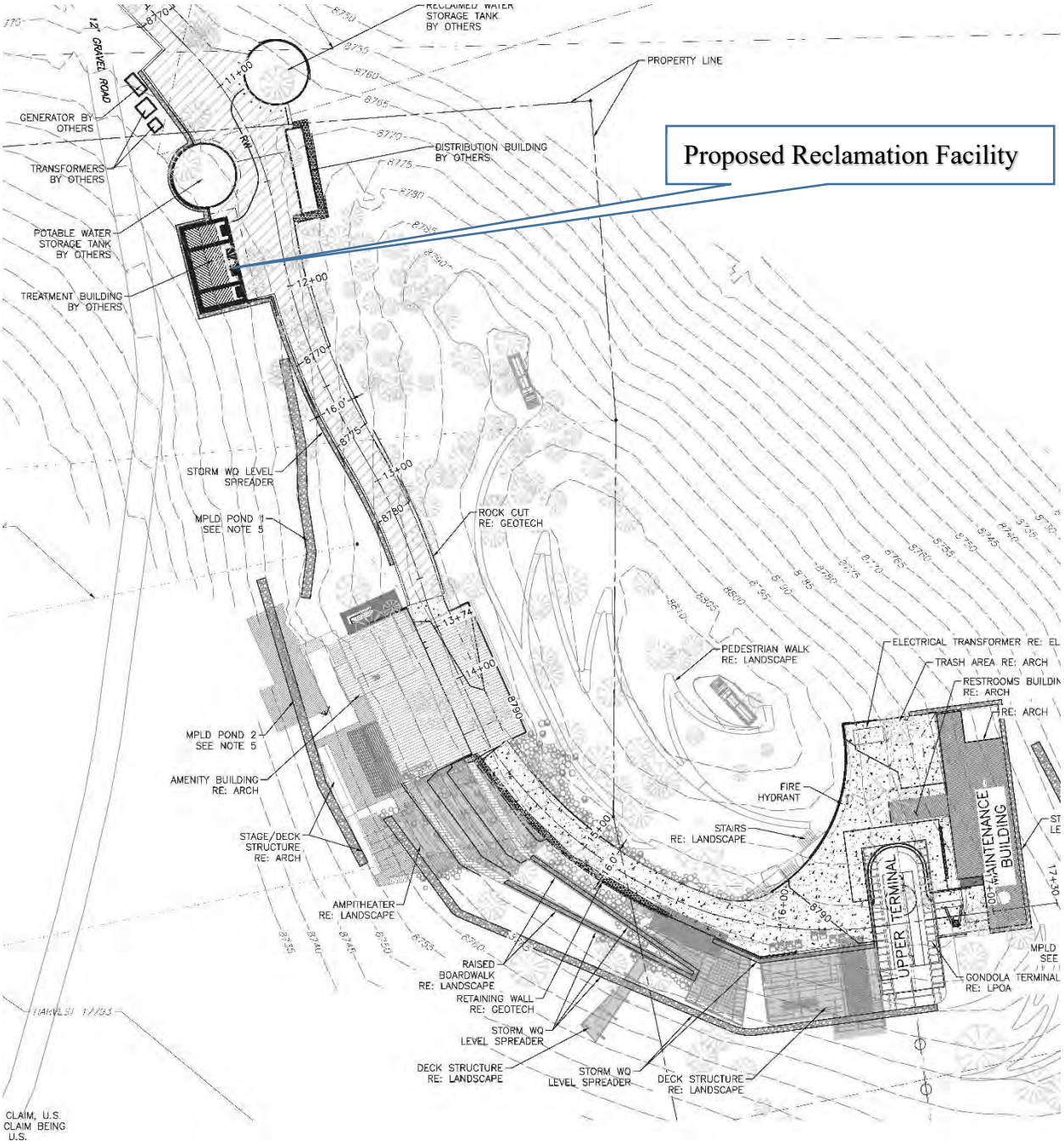
Figure 4: 5-Mile Radius Map



4 Proposed Site, Site Alternatives, Treatment Alternatives

The site for the proposed reclamation facility will be near the other land uses at the upper landing site. Wastewater from the proposed buildings will flow to the facility by gravity.

Figure 5: Upper Landing Site Plan



4.1 Proposed Selected Site Location Description

The reclamation facility's site will be located on the upper landing area in the City of Idaho Springs. The upper landing site is over 3 miles from the commercial core of Idaho Springs via existing roads. The upper landing area is accessed off Franklin Mine Road. An address for the site has not yet been assigned by the county.

The upper landing site is in Section 25, Township 3 South, Range 73 West, of the 6th Principal Meridian (39° 45' 86" N, 105° 30' 29" W). The elevation of the site will be between 8,900 and 9,000 feet, depending upon the siting of the facility. The elevation of the project will need to be factored into the design of the proposed project. The facility will need to include additional capabilities to compensate for the lower presence of ambient oxygen encountered at this elevation.

4.2 Evaluation of Alterative Sites

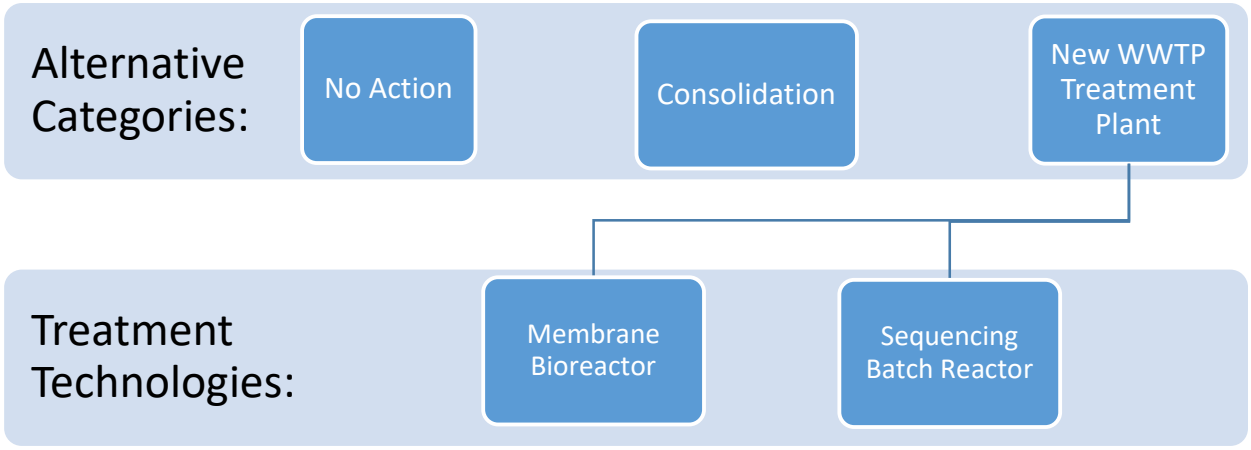
This section is not applicable. Due to the rugged topography, there are limited locations in the upper landing area where wastewater can flow by gravity from the proposed structures to the reclamation facility. Locating the facility off-site is not feasible.

4.3 Treatment Alternatives

An analysis of potential reasonable alternatives was conducted for this project. The following alternatives were evaluated:

- No action.
- Consolidation.
- Installing new treatment works with one of the following process options:
    - Membrane Bioreactor (MBR)
    - Sequencing Batch Reactor (SBR)

Figure 6: Chart of Alternative Assessment Options



NO ACTION

This alternative is not feasible as a facility needs to be provided at the site to develop the project.

CONSOLIDATION

The CDPHE provides direction in Section 22.3(1)(c)(v), Consolidation Analysis of the Implementation Policy for Regulation 22 (Policy CW-14), for determining whether interconnecting with existing facilities is feasible. The guidance document states that meeting only one of five factors is required to preclude consolidation and make connecting to an existing facility infeasible.

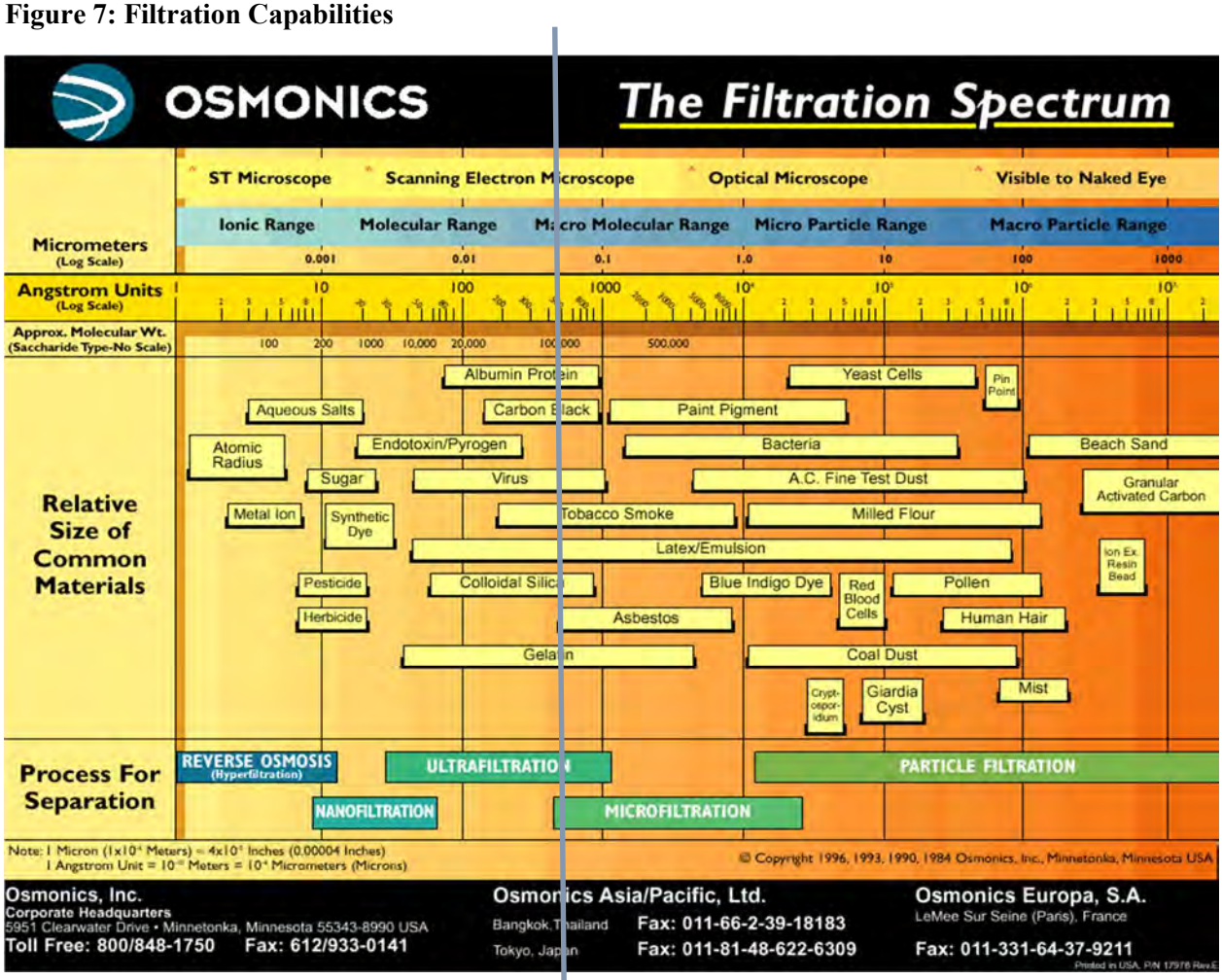
This project meets two of the factors precluding consolidation. First, the project is proposing reuse opportunities for water conservation. It would not be able to further these efforts if it was connected to a regional facility. Second, it is over three miles via a difficult mountain road from the site to Idaho Spring's nearest collection line. The cost to install water and sewer lines to serve the project is estimated at twice the cost of constructing the proposed decentralized reclamation facility.

ALTERNATIVE 1: MEMBRANE BIOREACTOR

The Membrane Bioreactor MBR was evaluated as Alternative 1. MBR equipment package would consist of an influent fine screen, an equalization basin, aerobic sludge digestion, anoxic zone, an aerobic tank, two membrane filtration tanks, chemical addition, and UV and chlorine disinfection. The configuration is typical for most MBR equipment manufacturers that will be designed to produce reclaimed water.

The use of the membrane provides advanced capabilities for meeting effluent quality standards. The physical separation created by a semi-permeable membrane allows the MBR to produce high-quality effluent. The membrane prohibits solid material from reaching the effluent discharge. The nominal pore size for many membranes is 0.04 μm. This porosity limits pathogenic flow-through and improves the ability to produce consistent effluent quality.

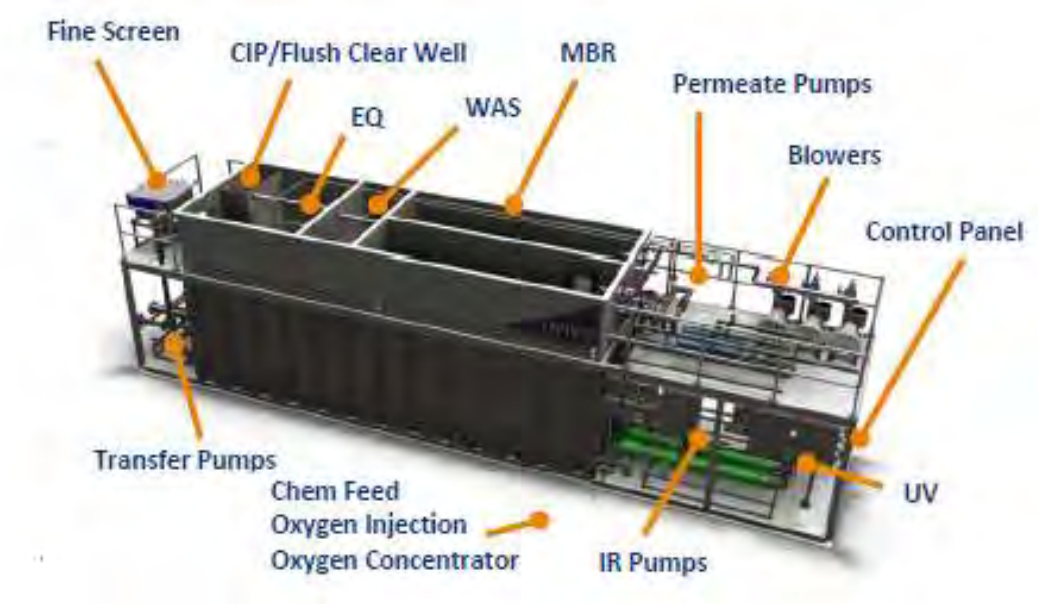
Figure 7: Filtration Capabilities



Not Filtered by Membrane ← → Filtered by Membrane

In this design, significant portions of the MBR equipment can come installed in a containerized system. In-basin equipment will come shipped loose for installation in the new concrete tankage poured onsite. Packaging as much the equipment as possible will allow for expedited installation times and reduced construction costs. Much of the equipment shown below would be installed in new concrete tanks or the containerized system.

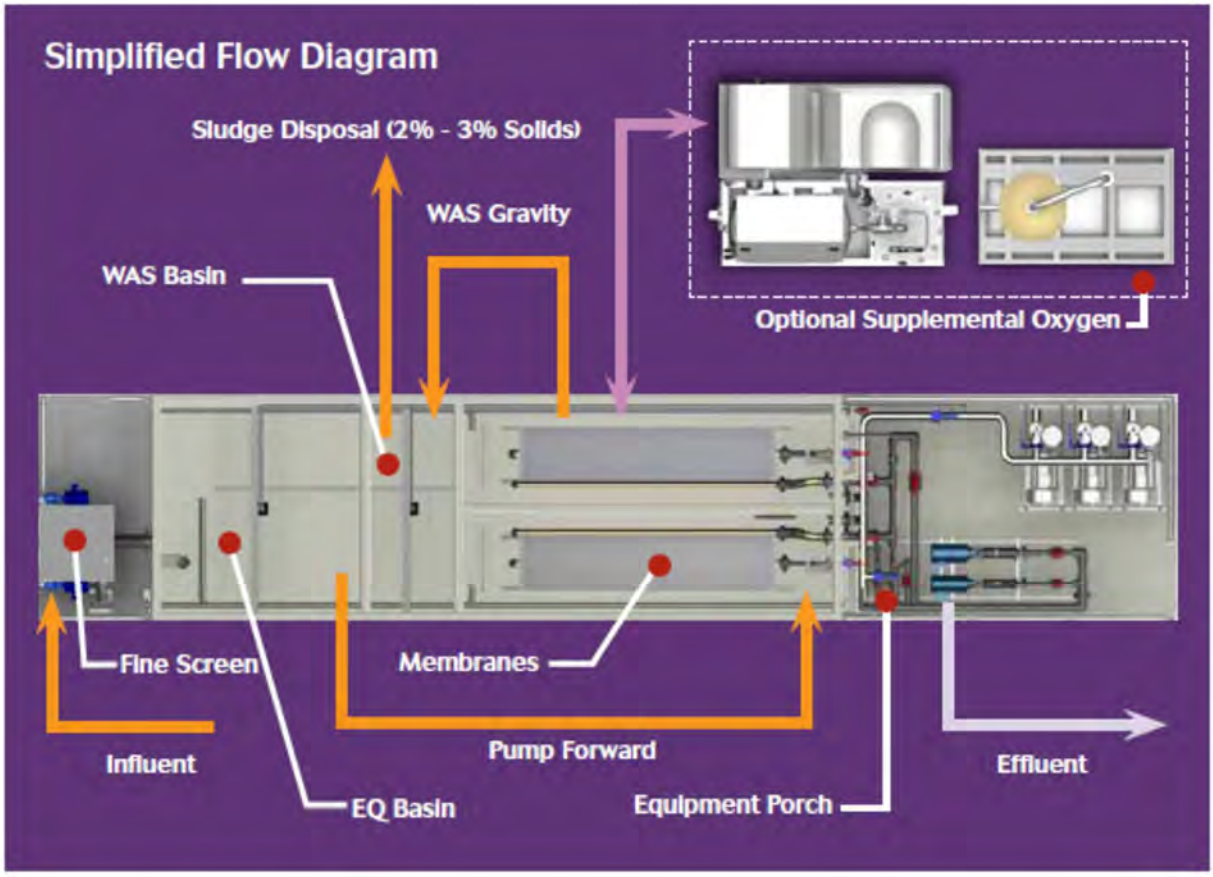
Figure 8: Overview of MBR Equipment



Primary equipment components include:

- Influent coarse screening (not shown)
- Influent fine screening
- Influent flow measurement
- Equalization zone/aerated grit storage
- Aerobic sludge holding
- Anoxic treatment
- Aerobic treatment
- Coagulant addition (phosphorus reduction)
- Carbon addition (denitrification)
- Membrane filtration
- UV disinfection
- Chlorine disinfection
- Sodium hypochlorite and citric acid addition for membrane cleaning
- Real-time DO sensor equipment
- Pre-wired, factory-tested equipment
- Remote monitoring controls and alarm exporting

Figure 9: Sample MBR Design Flow Diagram



The system's operational processes are discussed below.

Coarse Screening

The influent will run through a 1" course manual bar screen before the liquid drops into the influent equalization basin (EQ tank). Screenings will be processed into a bin for ease of removal and disposal in a solid-waste facility.

Equalization Zone/Transfer Pumps

After the coarse screen, wastewater then enters an equalization tank (EQ). The integrated EQ tank accommodates peak flow and I&I events to circumvent short-circuiting of peak events and will be designed to facilitate grit removal as grit will settle to the bottom of the tank. EQ tank aeration blowers and diffusers will be installed to keep the liquid from becoming septic. EQ Transfer pumps pump equalized from the EQ tank to the fine screening and into the biological treatment process. The EQ Transfer pumps help control downstream treatment, including the membrane permeable flow-through rates. Redundancy in the design includes at least two transfer pumps (one duty and one standby). The basin will be designed for grit to settle to the bottom.

Influent Flow Measurement and Fine Screening

After equalization, wastewater passes through an automatic fine screen as the first treatment process in the modularized system. The fine screening will be designed to meet peak influent flow rates. The fine screens will have perforated openings of 2 mm for removing solids to protect the membranes. Two fine screens will be supplied, and a shelf spare part will be provided. After fine screening, screened wastewater then enters the biological treatment basins.

Screenings will be processed into a bin for ease of removal and disposal at a solid waste facility.

Biological Nutrient Reduction

The MBR treatment process can be designed for BOD and ammonia treatment and may be modified to include denitrification for nitrogen removal. The design will include a pre-anoxic tank to facilitate denitrification to remove total inorganic nitrogen and organic carbon. The pre-anoxic tank will include a mixing pump to optimize denitrification. Downstream of the pre-anoxic tank, the aerobic tank provides BOD and ammonia reduction. The aerobic tank includes submerged fine bubble diffusers, and mixed liquor recycle pumps. Blowers are supplied to provide constant aeration of the mixed liquor in the aerobic tank. Finally, another set of transfer pumps move treated wastewater from the end of the aerobic tank to the membranes for solids removal. Throughout the biological processes, the system's controls monitor tank water levels dissolved oxygen concentrations, and pH to indicate the changing biological oxygen demand and nitrification needs.

Submerged Membranes

The MBR system's core treatment is housed in the MBR arrays located on the deck. In the arrays, an MLSS of 9,000 mg/L is maintained under constant aerobic conditions. Membranes use filtration to separate treated water from the mixed liquor. Blowers are supplied to provide constant aeration of the mixed liquor. The continuous scouring acts as a primary means of anti-fouling of the membranes. Typical operation of membranes calls for a set permeate time, determined by the manufacturer, followed by a rest function and/or a reverse flow. This alternating operation helps prevent overloading and fouling of the membrane cartridges.

The membrane tanks are in a parallel arrangement of modules that use a permeate vacuum pump to achieve an optimal flow-through rate. Adjustments are made by the operator to achieve constant pressure. This feature provides optimal flux among flow-through capabilities, membrane surface area, and prevention of membrane fouling.

Figure 10: Hollow Fiber Membrane

Effluent Operation

The effluent discharge rate is regulated by the permeate pumps, which are controlled and monitored by the system's internal controls governed by the PLC. The flow rate is measured by an integral effluent magnetic flow meter and controlled with the PLC.

From filtration, the permeate pumps convey filtered effluent to disinfection as well as reverse osmosis treatment as needed to control total dissolved solids.

Disinfection System

Filtered water from the membrane tanks is pumped through UV disinfection and chlorine disinfection. The UV and chlorine disinfection processes will be designed to provide the log inactivation credits needed for all reuse activities. The chlorine disinfection process will provide residual chlorine concentration adequate to maintain a chlorine residual entering the reclaimed water distribution system. In addition, a chlorine booster station is anticipated to help maintain minimum chlorine residuals through the distal ends of the distribution system as required under Regulation 84.

Operation & Maintenance

Process control of the MBR is performed through an integral HMI interface panel. The panel manipulates and monitors the operation of blowers, pumps, flows, and chemical addition.

The manufacturer suggests that the basins be cleaned with a chemical cleaner for organic and inorganic fouling. The frequency of cleaning will be dependent upon influent loading characteristics. The chemicals used will consist of sodium hypochlorite and citric acid.

As with any process, a proactive procedure provides optimal performance for continuous quality treatment. Influent, effluent, and in-basin monitoring of wastewater conditions will allow trending and predictive measures to be taken to forecast possible interruptions in effluent quality. A

scheduled routine of sludge removal will be required at the intervals deemed necessary.

Chemical Addition

The MBR process will require the five following chemicals for operations and maintenance:

- Alum to promote the removal of phosphorus.
- Carbon addition if needed for additional denitrification.
- Caustic soda for pH and alkalinity adjustment.
- Sodium hypochlorite for back-pulsing of membranes.
- Citric acid for cleaning to prevent inorganic fouling of membranes.

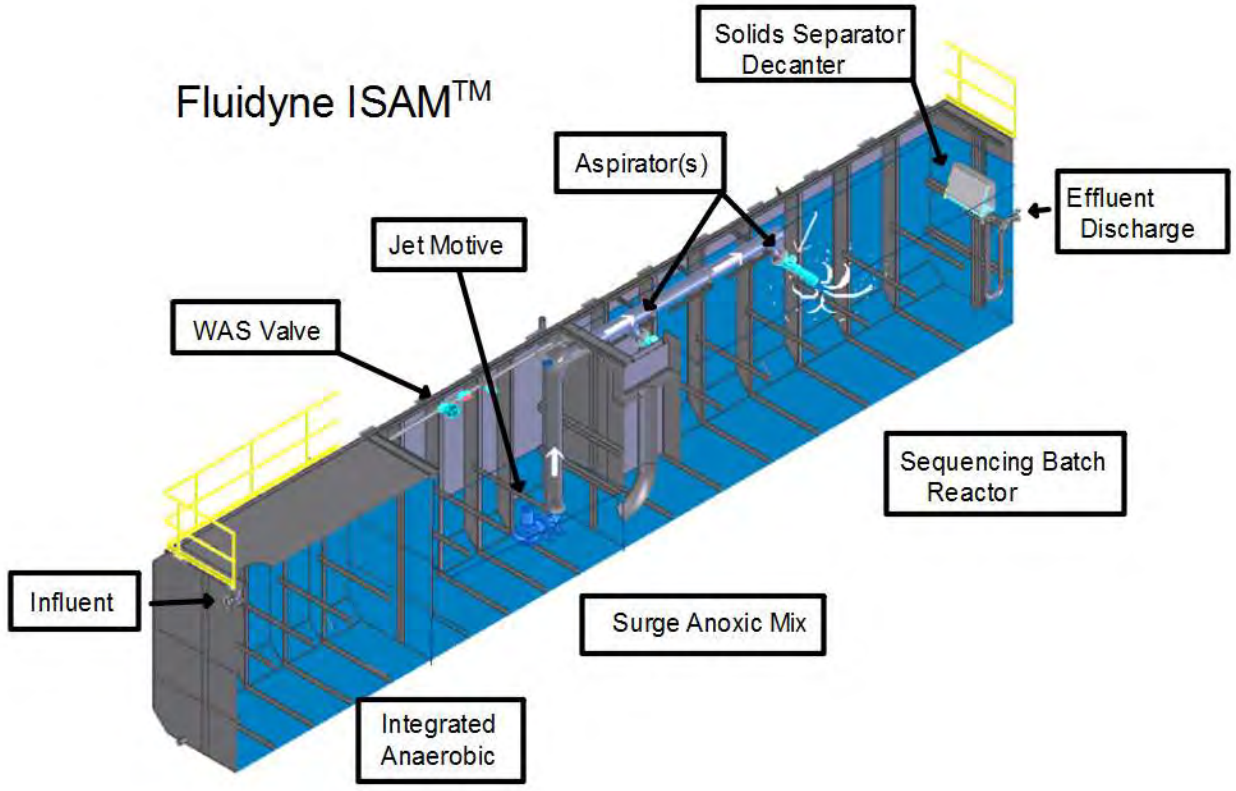
ALTERNATIVE 2: SEQUENCING BATCH REACTOR

The Sequencing Batch Reactor (SBR) was evaluated as Alternative 2. The SBR treatment facility consists of an activated sludge system with the most required equipment and controls supplied by a common manufacturer. The equipment features the following major components:

- Influent conditioning/equalization.
- Sludge storage tank.
- Jet motive/wastewater transfer pumps.
- Jet aspirator aeration system.
- SBR basin.
- Automated floating solids excluding decanter.
- Biological phosphorus removal.
- Fixed cloth media filter.
- UV and chlorine disinfection.
- PLC-based control system.

The proposed package system consists of a one-train design. The process design is rated at 20,000 GPD with built-in redundancy, automation, and operational flexibility to create a consistent biological treatment environment to meet the effluent limits. This configuration provides enhanced operator control and additional redundancy capabilities. The functions and bases of design for each of these project components are discussed below.

Figure 11: Overview of the SBR Process



Influent Conditioning/Sludge Storage Tanks

After the influent flow measurement and automatic screening, raw wastewater will flow by gravity into the first component of the biological process: the influent conditioning/equalization chamber. This chamber will be a variable-level chamber where heavy influent solids and grit will settle out, much as they do in a primary clarifier. Here, settleable solids will be converted to soluble BOD. Underflow baffles will be provided to prevent direct short-circuiting.

Waste Sludge Storage

A separate storage tank for aerobic waste sludge will be provided. The tank is designed to provide approximately 31 days of sludge storage, subject to influent conditions.

SBR manufacturers have documented significant volatile-solid reductions and typical sludge solid concentrations of 3–4%. This results in an extremely efficient sludge storage system and minimizes the frequency of hauling. Sludge will be removed periodically, according to observations of the stored sludge levels, with a vacuum truck and hauled offsite to a permitted facility.

Jet Motive – Wastewater Transfer Pumps

The multipurpose jet motive pumps serve three essential functions for the SBR. First, the pumps act on an intermittent cycle to forward-feed partially treated water into the SBR while simultaneously acting as Venturi aerators. Second, the pumps cycle water between the SBR and the anoxic basin to denitrify the wastewater. Third, the jet motive pumps feed WAS to the front of the plant by siphoning a side stream of the sludge. Enough jet motive pumps will be supplied to provide redundancy.

Biological Nutrient Reduction (BNR)

The SBR has features that allow for BNR through the modulation of the MLSS and react cycles. Uric nitrogen is removed first through anaerobic denitrification, which converts urea-based nitrogen into ammonia. The SBR then allows for nitrification via a semi-anaerobic or anoxic process whereby the ammonia is converted to nitrite/nitrate molecules.

Aeration System – Aspirating Nozzles

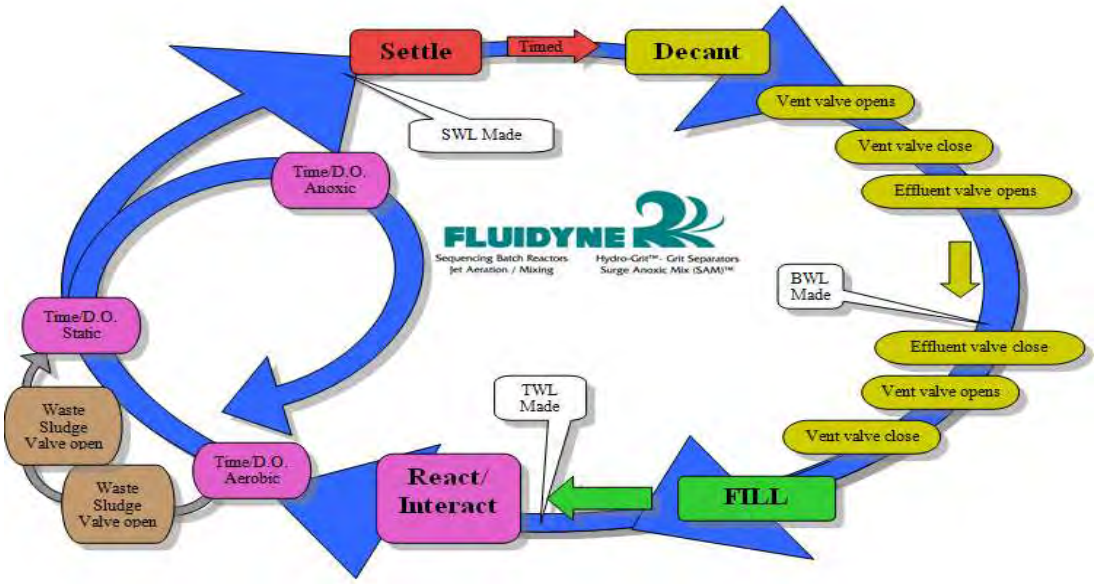
The motive pump also activates an aspirating jet aerator. The nozzles are in the SBR's basin. The oxygen-delivery system is sized to exceed the calculated oxygen requirements to accomplish treatment (BOD and ammonia conversion).

Sequencing Batch Reactor (SBR)

Each batch of wastewater is treated within a cycle in the SBR basin. Each cycle has four distinct phases:

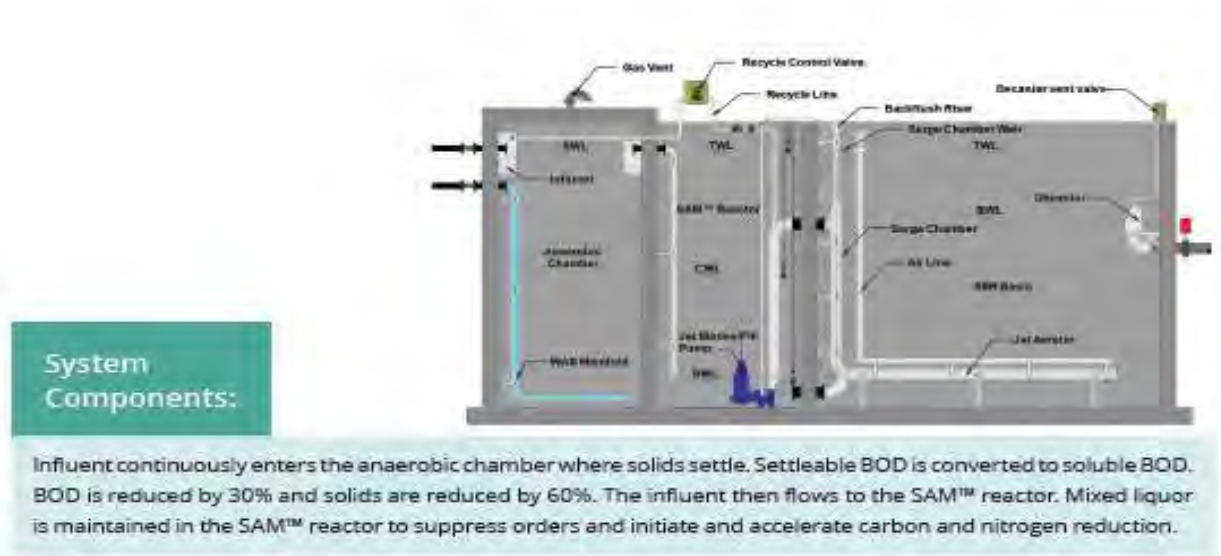
1. Fill/react
2. Interact/react
3. Settle
4. Decant

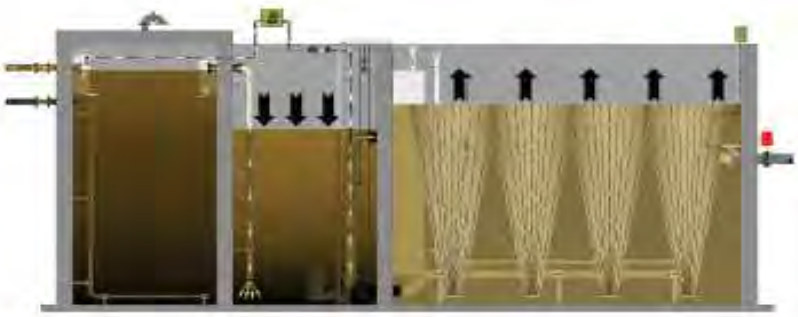
Figure 12: SBR Operational Cycle



The following is a description and illustration of the five phases of the SBR process:

Figure 13: SBR Phases



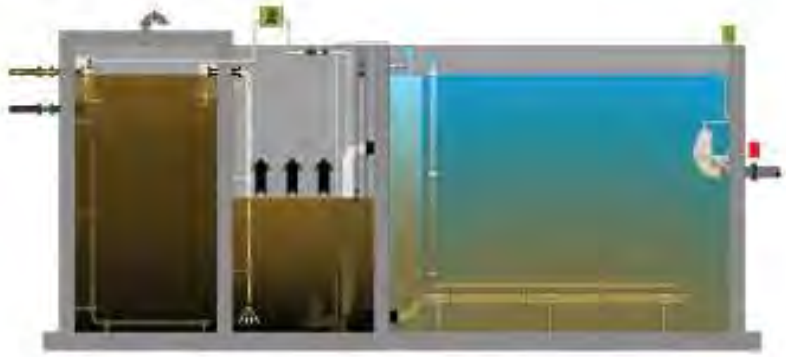


Fill Phase:

When the level in the SAM™ reactor reaches a predetermined "control level" the motive liquid pump is started. The SBR basin is filled and mixed. A percentage of the pumped flow is returned to the anaerobic chamber where biological solid settle. Settled solids in the anaerobic chamber are digested.

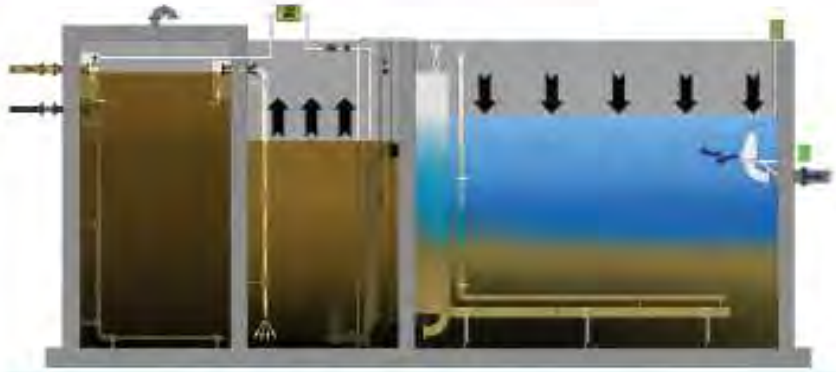
Interact Phase:

When the level in the SBR reaches TWL, nitrified mixed liquor overflows the surge chamber weir and is returned to the SAM™ chamber to mix and react with the raw influent. Aeration is cycled on and off to provide the required oxygen. Denitrification is reliable and complete. Scum is also removed from the SBR basin.



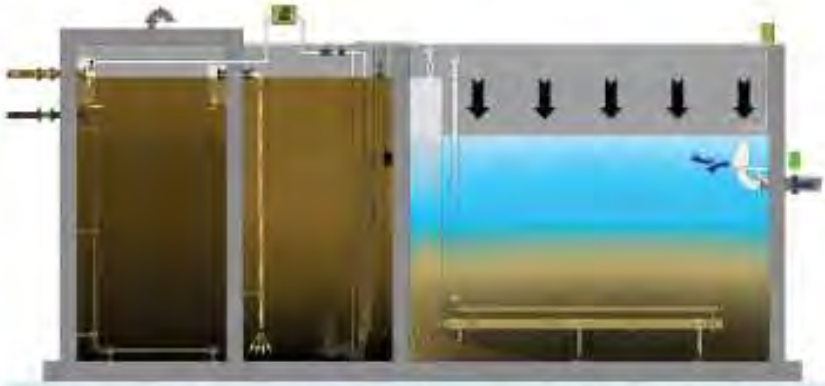
Settle Phase:

When the level in the SAM™ reactor again reaches "control level" aeration is discontinued and the SBR basin settles under perfect quiescent conditions.



Decant Phase:

When the settle timer expires, the decant valve is open and treated effluent is withdrawn from the upper portion of the SBR basin by means of a fixed solids excluding decanter.



Filled Decant Phase:

If, during peak flow events, the SAM™ reactor reaches TWL before the decant phase ends, influent flows in a reverse direction through the surge return line and overflows the surge chamber secondary weir and is diffused into the settled sludge at very low velocity as the decant phase continues.

The operating parameters for the SBR include 3,000 mg/L of MLSS and an SRT of 15.5 days.

Filtration

The supernatant will be decanted from the SBR basin for solids separation by a fixed-media cloth filter. For coagulation and precipitation formation, alum will be injected into the process before it reaches the filter. The supernatant in the SBR basin will be pumped up and into the filtration housing, which contains independent media plates of rectangular cloth panels. The influent enters the filter and is then directed to the bottom side of each plate. Suspended solids will fall to the bottom of the channel or collect on the interior surfaces of the cloth plates, with the clean, treated water collecting in the filter's main bay. As solids accumulate on the cloth surfaces, the water level in the influent channel will begin to rise, eventually initiating a backwash operation. Each independent cloth plate is cleaned in sequence by allowing gravity to force flow in reverse.

Disinfection System

Filtered water from the membrane tanks is pumped through UV disinfection and chlorine disinfection. The UV and chlorine disinfection processes will be designed to provide the log inactivation credits needed for all reuse activities. The chlorine disinfection process will provide residual chlorine concentration adequate to maintain a chlorine residual in the reclaimed water distribution system. In addition, a chlorine booster station is anticipated to help maintain minimum chlorine residuals through the distal ends as required under Regulation 84.

OPERATION & MAINTENANCE

The SBR is operated by a PLC with HMI manipulation. The process is automated and allows for operator adjustment to achieve a quality effluent. As with all wastewater facilities, the SBR runs best with daily supervision but provides consistent operation if a proactive regiment is implemented. A true understanding of influent/effluent and in-basin conditions will allow the operator to make educated adjustments and predictions for wastewater treatment. Daily or weekly maintenance may include settleability, MLSS testing of the SBR, and a monthly sludge judge analysis of the sludge storage basin. Pump maintenance should be performed in accordance with the manufacturer's O&M requirements.

Sludge hauling is typically done monthly but is subject to influent loading conditions. Design criteria will influence how frequently sludge must be removed.

Chemical Addition

The SBR process will require the addition of the three following chemicals:

- Alum, to promote the removal of phosphorus.
- Caustic soda, for alkalinity adjustment.

- Carbon addition if needed for additional denitrification.
- Sodium hypochlorite for disinfection.

The following is a summary of the advantages and disadvantages of each alternative:

Table 4: MBR Advantages/Disadvantages

Advantages	Disadvantages
Controls, pumps, chemical feed system, and blowers come mounted in a container	Membranes require replacing approximately every 10 years
Uninterrupted quality effluent due to the physical nature of the membrane	Higher power costs due to continuous blower and permeate pump operation
High-quality BOD, NH_3 removal	Can generate more sludge because it is more efficient at removing solids.
Lower probability of coarse diffusers becoming plugged	Lower oxygen transfer rate due to the coarse diffusers
Increased MLSS concentration >9,000 mg/L (smaller footprint required)	Potential for membrane fouling

Table 5: SBR Advantages/Disadvantages

Advantages	Disadvantages
Lower equipment costs	Requires significant site work and building structure
Reduced amount of sludge generated as well as the ability to store sludge	If the anaerobic tank is not maintained below a set sludge level, it can provide unsightly scum in the SBR, eventually causing poor settleability.
Lower electrical consumption	Does not have a membrane as a barrier to retain solids
No consumables (membranes) to replace	

5 Water Quality Planning Targets (WQPTs)

Mighty Argo Upper Landing will reuse effluent to the fullest extent possible. However, due to the accumulation of TDS and potential off-specification reuse water, the design will include two disposal options, including a groundwater discharge well and the option to haul waste (e.g., brine) to the City of Idaho Springs WWTP. The Regulation 84 Reclaim Water treatment requirements and water quality requirements for reuse uses including: toilet flushing, landscape irrigation, washwater applications (i.e., gondola) washing, and non-residential fire protection were issued by the CDPHE on April 28, 2023, and are provided below:

Table 6: Effluent Quality Planning Targets

Effluent Standards to Use Category 3 Reclaimed Water Treated from a Localized Reclaimed Water Treatment System	
Parameter	**Limitations**
BOD5 (mg/l)	30 (30-day average), 45 (7-day average)
Total Suspended Solids (mg/L)	30 (30-day average), 45 (7-day average)
CBOD5 (mg/L)	25 (30-day average), 45 (7-day average)
Residual Chlorine (mg/L)	0.5 (inst. Max)
pH (s.u.)	6.0-9.0 (inst. Max)
Oil and Grease (mg/L)	10 mg/L (inst. Max)
Turbidity (NTU)	3 (monthly avg.) not to exceed 5 in more than 5% of individual samples
E. coli cfu/100mL	None detected in at least 75% of samples per calendar month and 126/100mL single sample
At a location at a distance of no greater than 50 feet from the location of use at the distal end, or a location that represents the oldest water age within the reclaimed water premise plumbing system within the building.	0.2 mg/L minimum free chlorine or 0.5 mg/L minimum monochloramine
Localized System Log_{10} Reduction Target (10^{-4}) Category 3 (minimum required)	Enteric Viruses = 8.5 Parasitic Protozoa = 7.0 Enteric Bacteria = 6.0

While the reuse water quality planning targets issued in April include fire protection and washwater applications, these two uses have been removed from the design. Only toilet flushing and landscape irrigation uses are included.

The facility will be designed to meet Category 3 Reclaimed Water Standards, and due to the system being classified as a localized system, the design will be capable of providing minimum log reductions for each pathogen category specified in Table 6.

In addition to the reclaimed water treatment and quality requirements, the water that is discharged to groundwater must meet groundwater discharge effluent limits. The CDPHE issued preliminary

effluent limits for the groundwater discharge on December 8, 2020, and are provided in Table 7 below. Since these effluent limits are nearly three years old, the CDPHE groundwater permitting unit was contacted regarding using these PELs for the site application review process. Based on their response, it was determined that the PELs have not changed and can be used to apply for site location approval.

Table 7: Groundwater Discharge PELs

Preliminary Effluent Limitations for Evaluation under the Site Approval Process Discharge to Groundwater	
Parameter	**Limitations**
TECHNOLOGY-BASED LIMITATIONS—Regulation No. 62	
BOD_5 (mg/l)	45 (7-day average), 30 (30-day average)
BOD_5 (% removal)	85 (30-day average)
Oil and Grease (mg/l)	10 (maximum)
Total Suspended Solids (mg/l)	45 (7-day average), 30 (30-day average)
TSS (% removal)	85 (30-day average)
Total Suspended Solids (mg/l), Non-aerated waste stabilization ponds*	160 (7-day average), 105 (30-day average)
Total Suspended Solids (mg/l), Aerated waste stabilization ponds*	110 (7-day average), 75 (30-day average)
*Where adjusted TSS limitations are used, the 85 percent removal requirement for TSS shall be waived, pursuant to Regulation No. 62.	
GROUNDWATER-QUALITY BASED LIMITATIONS—Regulation No. 41	
Total Coliforms, (30 day average)	2.2 organisms/100 ml
Total Coliforms, (maximum in 30 days)	23.0 organisms/100 ml
Total Inorganic Nitrogen, dissolved	10 mg/l (daily maximum)
Chloride, dissolved	250 mg/l (30-day average)
pH (s.u.)	6.5-8.5 (minimum-maximum)
Total Dissolved Solids	400 mg/l or 1.25 times the background level, whichever is least restrictive (daily maximum)
Sulfate, dissolved	250 mg/l (30-day average)

6 Existing Facilities within Service Area

This section is not applicable. There are no existing facilities within the service area.

7 Consolidation Analysis

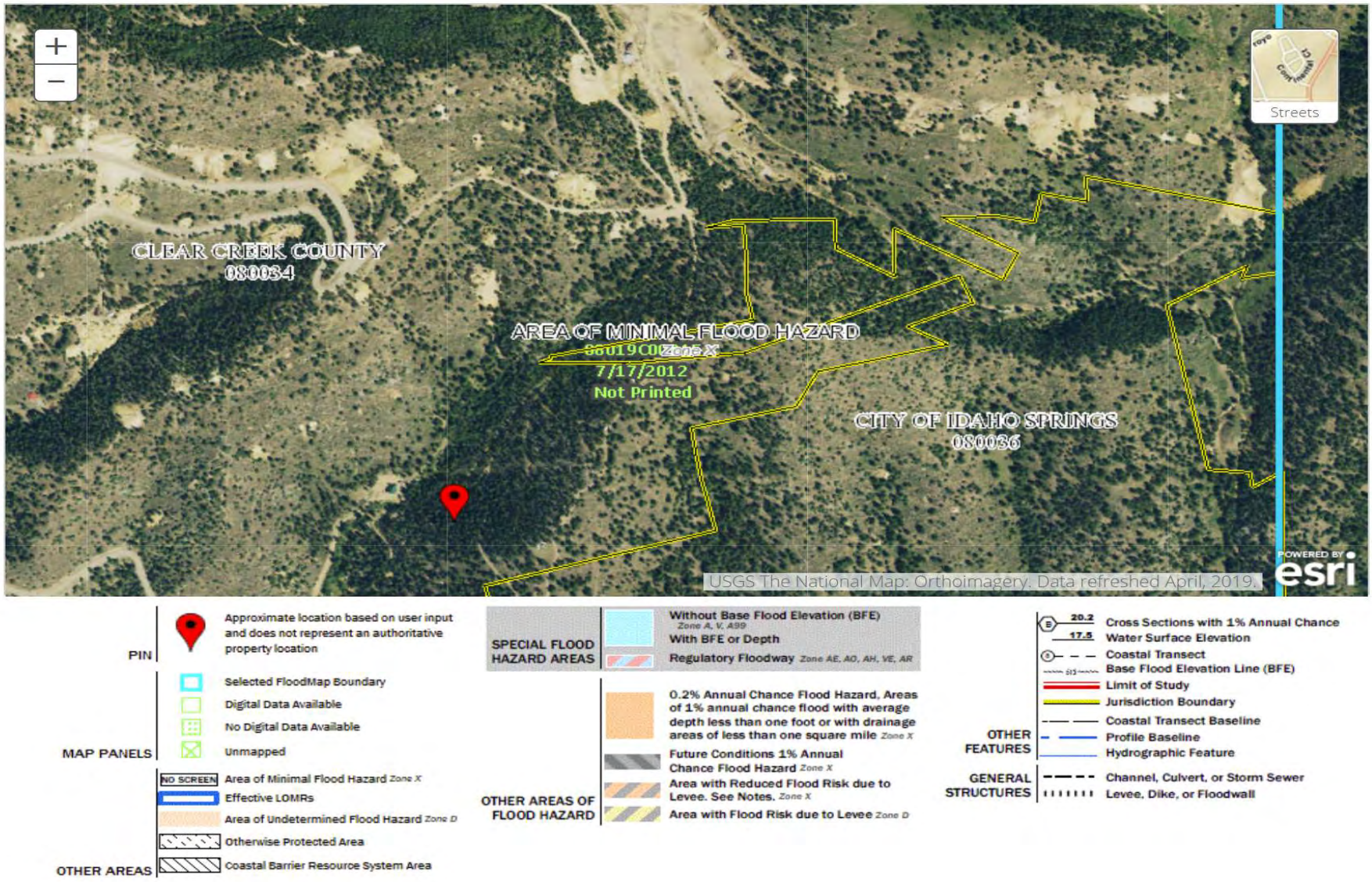
The CDPHE provides direction in Section 22.3(1)(C)(v), Consolidation Analysis of the Implementation Policy for Regulation 22 (Policy CW-14), for determining whether interconnecting with existing facilities is feasible. The policy document states that meeting only one of five factors is required to preclude consolidation and make connecting to an existing facility infeasible.

This project meets two of the factors precluding consolidation. First, the project is proposing reuse opportunities for water conservation. It would not be able to further these efforts if it was connected to a regional facility. Second, it is over three miles via road and difficult terrain from the site to Idaho Spring's nearest collection line. The cost to install water and sewer lines to serve the project is estimated at twice the cost of constructing its own decentralized reclamation facility.

8 Floodplain of Other Natural Hazards

The area was mapped for potential floodplain hazards. The site is outside FEMA's 100-year floodplain and is considered an area of minimal flood hazard. The project is not aware of any other natural hazards.

Figure 14: FEMA Floodplain Map



9 Geotechnical Analysis

The USDA Natural Resources Conservation Service soil map was consulted to provide broad information on the geotechnical conditions at the proposed site. A copy of the soils map is provided in the appendix.

In addition, Ground Engineering Consultants, Inc. completed a geotechnical evaluation in December 2020. Their report provides a summary of their findings and recommendations for the foundation design, given the site's geotechnical conditions. A copy of the geotechnical report is provided in the appendix.

10 Selected Alterative Description

Mighty Argo Upper Landing proposes implementing the membrane bioreactor treatment technology including biological nitrogen reduction followed by ultraviolet light disinfection and chlorine disinfection to meet all pathogen treatment targets. In addition, the process will include reverse osmosis to control total dissolved solids. This approach provides a robust level of wastewater treatment in a small footprint and provides the treatment necessary for each of the given water reuse uses. The overall site process flow diagram for all water is provided in Figure 15 below.

The MBR can produce effluent quality better than other available technologies such as conventional activated sludge, rotating biological contactors, moving bed bioreactor, sequencing batch reactors, lagoons, and oxidation ditches. The MBR contains an ultrafiltration membrane with 0.04-micron openings for removal of particulates, bacteria, and viruses. Anything larger than this opening is unable to pass through the membrane. The membrane is beneficial as pathogen filtration barrier for producing reclaimed water.

The MBR technology was also selected because this technology is offered in a containerized solution manufactured by Newterra. The treatment is installed inside a container offsite. No further building is required to house the treatment equipment. The container can be manufactured off site while utilities, the excavation, and concrete tanks are completed on site, significantly reducing construction time. The equipment installation process is greatly simplified with this approach as it does not require the onsite contractor to complete the specialized process equipment, electrical, and controls work

Figure 15: Overall Water Process Flow Diagram

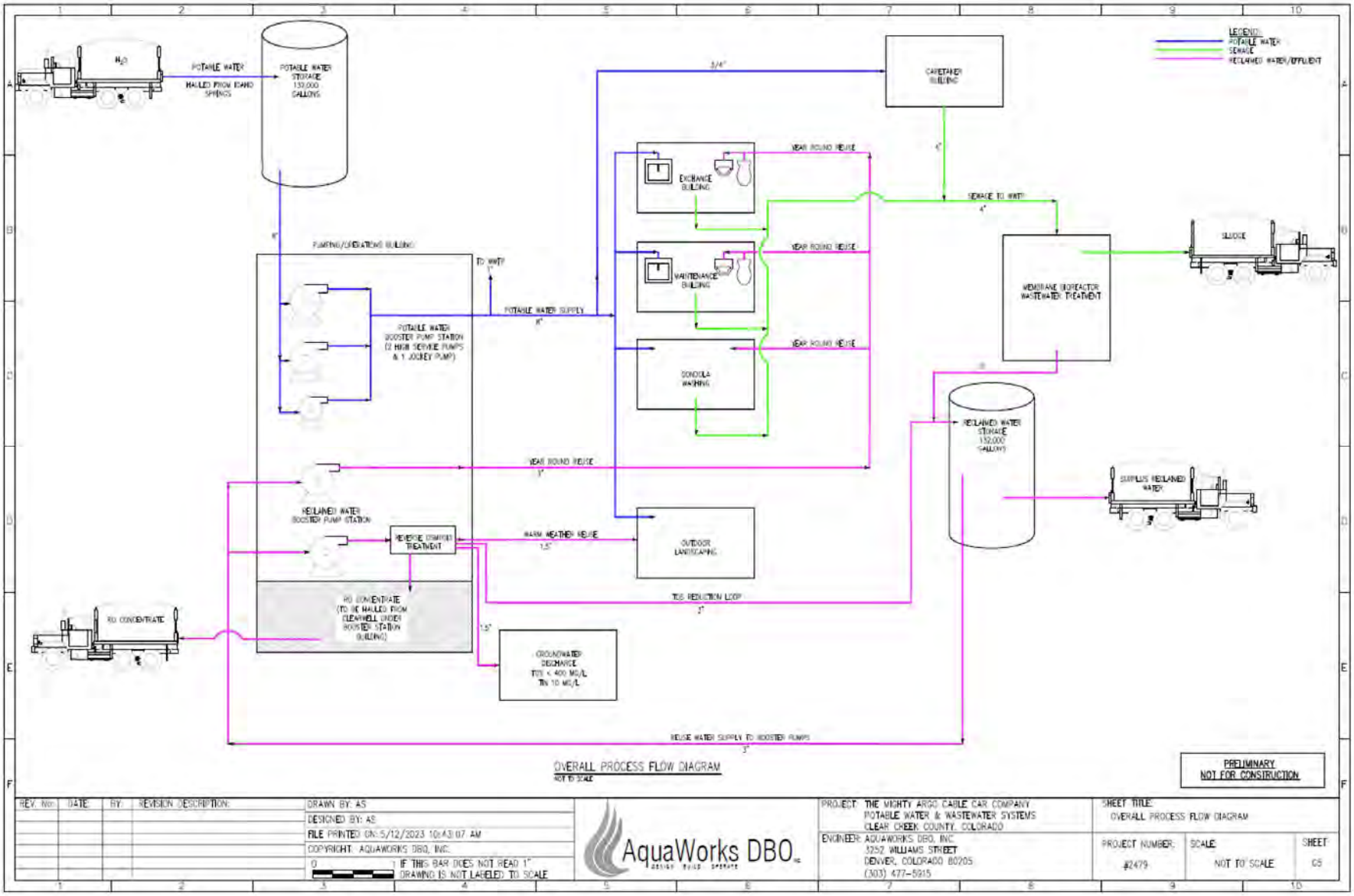
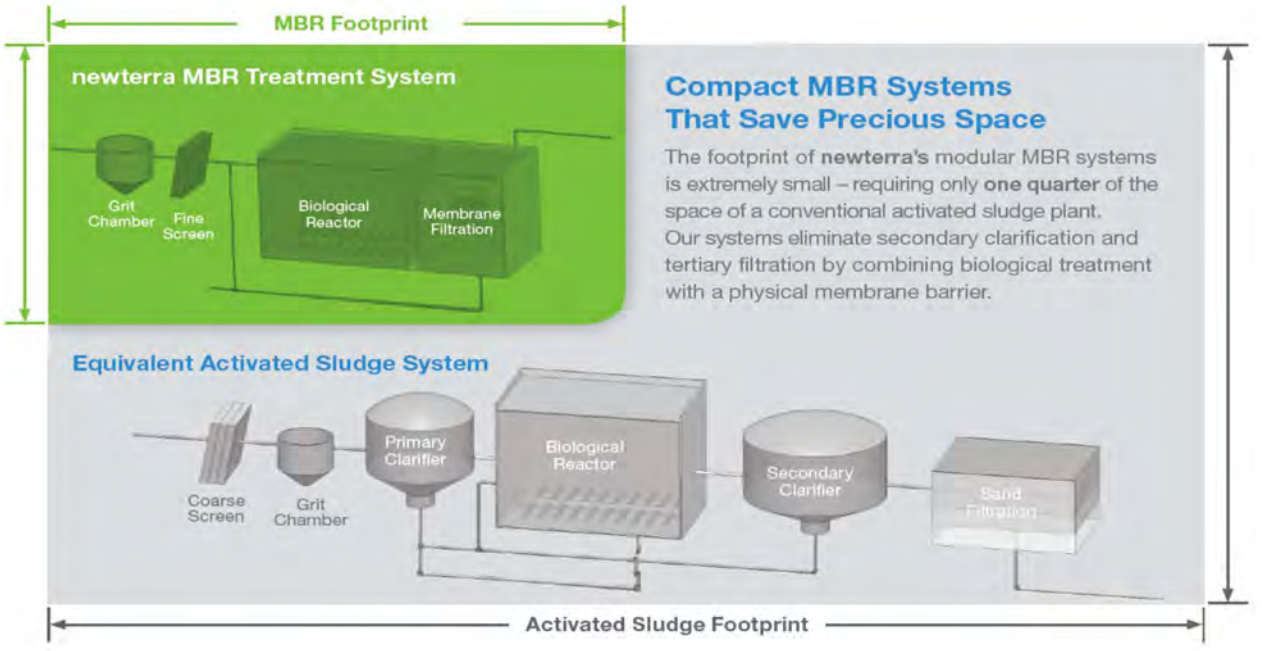


Figure 16: Newterra Containerized MBR System

Additionally, the availability of land is limited at the site and the small foot the MBR requires is desirable to the property's owner.

Figure 17: MBR Space Saving Features



10.1 Legal Description of the Site

An ownership map is included in the Appendix. A metes and bounds description of the upper landing site can be provided if required by the CDPHE.

10.2 Treatment Technical Description and Process Flow Diagram

The Mighty Argo Upper Landing proposes implementing the membrane bioreactor (MBR) treatment technology at the plant site to replace the current system. The MBR technology together with disinfection will be the most capable of meeting the reuse effluent limits for this project. Specifically, the membrane provides protection against anything larger than its pore size from being discharged.

The MBR has several added benefits that distinguish it from the other treatment equipment options. Because of the high MLSS concentrations, less tank volume is required than other available technologies. In addition, the reverse osmosis treatment will control TDS for groundwater discharge and for reuse purposes.

The proposed MBR and RO technology is supplied by Newterra and is a made-to-order system. Most of the equipment is installed inside a container offsite and shipped ready to operate. While the MBR system and the RO system will be located in separate containers, an additional building to house the containers is not required. The design is highly efficient because the container is the building, and the system is manufactured in a warehouse while site work and concrete tanks are completed at the Mighty Argo construction site. The cast-in-place concrete tanks act as a foundation for the containerized treatment system, which is simply placed on top when arriving on site. This approach significantly reduces construction time.

A process flow diagram for the MBR treatment process is provided in Figure 18. The MBR will include total inorganic nitrogen removal including both pre-anoxic and post-anoxic zones, to produce treated water quality with TIN less than 10 mg/L. After biological treatment, the wastewater is disinfected via ultraviolet disinfection. The UV reactors are located within the Newterra containerized MBR facility. After UV disinfection, the partially disinfected water flows out of the container to the booster station building, where the water is further treated with chlorine disinfection and reverse osmosis to reduce TDS. Figure 19 shows the treatment process after UV disinfection.

Figure 18: MBR Process Flow Diagram including UV Disinfection

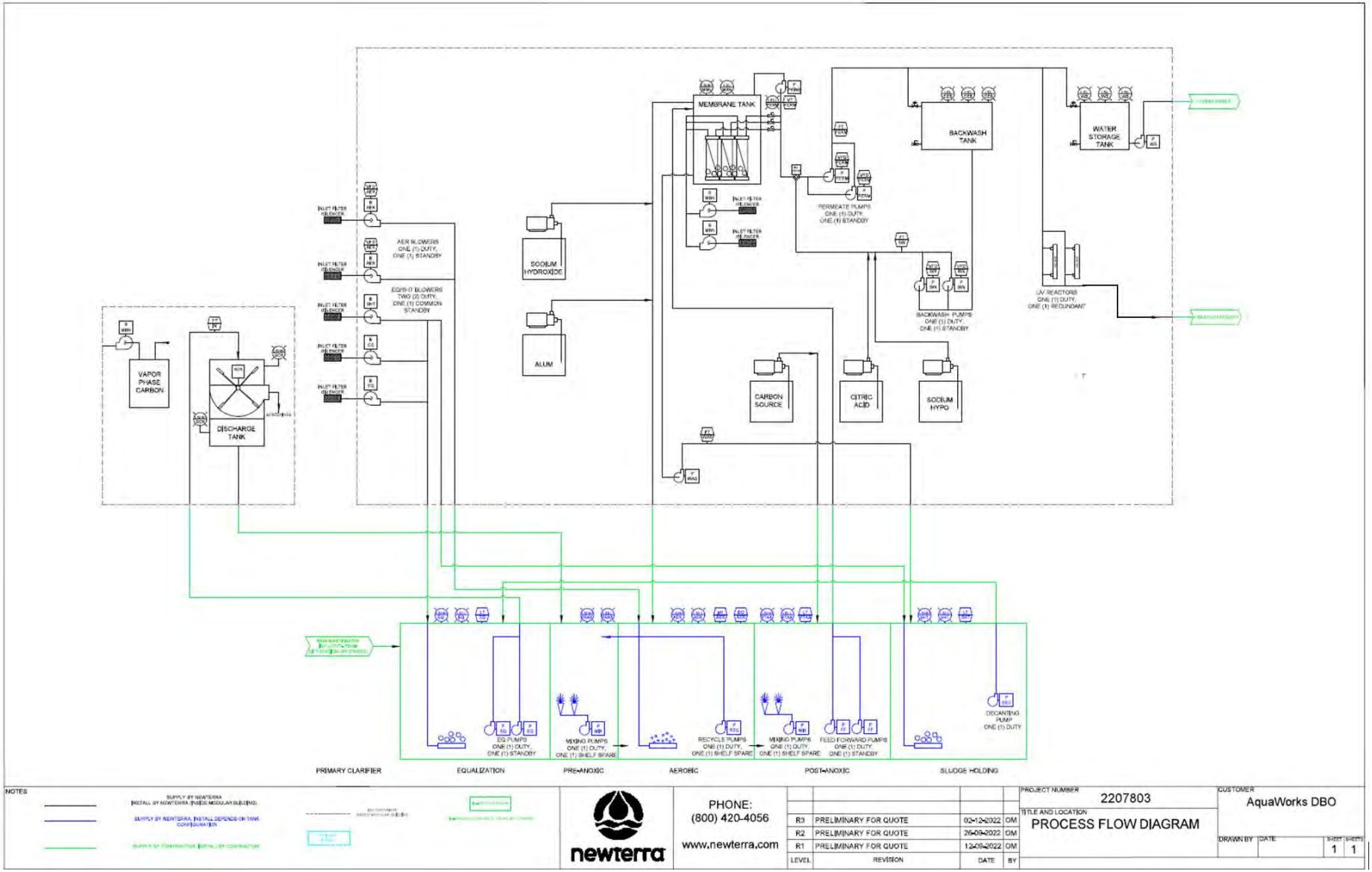
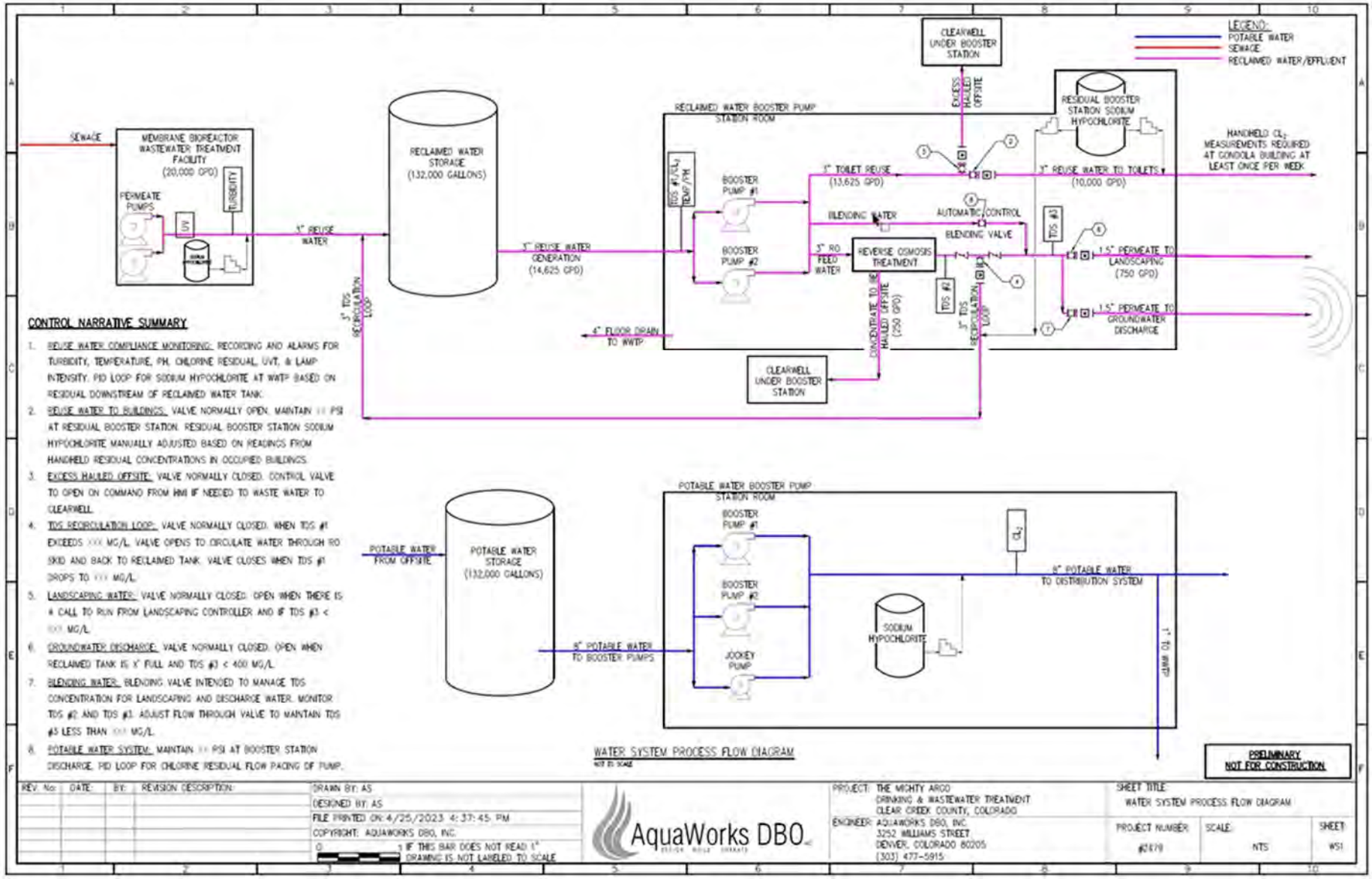


Figure 19: Process Flow Diagram Downstream of UV Disinfection



The treatment process will be required to provide log reductions specified under Regulation 84 and the water quality planning targets. The proposed MBR membranes are the Suez Zeeweed 500S ultrafilters. The National Blue Ribbon Commission indicates MBR utilizing ultrafiltration can be credited log removal of protozoa when properly operated and maintained as measured by effluent turbidity monitoring below target thresholds. The NBRC also indicates log inactivation credits for UV disinfection and chlorine disinfection for protozoa, bacteria, and viruses. These suggested log reduction credits are located in NBRC *Guidebook For Developing Onsite Non-Potable Water System Regulations* and are summarized below in Figure 20.

Figure 20: NBRC Suggested Log Reduction Credits

(From NBRC Guidebook for Developing Onsite Non-Potable Water System Regulations)

Treatment Process	Log_{10} Reduction Credits Virus/Protozoa/Bacteria	Example Information to be Included in an Engineering Report
Microfiltration or Ultrafiltration	0/4/0	Manufacturer's informational sheet indicating ability to detect 0.3µm breach
Membrane Biological Reactor (MBR)	1.5/2/4	Operation with the Tier 1 operating envelope as defined in the AWRCE 2016, *Membrane bio-reactor*, WaterVal validation protocol[2]
Reverse Osmosis	Up to 2/2/2	Manufacturer's informational sheet indicating ability to reject sodium chloride. Allow pathogen removal credit with continuous monitoring of either electrical conductivity or total organic carbon
Ultraviolet (UV) Light Disinfection	Up to 6/6/6 (dose dependent)	UV reactor's Validation Report following state-approved procedures[3] or NSF/ANSI 55 Class A validated.
Chlorine Disinfection	Up to 5/0/5 (CT dependent)	Calculations demonstrating log inactivation using CT disinfection, where CT = Concentration of Chlorine x Contact Time
Ozone Disinfection	Up to 4/3/0 (CT dependent)	Calculations demonstrating log inactivation using CT disinfection, where CT = Concentration of Ozone x Contact Time

The Tier 1 operating envelope is provided with MBR operating with effluent turbidity less than or equal to 0.2 NTU. The UV reactor must provide a UV dose of 80 mJ/cm^2 to receive 3.5 log virus and bacteria credit and 6 log protozoa credit. The chlorine disinfection process must provide 10 mg/L*min to achieve 5 log virus and 5 log bacteria inactivation credit.

Based on Figure 20, the proposed treatment plant will be capable of providing the minimum log reduction of pathogens. A breakdown of each treatment process included in the proposed design is provided in Table 8. Actual log removals will be dependent upon actual operating conditions. They will be verified by continuously monitoring filtered water turbidity, UV light intensity, UV transmissivity, flow rate, chlorine residual, water pH and temperature.

Table 8: Proposed Treatment Plant Log Reduction Treatment Credits

Treatment Process	Log Reduction Credits

	Virus	Protozoa	Bacteria
MBR	1.5	2.0	4.0
UV Disinfection (dose dependent, assumes 80 mJ/cm2)	3.5	6.0	3.5
Chlorine Disinfection (CT dependent, assumes 10 mg-min/L)	5.0	0.0	5.0
Total Credit Achieved*	10.0	8.0	12.5
Total Log Reduction Required	8.5	7.0	6.0

The design will be further developed in the design phases to demonstrate minimum log inactivation treatment capabilities. For the purposes of the site application, Table 8 is intended to demonstrate that the proposed treatment train can attain the minimum required treatment log reduction requirements.

In addition to the log reduction requirements for reclaimed water uses, groundwater discharge and some reclaimed water uses require TDS reduction. The design includes reverse osmosis treatment for TDS removal to meet required the effluent limits or treatment requirements. The brine and any other off-specification water will be held in a storage tank to be hauled offsite.

10.3 Operational Staffing Needs

The project owner will enter into an agreement with a contract operations service provider to operate and maintain the wastewater reclamation facility. There are several qualified firms that work in the area and travel the I-70 corridor. These firms have certified operators on staff to perform regular and emergency services. It is anticipated that an operator will need to be on site daily until the system is optimized. Once the plant is operating in a steady state, a plant of this size is typically visited by an operator 5 times per week. Onsite maintenance staff can be utilized to perform routine daily checks to supplement the contract operator.

MBR treatment requires a Class B wastewater operator. The contract operations company selected for this project will be required to have at least one operator on staff with this level of certification.

The following is a conceptual-level annual estimate of the O&M costs for the selected alternative:

Table 9: O&M Estimate

	MBR
Contract Operations	$60,000

Sludge Disposal	$12,000
Power	$12,000
Chemicals	$3,000
Membrane Replacement Budget	$1,000
Replacement Parts Budget	$5,000
Miscellaneous	$15,000
Total:	$108,000

11 Control of Site Legal Arrangements for Project Life

The Mighty Argo development property is privately owned by one of the Mighty Argo owners, Mary Jane Loevlie. The Clear Creek County property card is provided in the Appendix. In addition, a property ownership map is also included in the Appendix.

12 Management Capabilities

The management of the facility will be streamlined because the users within the service area will be part of the upper landing development. The project owner will have the ability to exert management and governance over the users through the agreements it has with individual leaseholders.

Controlling the wastewater loading to the proposed treatment works within capacity limitations will be managed through the agreements. For example, the owner will have the authority through lease provisions to require that an occupant install a pretreatment grease trap.

13 Financial System Information for Capital and O&M Costs Over Project Life

The following is an engineer's opinion of the probable costs for this project:

Table 10: Engineer's Preliminary Opinion of Probable Costs

Division:	Item:	Quantity:	Unit:	Total:
	TBD. Cost estimate table will be updated upon receiving updated quote from Newterra			

The developer will privately finance the initial capital investment for the facility. Ongoing O&M expenses for the reclamation facility will be funded through the operating budget of the upper landing site.

13.1 Anticipated Annual Budget

The annual budget for the facility, including reserve costs, will be similar to the estimated O&M costs, $108,000. The administrative costs will be minimal as there isn't a community to bill each month. The system will not have the expenses a municipally owned facility will have, such as those needed to meet accounting and governmental compliance requirements.

13.2 Fee and Rate Structure

The system will not seek revenue through fees and rates assessed to users. Rather, the project's owner will fund the ongoing maintenance costs through the operational budget for the upper landing site.

14 Implementation Plan and Schedule

The following milestones highlight the anticipated implementation schedule. However, the final schedule depends upon several factors, not all of which are under the control of the system, such as application review times, intergovernmental coordination, and weather.

Table 11: Implementation Schedule

Date	Activity
June 2023	Submit Site Application to CDPHE
November 2023	Obtain Site Application Approval
November 2023	Submit Final Plans and Specifications to CDPHE
Spring 2024	Obtain Final Design Approval from CDPHE
Summer 2024	Commence Construction
Fall 2024	Complete Construction
Fall 2024	Begin Field Verification and Commissioning Testing

14.1 Estimated Construction Time

Having the MBR equipment arrive preinstalled in the container will shorten the construction schedule. Most of the time-consuming and skilled work will be performed offsite by a manufacturer that has fabricated dozens of similar systems. Upon startup, Regulation 84 requires localized systems to perform field verification and commissioning testing. The testing must confirm the efficacy of the treatment process to meet the water quality planning targets and the minimum log removal of pathogens to protect the public and user (employee) health. The field verification and commissioning plan will be provided with the Regulation 84 Treater's application. During the verification and commissioning process, the treated wastewater will either be held or discharged to the groundwater discharge infiltration field in compliance with the discharge permit.

15 Capacity to Operate and Maintain the Facility

The owner will not directly operate and maintain the facility as its relatively small size and limited complexity does not require a full-time operations staff. The most cost-effective approach will be for the owner to contract with an operations firm that has the capacity to operate and maintain the facility. The owner can supplement the operator's services by having their onsite staff perform

daily checks and simple maintenance activities such as cleaning the manual bar screen.

15.1 Emergency Operations Plan

Included in the Appendix is an Emergency Response Planning Template. This document will be completed during the design phase once more project-specific information is known. The completed document will be included in the Operations and Maintenance Manual submitted to the CDPHE.

16 Site Application Review and Comments

The site application has been distributed to the City of Idaho Springs and Central Clear Creek Health Department. The signed certificates will be returned to the CDPHE once completed. The applicant is not aware of management agencies or 208 planning agencies that operate in the area. The site is not adjacent to other federal or state agencies or located in a Water Quality Control Commission Watershed Protection Control Area.

17 Site Location Posting Documentation

The public notice sign was posted on February 28, 2020.

Figure 21: Initial Sign Posting

The required 15 days of posting was completed on March 13, 2020.

Figure 22: Sign After 15-Day Posting

REFERENCES

Colorado Department of Public Health & Environment (2020). *Implementation Policy Regulation 22 - Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works (5 CCR 1002-22). Clean Water Program Policy Number CW-14. Denver, CO.*

Colorado Department of Public Health & Environment (2020). *Regulation 22 - Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works 5 CCR 1002-22.* Denver, CO.

Colorado Department of Public Health & Environment (2018). *Regulation 43 – On-Site Wastewater Treatment Regulation 5 CCR 1002-43.* Denver, CO.

Colorado Department of Public Health & Environment (2022). *State of Colorado Design Criteria for Domestic Wastewater Treatment Works*. *Clean Water Program Policy Number WPC-DR-1*. Denver, CO.

Lindeburg, M. R. (2003). *Civil Engineering Reference Manual* (9th Edition). Belmont, CA: Professional Publications.

Metcalf & Eddy (1991), *Wastewater Engineering Treatment Disposal Reuse*. Third edition.

National Blue Ribbon Commission, *A Guidebook for Developing and Implementing Regulations for Onsite Non-potable* Water Systems ©2017 US Water Alliance, WE&RF, and WRF

APPENDIX: SUPPLEMENTAL INFORMATION

- Regulation 22 Application Form
- WQPT - Regulation 84 Effluent Water Quality Planning Target (April 28, 2023)
- WQPT – Groundwater Discharge PELs & CDPHE correspondence
- One Mile Zoning Map
- Newterra Brochure
- Fluidyne Brochure
- Geotechnical Report
- Clear Creek County Property Card
- US Fish and Wildlife Wetlands Map
- FEMA Map
- Emergency Response Planning Template
- Process Flow Diagram

COLORADO
Department of Public Health & Environment

Water Quality Control Division
Engineering Section

4300 Cherry Creek Drive South, B2
Denver, Colorado 80246-1530
CDPHE.WQEngReview@state.co.us
303-692-6298

Regulation 22 Site Location Application Form
Section 22.6 - New Domestic Wastewater Treatment Plant

A. Project and System Information			
System Name	Mighty Argo		
Project Title	Mighty Argo Upper Landing Wastewater Reclamation Facility		
County	Clear Creek		
CDPS Permit No.	N/A		
Date Fee Paid or payment attached		Invoice Number and Check Number	
Design Company Name	AquaWorks DBO		
Design Engineer	Adam Sommers	CO License Number	38,169
Address	3252 Williams Street		
	Denver, CO 80205		
Email	adam@aquaworksdbo.com	Phone	303-477-5915
Applicant/Entity	Mighty Argo		
Representative Name	Bryan McFarland, Development Partner		
Address	1431 Miner Street		
	Idaho Springs, CO 80452		
Email	bryanmcfarland@mightyargo.com	Phone	(303) 434-9435

B. Project Information			
Location (existing or proposed site)		*Proposed Project Design Capacity*	
Brief location description		Hydraulic Capacity Maximum Month Average	0.02 MGD
Legal Description (e.g., Township, Range)	Section 25, Township 4S, Range 73W	Peak Hour Hydraulic Capacity	0.08 MGD
County	Clear Creek		
Latitude	39 45' 86" N	Organic Loading Capacity – Treatment Plant Only (Maximum Month Average)	95 lbs. BOD_5/day or lbs. cBOD/day
Longitude	-105 30' 29" W		

Funding Process	Will the State Revolving Fund (SRF) loan program be used to finance any portion of the project?	Yes	☐	No	☒	If yes, please list project number	

Project Schedule and Cost Estimate	
Estimated Bid Opening Date	
Estimated Completion Date	
Estimated Project Cost	

Project and System Information	
System Name	Mighty Argo
Project Title	Mighty Argo Upper Landing Wastewater Reclamation Facility
County	Clear Creek
CDPS Permit No.	N/A

Treatment Works Information

1. Type and capacity of treatment works proposed including major processes used.

The proposed treatment facility will include MBR, UV, chlorine and RO treatment.

Site Information

2. Vicinity maps of site location which includes the following:

a) 5-mile radius map: all treatment plants, lift stations and domestic water supply intakes

b) 1-mile radius map: habitable buildings (e.g., residences, schools, and commercial structures), location of public and private potable water wells, an approximate indication of the topography of the area, and neighboring land uses

Provided in site application

3. Site Location Zoning

a) Present zoning of the site location?

Mining One (M1)

b) Zoning within a one (1) mile radius of the site location?

Privided in report

4. Floodplain and Natural Hazards

a) Is the site located in a 100-year floodplain or other natural hazard area? If so, what precautions are being taken?

No, see FEMA Firmette included in the report appendix.

b) Has the floodplain been designated by the Colorado Water Conservation Board, Department of Natural Resources or other agency? If so, please list agency name and the designation.

No.

5. Legal Arrangements Demonstrating Control of the Site

Please provide the legal arrangements showing control of the site or right-of-way for the project life or showing the ability of the entity to acquire the site or right-of-way and use it for the project life.

Clear Creek County property record

6. Nearby Facilities

Please list all municipalities and water and/or sanitation districts within 5-miles downstream of the proposed treatment works site.

The facility discharges to reuse and to groundwater. Idaho Springs is within 5 miles of the proposed facility.

Treatment Works Effluent Information

7. Effluent disposal method (check all that apply)

☐	Surface Discharge to watercourse (enter watercourse name below)
☒	Groundwater Discharge
☐	Land application
☒	Treated Effluent Reuse (Regulation 84)
☐	Evaporation
☐	Other (describe below)

8.	**Water Quality Planning Targets** (please attach a copy in Engineering Report)
	a) Identify the document to be used as the Water Quality Planning Targets:
	WQPTs were received for the reclaimed water uses. Groundwater discharge PELs are from 2020 are adequate for site application review (confirmed by Permit Unit Manager). Both documents are included in the report appendix.
	b) If Preliminary Effluent Limits are required, please identify the date the document was received:
	Reclaim water WQPTs: April 28, 2023 GW PELs issued: December 8, 2020; confirmed May 2, 2023
9.	**Downstream Distances**
	a) Downstream distance from the discharge point to the nearest domestic water supply intake? Name of supply? Address of supply?
	Distance: *Name of Supply:* *Address of Supply:*
	b) Downstream distance from the discharge point to the nearest other point of diversion? Name of user? Address of user?
	Distance: *Name of User:* *Address of User:*
Project Information	
10.	What entity is financially responsible for the construction of the treatment works?
	Mighty Argo
11.	What entity has the financial responsibility for owning and long term operating expense of the proposed treatment works?
	Mighty Argo
12.	What entity has the responsibility for managing and operating the proposed treatment works after construction?
	Mighty Argo
Additional Factors	
13.	Please identify any additional factors that might help the Division make an informed decision on your site location application.

COLORADO
Department of Public Health & Environment

Water Quality Control Division
Engineering Section

4300 Cherry Creek Drive South, B2
Denver, Colorado 80246-1530
CDPHE.WQEngReview@state.co.us
303-692-6298

Applicant Certification and Review Agencies Recommendation
Section 22.6 - New Domestic Wastewater Treatment Plant

Project and System Information	
System Name	Mighty Argo
Project Title	Mighty Argo Upper Landing Wastewater Reclamation Facility
County	Clear Creek
CDPS Permit No.	N/A

1. Applicant Certification

I certify that I am familiar with the requirements of *Regulation 22 - Site Location and Design Regulations for Domestic Wastewater Treatment Works*, and have posted the site location in accordance with the regulations. An engineering report, as described and required by the regulations, has been prepared and is enclosed.

Applicant Legal Representative			
Position/Title Development Partner	Typed Name Mary Jane Loevlie	Signature Mary Loevlie (Jun 6, 2023 07:51 MDT)	Date Jun 6, 2023
Email bryanmcfarland@mightyargo.com		Phone (303) 434-9435	
The system legal representative is the legally responsible agent and decision-making authority (e.g. mayor, president of a board, public works director, owner). The Design Engineer is not the legal representative and cannot sign this form.			

2. Recommendation of Review Agencies

As required in Section 22.6(2), the application and the engineering report must be submitted to all appropriate local governments, local health authority, 208 designated planning and management agencies and other state or federal agencies for review and comment prior to submittal to the Division. By signing below, the review agency: 1) acknowledges receipt of the proposed site location application, 2) has reviewed the proposed application and may elect to provide comments, and 3) has provided a recommendation concerning the application to the Division. The recommendation should be based on the factors outlined in Section 22.6(2); for example, on the consistency of the proposed site location application with the local comprehensive plan(s) as they relate to water quality and the approved regional water quality management plan(s). *Please note: Review agencies are encouraged to provide project comments; however, if a review agency does not recommend approval then the agency must attach a letter describing the reason for their decision or comment on the next page.*

Signature of designated Management Agency (i.e., Water Quality Authority, Watershed Association, Watershed Authority)					
Agency Upper Clear Creek Watershed Association	Typed Name Dlane Kielty	Signature		Date	
Email UCCWA@live.com		Phone 303-916-4645	Recommend Approval?	*Yes* ☐ *No* ☐	
Signature of County, if the site is located in unincorporated areas of a county					
County Clear Creek	Typed Name Brian Bosshardt	Signature		Date	
Email bbosshardt@clearcreekcounty.us		Phone (303) 679-2312	Recommend Approval?	*Yes* ☐ *No* ☐	
Signature of City or Town, if the site is located within a City/Town boundary or within three miles of the City/Town boundary (if multiple, attach additional sheets as needed)					
City/Town Idaho Springs	Typed Name Chuck Harmon	Signature		Date	
Email mayor@idahospringsco.com		Phone 303-567-4421	Recommend Approval?	*Yes* ☐ *No* ☐	

Signature of Local Health Authority					
Agency Clear Creek Environment Health Department	Typed Name Gary Hague	Signature		Date	
Email ghague@clearcreekcounty.us		Phone 303- 679-2300	Recommend Approval?	*Yes*	☐
				No	☐
Signature of 208 Designated Planning Agency					
Agency n/a	Typed Name	Signature		Date	
Email		Phone	Recommend Approval?	*Yes*	☐
				No	☐
Signature of other State or Federal Agencies, if treatment works is located on or adjacent to a site that is owned or managed by a federal or state agency.					
Agency n/a	Typed Name	Signature		Date	
Email		Phone	Recommend Approval?	*Yes*	☐
				No	☐
Signature of other undesignated Basin Water Quality Authority, Watershed Association, Watershed Authority, etc.					
Agency n/a	Typed Name	Signature		Date	
Email		Phone	Recommend Approval?	*Yes*	☐
				No	☐

Review Agency Comments:

COLORADO
Department of Public Health & Environment

April 28, 2023

Bryan McFarland
Mighty Argo Upper Landing
1431 Miner St.
Idaho Springs, CO 80452

Dear Mr. McFarland,

The Water Quality Control Division (division) reviewed your Water Quality Planning Target Application for the Mighty Argo Upper Landing WWTP. This letter is for informational purposes only and does not authorize the Mighty Argo Upper Landing WWTP to treat or use reclaimed water. The Treater must submit a Treater Application, Field Verification and Commissioning Report, Operations and Maintenance Plan and User Application and Site Management Plan(s) (UASMP) to the division to be approved prior to treatment and use of reclaimed water (refer to this guidance for additional information). This letter is to inform about the water quality standards and additional requirements to become and authorized Treater.

Water Quality Planning Targets for Mighty Argo Upper Landing WWTP

The **p**roposed uses of reclaimed water from the localized reclaimed water treatment system are:

- Washwater Applications
- Toilet and Urinal Flushing
- Non-residential Fire Protection
- Unrestricted Access Landscape Irrigation

Mighty Argo Upper Landing WWTP must meet the following treatment goals and water quality standards in Regulation 84:

- Category 3 reclaimed water standards at the point of compliance ((84.7(C))
- Localized Reclaimed Water Treatment Log Removal Targets for Category 3 reclaimed water (84.16(D)(c)).
- Chlorine or Monochloramine disinfection residual, or an alternative disinfection method approved by the division (84.10(B)(18)(a)).

Table 1 shows the secondary water quality standards (Regulation 62 – Regulations for Effluent Limitations) and reclaimed water quality standards (Reclaimed Water Control Regulation 84) to be met at the point of compliance. Table 1 also shows the disinfectant residual that must be maintained in the indoor premise plumbing for indoor reclaimed water use. Table 2 shows the log reduction targets for pathogen removal that must be met at the point of compliance for localized reclaimed water treatment systems meeting Category 3 standards.

Table 1: Effluent Standards to Use Category 3 Reclaimed Water Treated from a Localized Reclaimed Water Treatment System

Parameter	Parameter Limitations
BOD_5 mg/L	30 (30-day average) 45 (7-day average)
Total Suspended Solids mg/L	30 (30-day average) 45 (7-day average)

$CBOD_5$ mg/L	25 (30-day average) 40 (7-day average)
Residual Chlorine mg/L	0.5 (inst. Max)
pH s.u.	6.0-9.0 (inst. Max)
Oil and Grease mg/L	10 mg/L (inst. Max)
Turbidity NTU	3 (monthly avg.) not to exceed 5 in more than 5% of individual samples
E. coli cfu/100mL	None detected in at least 75% of samples per calendar month and 126/100mL single sample max
At a location at a distance of no greater than 50 feet from the location of use at the distal end, or a location that represents the oldest water age within the reclaimed water premise plumbing system within the building.	0.2 mg/L minimum free chlorine or 0.5 mg/L minimum monochloramine

Table 2: Localized System Log Removal Targets for Treatment Design

	Enteric Viruses	Parasitic Protozoa	Enteric Bacteria
Log_{10} Reduction Target (10^{-4}) Category 3	8.5	7.0	6.0

Other Regulation 84 Requirements

Regulation 84 contains other Treater and User requirements in addition to meeting these treatment goals and standards. Please review the attached copy of Regulation 84 and contact Brandi Honeycutt with questions.

Brandi Honeycutt, M.S.
Environmental Protection Specialist
Permits Section
P 303-692-6357
4300 Cherry Creek Drive South, Denver, CO 80246
brandi.honeycutt@state.co.us | www.coloradowaterpermits.com

CC: Amy Zimmerman, Aquaworks DBO, Inc.

From: Johnson-Hufford - CDPHE, Randi
To: Amy Zimmerman
Cc: Adam Sommers; Honeycutt - CDPHE, Brandi; Zachary Richardson - CDPHE
Subject: Re: Mighty Argo
Date: Tuesday, May 2, 2023 1:14:45 PM
Attachments: image.png

Amy, thank you for the follow up. Apologies in the delay. We don't deal with a lot of WQPT requests in groundwater so I'm still working to understand all the processes. The permittee is able to go forward with an existing PEL if they want to: https://cdphe.colorado.gov/WQ_Planning_Targets_and_PELs. If you go through the flowchart, you'd look to see if Reg 41 was updated (it wasn't) and decide if you want to move forward. Hope this helps! Randi

If you already have a PEL:

- Use this flowchart to determine if it can be used as a Water Quality Planning Target.
- Note that you may now be able to use a PEL that is more than 18 months old. If you can use your existing PEL, notify the WQCD Engineering Section. If you cannot use your existing PEL, apply for a new Water Quality Planning Target using the Domestic Water Quality Planning Target/PEL application form. You may email this form to cdphe.wqrecordscenter@state.co.us.

On Tue, Apr 18, 2023 at 9:57 AM Amy Zimmerman <amy@aquaworksdbo.com> wrote:

> Hi Brandi, I have not provided a groundwater WQPT application because I wanted to check if we could use the ones we already have for this project.
>
> If not, I will submit a new application. Please advise.
>
> Thanks,
>
> Amy
>
> ---
>
> **From:** Johnson-Hufford - CDPHE, Randi <randi.johnson-hufford@state.co.us>
> **Sent:** Tuesday, April 18, 2023 9:40 AM
> **To:** Amy Zimmerman <amy@aquaworksdbo.com>
> **Cc:** Adam Sommers <adam@aquaworksdbo.com>; Honeycutt - CDPHE, Brandi <brandi.honeycutt@state.co.us>
> **Subject:** Re: Mighty Argo
>
> Thank you for the background - the reclaimed water WQPT didn't really explain the whole picture. Did you submit a WQPT application for the groundwater side as well? It would make sense to review those applications in tandem since the system relies on both reclaimed

water and groundwater discharge.

Thanks! Randi

On Tue, Apr 18, 2023 at 8:54 AM Amy Zimmerman <amy@aquaworksdbo.com> wrote:

> Hi Randi,
>
> The Mighty Argo project is re-starting. The project was put on hold for a couple of years after someone stole their capital funding and they had to re-fund the project.
>
> That said, the project scope has not changed since 2020. The project still incudes a water reuse and a groundwater discharge. Excess wastewater will be hauled to Idaho Springs WWTP. As you know, I've already been in touch with Brandi about reclaim WQPTs. For the groundwater discharge, I want to confirm if we can still use the GW PELs (WQPTs) from 2020 to re-submit a site application to engineering section since the 2020 site approval expired prior to beginning construction.
>
> As a summary, the WWTP includes several layers of treatment including MBR, UV disinfection and RO, which will achieve effluent quality to meet GW discharge limits.
>
> See attached 2020 PELs and 2020 site approval for background. If you have any questions, please let me know.
>
> I am happy to call to discuss further or answer any questions.
>
> Thanks,
>
> Amy

Amy Zimmerman, P.E. | **AquaWorks DBO, Inc.**

3252 Williams Street | Denver, CO 80205

Phone 720-319-8848

--

Randi Johnson-Hufford, MPA
Unit 1 Manager, Permits Section
(Stormwater, Dewatering, Groundwater, Reclaimed)

Temp P 720.251.4828 | F 303.782.0390

4300 Cherry Creek Drive South, Denver, CO 80246

randi.johnson-hufford@state.co.us | https://cdphe.colorado.gov/water-quality

24-hr Environmental Release/Incident Report Line: 1.877.518.5608

Due to the COVID-19 response, please know there may be a prolonged delay for a reply.
For COVID-19 specific information, please call the CDPHE Call Center at 303-692-2700 or go to CDPHE COVID-19.
For general questions about COVID-19: Call CO-Help at 303-389-1687 or 1-877-462-2911 or email COHELP@RMPDC.org, for answers in English and Spanish (Español), Mandarin (普通话), and more.

--

Randi Johnson-Hufford, MPA
Unit 1 Manager, Permits Section
(Stormwater, Dewatering, Groundwater, Reclaimed)

Temp P 720.251.4828 | F 303.782.0390
4300 Cherry Creek Drive South, Denver, CO 80246
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Adam Sommers, P.E.
AquaWorks, DBO, Inc.
3252 Williams Street
Denver, CO 80205
adam@aquaworksdbo.com

MEMORANDUM

TO: Adam Sommers, P.E.

FROM: Randy T. Ogg, 303-692-3560, randy.ogg@state.co.us

DATE: 12/8/2020

RE: PEL200627 - Groundwater Preliminary Effluent Limits (PELs)

Permittee/
Facility: The Mighty Argo – Mighty Argo Upper Landing Wastewater Treatment Facility (WWTF)

The Water Quality Control Division (division) of the Colorado Department of Public Health and Environment has prepared Preliminary Effluent Limits (PELs) for Mighty Argo Upper Landing wastewater treatment facility (WWTF). PELs are used for planning purposes and are required as part of the Site Approval process. As described in the attached document, these PELs have been developed based on the current available information, including, but not limited to: information provided in the PEL application; current water quality regulations and/or standards; and current division policies and standard practices. A determination of which effluent limits ultimately apply in a permit will be dependent on information available at the time of permit application and development, including but not limited to: current regulations and/or standards; permit application information; process knowledge; and monitoring data. Therefore, final permit effluent limits may differ from the limits in the PELs.

Table 1 contains a summary of the limitations that have been developed in this PEL for which the proposed treatment facility will be evaluated against under the Site Approval process. This evaluation will include a determination of whether the proposed treatment facility as designed, can meet these limitations. A new or modified wastewater treatment facility will be expected to meet the limitations for these parameters upon commencement of discharge or upon starting-up the modified treatment process.

Appendix A describes the purpose and basis for these PELs.

**NOTE: The PELs provided herein are a projection of effluent limits that would be contained within a Colorado Discharge Permit System (CDPS) discharge permit based on the regulatory requirements in place at the time of this analysis and information disclosed by the applicant. They do not constitute permission to discharge pollutants under the Water Quality Control Act (25-8-101, et. seq., C.R.S.). Final permit limits must be calculated after receipt of a discharge permit application and under the terms and conditions of Regulations 41, 61 and 62 (5 CCR 1002-41, 61, and 62). Final effluent limits are expected to be similar, but will not necessarily be identical to the projections in this PEL.

The proposed maximum month daily average hydraulic design capacity is 0.02 million gallons per day (MGD).

All permitted groundwater monitoring and compliance wells must be located on Mighty Argo Upper Landing WWTF property, and in accordance with Regulation 41.6, Point of Compliance.

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Table 1 Preliminary Effluent Limitations for Evaluation under the Site Approval Process Discharge to Groundwater	
Parameter	**Limitations**
TECHNOLOGY-BASED LIMITATIONS—Regulation No. 62	
BOD_5 (mg/l)	45 (7-day average), 30 (30-day average)
BOD_5 (% removal)	85 (30-day average)
Oil and Grease (mg/l)	10 (maximum)
Total Suspended Solids (mg/l)	45 (7-day average), 30 (30-day average)
TSS (% removal)	85 (30-day average)
Total Suspended Solids (mg/l), Non-aerated waste stabilization ponds*	160 (7-day average), 105 (30-day average)
Total Suspended Solids (mg/l), Aerated waste stabilization ponds*	110 (7-day average), 75 (30-day average)
*Where adjusted TSS limitations are used, the 85 percent removal requirement for TSS shall be waived, pursuant to Regulation No. 62.	
GROUNDWATER-QUALITY BASED LIMITATIONS—Regulation No. 41	
Total Coliforms, (30 day average)	2.2 organisms/100 ml
Total Coliforms, (maximum in 30 days)	23.0 organisms/100 ml
Total Inorganic Nitrogen, dissolved	10 mg/l (daily maximum)
Chloride, dissolved	250 mg/l (30-day average)
pH (s.u.)	6.5-8.5 (minimum-maximum)
Total Dissolved Solids	400 mg/l or 1.25 times the background level, whichever is least restrictive (daily maximum)
Sulfate, dissolved	250 mg/l (30-day average)

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Appendix A
Purpose and Basis for Preliminary Effluent Limitations
Groundwater Discharge
Mighty Argo Upper Landing Wastewater Treatment Facility

Introduction

The Water Quality Control Division (division) has developed Preliminary Effluent Limitations (PELs) for Mighty Argo Upper Landing Wastewater Treatment Facility (WWTF), proposed to be located in Clear Creek County Colorado. This evaluation was conducted to facilitate issuance of groundwater PELs for pollutants of concern that may be discharged from a domestic and/or industrial WWTF. The design capacity of the proposed WWTF is 0.02 million gallons per day (MGD) at maximum month daily average flow.

The proposed WWTF discharge location is shown in Figure A-1. The latitude and longitude of the proposed groundwater discharge is:

Latitude: 39.757401

Longitude: -105.508177

PURPOSE OF PRELIMINARY EFFLUENT LIMITATIONS

In order for Mighty Argo Upper Landing WWTF to receive a discharge permit for their new and/or upgraded WWTF; the system must obtain PELs that are for a groundwater discharge.

The goal of the Water Quality Control Commission (Commission) is to provide maximum beneficial use of groundwater resources, while assuring the safety of the users by preventing or controlling those activities which have the potential to impair existing or future beneficial uses of groundwater or to adversely affect public health. This process is to be administered in a manner that is consistent with and complementary to the provisions of the Colorado Water Quality Control Act. *The Basic Standards for Groundwater* (Regulation 41) establishes a system of classifications for determining the appropriate degree of protection necessary to maintain beneficial uses of groundwater. These standards and classes are intended to complement regulations 31, *The Basic Standards and Methodologies* which are primarily applicable to surface waters. Together, Regulations 31, 41, 42, and 62 protect state waters as defined in Section 25-8-203, CRS (1982).

Facility and Nature of Discharge

Mighty Argo Upper Landing WWTF is located in Clear Creek County Colorado.

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Figure A-1
Location Map

BASIS FOR DEVELOPMENT OF LIMITATIONS

Pollutants of Concern

For minor domestic WWTFs (less than one million gallons per day), it has been documented that the following pollutants are generally associated with domestic wastewater:

- Total Inorganic Nitrogen (TIN)
- Total Coliform
- Biological Oxygen Demand (BOD)
- Total Suspended Solids (TSS)
- Oil and Grease
- Sulfate
- Chloride

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- pH
- Total Dissolved Solids (TDS)

The PEL application did not identify additional pollutants of concern. Generally for minor domestic WWTFs that do not receive industrial waste, metals and other parameters (such as organics and radionuclides) are not present at concentrations that have reasonable potential to cause or contribute to an exceedance of a water quality standard and, therefore, were not evaluated in this PEL. However, if future information establishes a reasonable potential for other pollutants to be present at such concentrations, discharge permit effluent limitations for these parameters may be added at that time. The water quality standards and technology-based limitations for these pollutants are contained in the following regulations:

- Regulation No. 62; Technology-Based Effluent Limitations
- Regulation No. 41; Groundwater Standards, Tables 1-4

TECHNOLOGY-BASED EFFLUENT LIMITATIONS

Regulation No. 62, the *Regulations for Effluent Limitations*, includes effluent limitations that apply to all discharges of wastewater to State waters, with the exception of storm water and agricultural return flows. These regulations are applicable to the proposed discharge from Mighty Argo Upper Landing WWTF. Table 1 contains a summary of the applicable "technology-based" limitations for pollutants of concern for all WWTFs.

There are no groundwater quality standards for BOD_5, TSS, and oil and grease. Therefore, the applicable technology-based effluent limitations for these pollutants are established in Regulation No. 62. The technology-based effluent limitations, based on Regulation No. 62, shall be monitored at a point subsequent to treatment and prior to discharge to groundwater.

WATER-QUALITY BASED LIMITATIONS

The numeric groundwater standards are contained in Tables 1, 2, 3, and 4, and Table A of Regulation No. 41, *The Basic Standards for Groundwater*. The majority of the numeric standards listed in Table 1 of Regulation 41 are the maximum contaminant levels (MCLs) for public drinking water supplies, as established by the National Primary Drinking Water Regulations. The remainder are derived from the Colorado Basic Surface Water Standards. These human health levels are set to protect the public from negative health effects.

In Regulation No. 41, Table 2 contains additional numeric standards for "Domestic Use-Quality" groundwater. These parameters are the National Secondary Drinking Water Standards and are instituted to maintain groundwater as a drinking water source requiring appropriate treatment.

Numeric standards meant to protect a water source for agricultural uses are listed in Table 3 of Regulation No. 41. These values are set at levels to protect livestock and crops. All "Agricultural Use-Quality" groundwater must meet these standards.

In Regulation No. 41, Table 4 includes limits for total dissolved solids (TDS). The TDS limits are applicable to all classes of groundwater, except "Domestic Use-Quality" and "Limited Use Quality" groundwater. The division may establish TDS limits according to the background TDS levels.

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Groundwater limitations for a domestic and/or industrial WWTF are based on Regulation No. 41, *The Basic Standards for Groundwater* and Regulation No. 62, the *Regulations for Effluent Limitations*, and are shown in Table 1.

POINTS OF COMPLIANCE

Points of compliance are established in accordance with section 41.6 of the "Basic Standards for Ground Water", Regulation 41 (5 CCR 1002-41), and sections 61.8(4)(d) and 61.14(4) of the "Colorado Discharge Permit System Regulations", Regulation 61 (5 CCR 1002-61). Regulation 61.8(4)(d) provides that the division must include in its permits "required monitoring including type, intervals, and frequency sufficient to yield data which are representative of the monitored activity." Based on review of the permit application, the proposed Mighty Argo Upper Landing WWTF discharge location is expected to be located in an area of weathered bedrock, crystalline bedrock, volcanic, or other geologic material other than sedimentary deposits or alluvial deposits. This geology precludes the use of groundwater wells as permit compliance monitoring wells because such wells are not expected to yield data that is representative of the monitored activity. Based on the proposed WWTF location and the information currently available to the division, the division has determined that the approved point of compliance for Mighty Argo Upper Landing WWTF will reflect **"end-of-pipe"** locations and will not include the use of compliance monitoring wells. These point(s) of compliance for the Mighty Argo Upper Landing WWTF will be used during the Site Approval process and reflected in any future permit certification.

Preliminary Effluent Limitations (PELs)

The PELs listed in Table 1 are based upon Regulations 41 and 62.

Please note: The Division reserves the right to include additional parameters and their respective limitations based on new information, WWTF process knowledge, permit application information, monitoring data, etc.

References

The Basic Standards and Methodologies for Surface Water, Regulation 31.

The Basic Standards for Groundwater, Regulation 41.

Site-Specific Water Quality Classifications and Standards for Groundwater, Regulation 42.

Colorado Discharge Permit System Regulations, Regulation 61.

Regulations for Effluent Limitations, Regulation 62.

Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works 5 CCR 1002-22.

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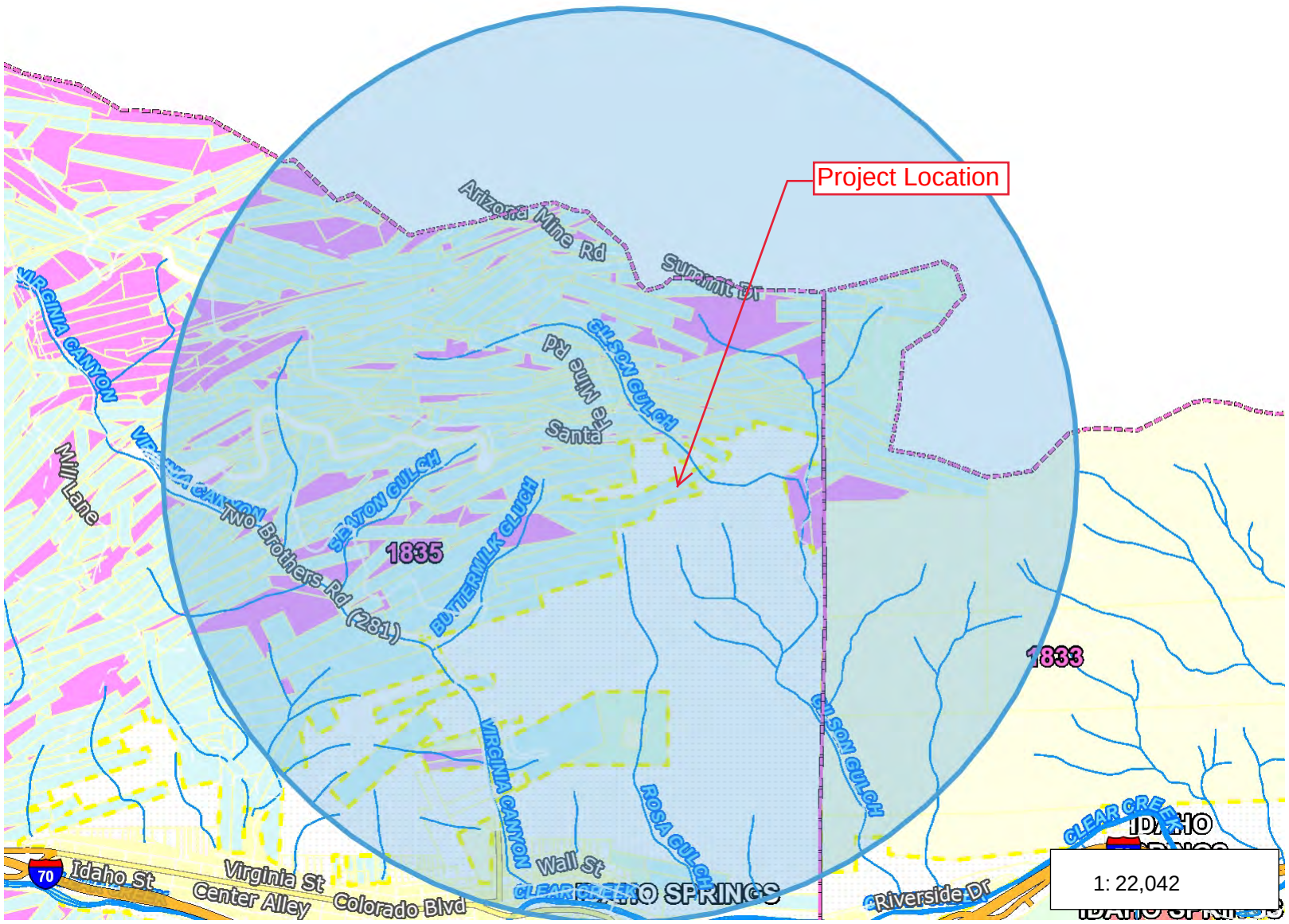
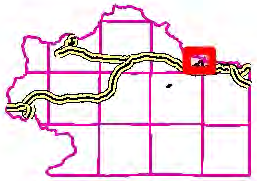
One Mile Zoning Map





Legend

- Township Lines
- Roads (1 inch = 1600 feet)
  - HIGHWAY
  - MAJOR ARTERIAL
  - COLLECTOR
  - LOCAL
  - SERVICE
  - 4WD
- Streams
- Lakes
- Towns (zoomed in)
- Parcels
- Zoning
  - Agricultural (AG)
  - Buffer (B)
  - Commercial One (C-1)
  - Commercial Two (C-2)
  - Commercial-Light Manufacturing (C
  - Commercial-Neighborhood (C-N)
  - Commercial-Outdoor Recreation (C
  - Commercial-Retail Office (C-RO)
  - Commercial-Tourism/Recreation (C
  - Commercial-Warehouse/Manufactu
  - Industrial One (I)
  - Mining One (M-1)
  - Mining Two (M-2)
  - Mountain Residential-Single Family
  - Mountain Residential-Large Lot Sin

Notes

3,673.6 0 1,836.82 3,673.6 Feet

NAD_1983_2011_StatePlane_Colorado_Central_FIPS_0502_Ft_US
Map Created: March 3, 2020

Modular Decentralized Water & Wastewater Systems

Scalable, cost-effective solutions for development projects and existing wastewater treatment plant retrofits.

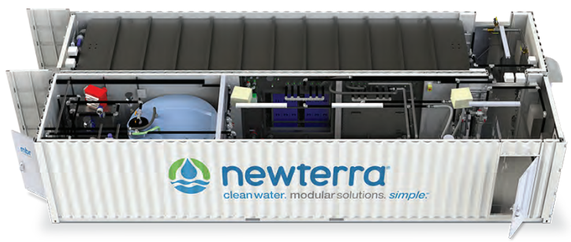
newterra®

clean water. modular solutions. *simple.*

newterra.com

Newterra Pre-Fabricated Modular Systems Are Designed To Grow As Your Development Grows

Newterra is leading the way with decentralized wastewater solutions that help you reduce project costs with a sustainable treatment approach. Our modular membrane bioreactor (MBR) systems are scalable – allowing treatment infrastructure to be added in stages as capacity requirements grow.



The Right Solution for a Wide Range of Projects

Newterra's innovative wastewater treatment systems are ideally suited to many types of projects, including:

- Greenfield & Retrofit Projects
- Existing Infrastructure Tie-ins
- Municipal WWTPs
- New Residential Developments
- Hotels, Resorts & Restaurants
- Campgrounds & Trailer Parks
- Mobile Home Communities
- Off-Grid & Remote Municipal Plants
- New Commercial Developments
- Service Area Expansions
- LEED® Certified & Green Buildings
- Schools & Hospitals
- Golf Courses
- Sports & Recreational Facilities
- Highway Rest Areas

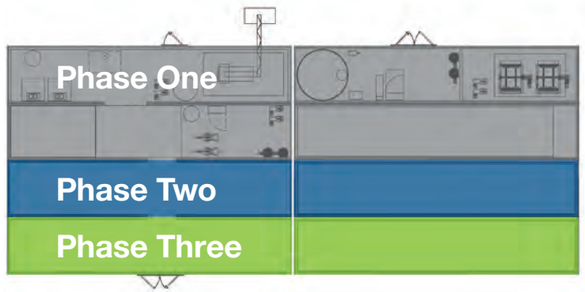
Self-Contained and Enclosed Systems

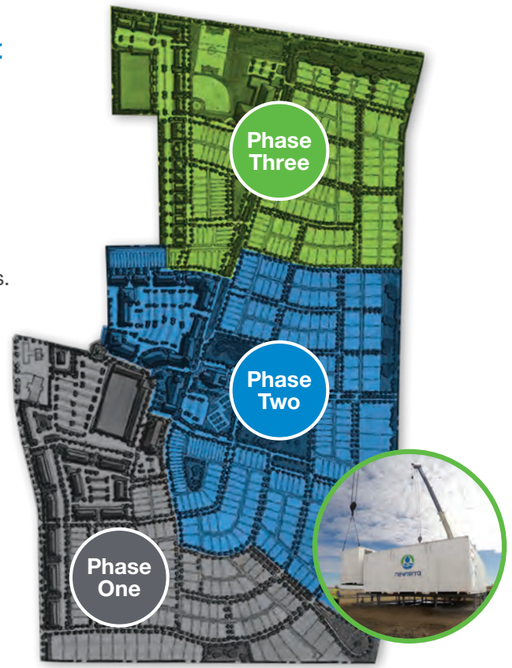
Newterra MBR wastewater systems are modular, and can be configured as fully self-contained units that can be clad with a variety of materials to blend in with surrounding structures, or integrated into new or existing treatment structures. They are built in our MET-certified manufacturing facility and have UL electrical certification.

Newterra systems can be clad to blend in with their surroundings *(above)*, or be loose-shipped for use with inground tanks and buildings *(inset, right)*.

Add Infrastructure with Each Phase of a Project

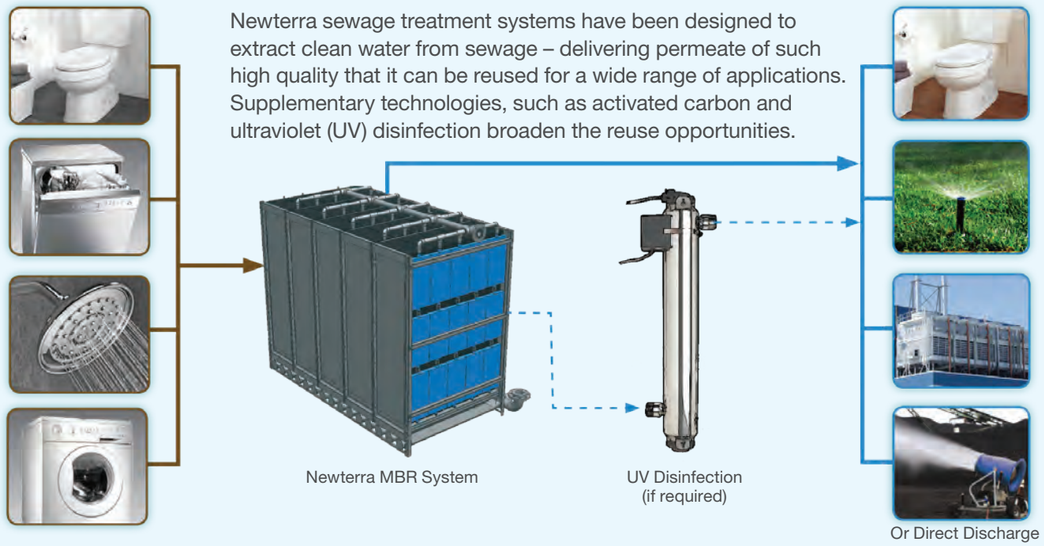
Our modular, scalable treatment technology allows you to phase in wastewater infrastructure in parallel with the treatment demands of your development. Newterra MBR systems can handle high loads, and are very resilient to flow and loading fluctuations. They are also extremely space efficient – reducing land requirements and providing more options of where the plant can be located. Newterra systems can be loose-shipped or pre-manufactured, and we offer you the option of renting or leasing to minimize your initial capital expenditures.





Sewage Treatment That Offers A Wide Range of Reuse Applications

Newterra sewage treatment systems have been designed to extract clean water from sewage – delivering permeate of such high quality that it can be reused for a wide range of applications. Supplementary technologies, such as activated carbon and ultraviolet (UV) disinfection broaden the reuse opportunities.



Compact, Operator-Friendly & Sustainable

Designed & Built for Minimal Maintenance

Newterra MBR systems are field proven in some of the most extreme conditions on the planet. Feedback from operators has been a key ingredient in the development and refinement of our low maintenance solutions:

- Intuitive, user-friendly controls and instrumentation
- Built-in telemetry & remote monitoring reduce plant visits by operator
- Air scouring & periodic membrane relaxation minimize CIP requirements
- Built-in redundancy to eliminate downtime
- Proven in a wide range of regions, climates and altitudes

Ambient Temperatures	High Altitudes
-40˚F to +104˚F	13,125 ft.
-40˚C to +40˚C	4,000 m

*Integrated cellular telemetry and our **SiteLink**™ technology allow 24/7 monitoring and operation by your staff, and proactive troubleshooting by our technical team*

Cost-Effective for New Facilities & Retrofits

At Newterra, we offer both custom-designed and pre-engineered, packaged MBR treatment systems for new facilities. Our technology is also very well suited to retrofitting conventional BNR and ENR plants to comply with higher regulatory standards or expand capacity. Newterra MBR modules can be easily incorporated into existing clarification tanks – more than tripling plant capacity within the current footprint and eliminating the need for costly infrastructure expansion.

A Global Water Technology Leader

Newterra is recognized as a leader in the development of modular treatment solutions for water, sewage, wastewater and groundwater remediation for industrial, municipal, land development, commercial & residential markets. Our heritage of innovation in providing clean water solutions dates all the way back to 1863. Over that time, Newterra has grown to over 200 people and we've installed thousands of treatment systems – some of which operate in the most extreme conditions on the planet.

Full Control from Start to Finish

At Newterra, we take full control of virtually every aspect of the treatment systems we build – from process design and engineering to manufacturing, installation, operations and ongoing parts & service support. That also includes manufacturing our own MicroClear® UF membranes in Newterra's ISO 9001:2008 certified facility. This award-winning approach ensures Newterra treatment systems meet our high standards for quality and on-time delivery.

200+ Employees

40+ Professional Engineers

10,000+ Installations Worldwide

newterra®
clean water. modular solutions. *simple.*

BEST MANAGED COMPANIES Platinum member

2015 Global Challenger 100

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ISAM™

INTEGRATED SURGE ANOXIC MIX

Proven Technology

FLUIDYNE'S ISAM™ IS A TOTAL TREATMENT SYSTEM

incorporating BOD, TSS and nitrogen removal along with sludge reduction in an integrated system. Raw (crude) sewage enters a covered anaerobic reactor for pretreatment, sludge thickening and sludge destruction. Complex organic solids undergo hydrolysis to simpler soluble organics which pass to the surge anoxic mix (SAM™) tank.

FLUIDYNE

The Experienced Leader in Wastewater Treatment Technology

fluidynecorp.com

319.266.9967

A TOTALLY NEW CONCEPT IN SBR DESIGN

FLUIDYNE ISAM™

In operation, all influent flow enters the anaerobic basin where influent solids are allowed to settle much like a primary clarifier. Elimination of primary solids in the anaerobic basin allows for much smaller SBR basins at equivalent SRT than conventional SBRs. The anaerobic selector also creates soluble carbon as a food source for biological nutrient removal through anaerobic conversion of settleable BOD to soluble BOD. The influent then flows to the SAM™ surge basin, or influent equalization basin. The surge basin provides flow and nutrient equalization to optimize treatment at the full range of flows and loadings.

100% ON-LINE STANDBY EQUIPMENT

Fluidyne's prepackaged ISAM SBRs are furnished with spare mixing/fill pump and aerator assembly installed for 100% redundancy.

REDUCES WASTE SLUDGE BY 75%

The Fluidyne ISAM™ Sequencing Batch Reactor incorporates an anaerobic selector chamber with the SAM™ SBR. The anaerobic selector not only provides consistent phosphorous removal by subjecting the recirculated biomass to anaerobic conditions, forcing the release of phosphorous, but also creates soluble carbon as a food source for phosphorous removal through anaerobic conversion of settleable BOD to soluble BOD. Additionally, anaerobic sludge digestion occurs in the anaerobic selector chamber, reducing waste solids production by up to 75% for the entire secondary process.

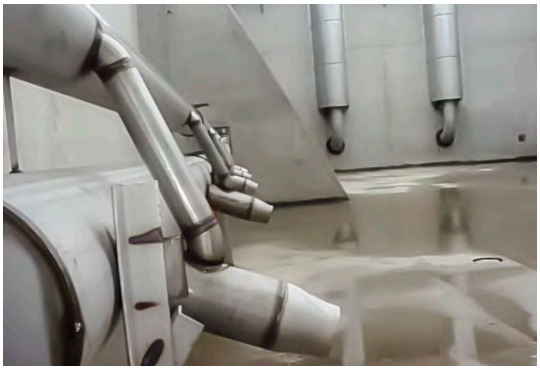
SEVERAL UNIQUE FEATURES

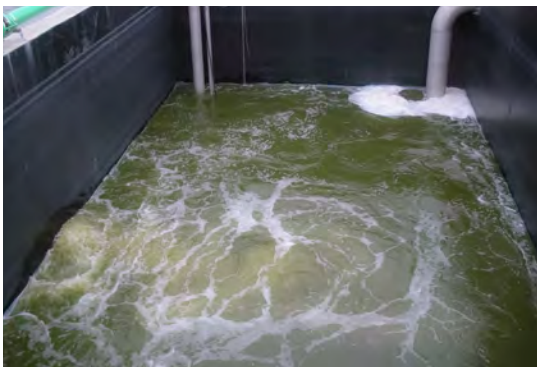
Several unique feature of the Fluidyne ISAM™ SBR include odor control and scum skimming. Mixed liquor is maintained in the SAM™ tank to immediately react with incoming flow from the anaerobic chamber to suppress odors and initiate and accelerate carbon and nitrogen reactions. Mixed liquor is recycled from the top of the SBR tank effectively removing scum by use of proprietary flow and scum control system. In addition, nitrates are recycled to the SAM™ tank for effective and rapid denitrification. Denitrification reactions are accelerated in the presence of the unreacted carbon from the raw sewage entering the SAM™ tank. Aeration and energy requirements are reduced as nitrates are fully reduced to nitrogen gas in the SAM™ tank.

EXPERIENCED LEADER IN
SEQUENCING BATCH REACTOR TECHNOLOGY

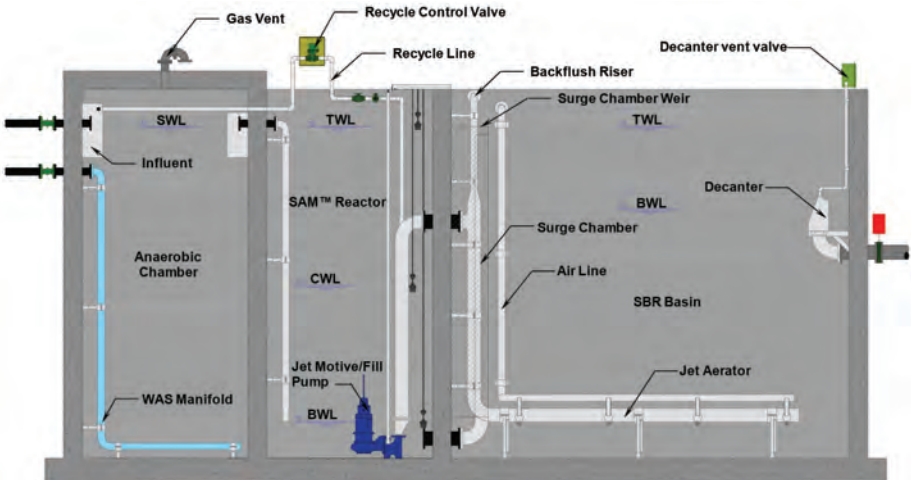
BENEFITS:

- Easy to operate and maintain
- Reduced operation and maintenance cost
- SBR basin has no moving parts that require maintenance.
- Power usage is controlled through the Fluidyne control panel
- Covered anaerobic selector chamber for odor control
- More flexible than continuous flow plants
- ISAM performs consistently regardless of influent flow changes
- Ability to handle highly variable flows and loading. Built in flow equalization is provided in the SAM™ reactor to handle peak hourly flows
- Built in sludge reduction system
- Aeration and mixing can automatically be adjusted to optimize power and prohibit filamentous growth
- Process utilizes quiescent settle and decant periods
- Small footprint with no digesters, secondary clarifiers,RAS piping and pumping
- Produces the highest quality effluent (Typical Fluidyne ISAM™ facilities are achieving less than 10 mg/L BOD5 and TSS, less than 1 mg/L NH3-N, less than 7 mg/L total N, and less than 2 mg/L phosphorus)
- Automatic scum skimming prior to effluent discharge provides highest quality effluent
- Easily expandable by adding additional flow trains



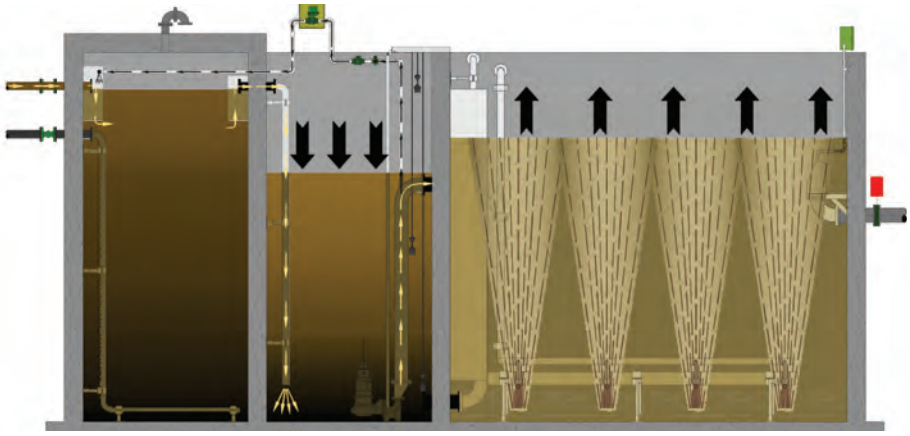


System Components:



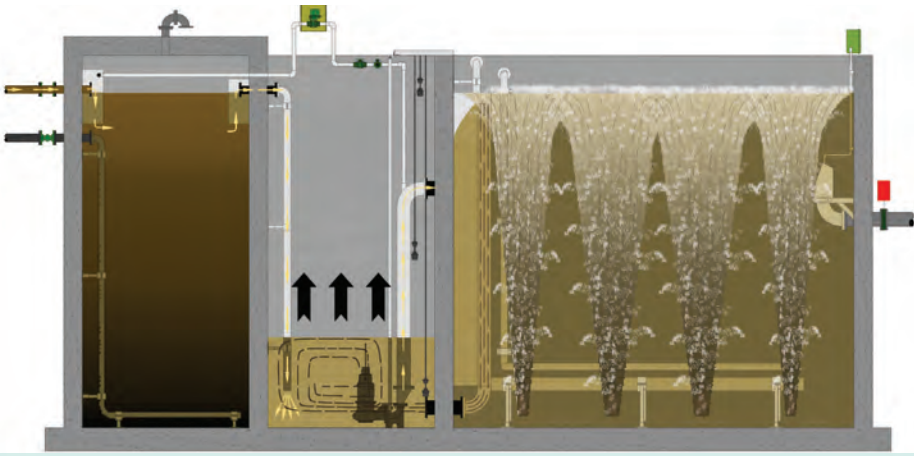
Influent continuously enters the anaerobic chamber where solids settle. Settleable BOD is converted to soluble BOD. BOD is reduced by 30% and solids are reduced by 60%. The influent then flows to the SAM™ reactor. Mixed liquor is maintained in the SAM™ reactor to suppress orders and initiate and accelerate carbon and nitrogen reduction.

Fill Phase:

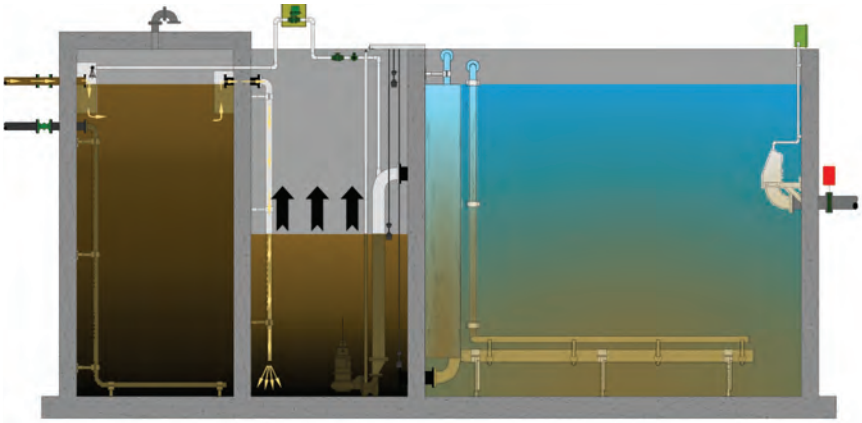


When the level in the SAM™ reactor reaches a predetermined “control level” the motive liquid pump is started. The SBR basin is filled and mixed. A percentage of the pumped flow is returned to the anaerobic chamber where biological solid settle. Settled solids in the anaerobic chamber are digested.

Interact Phase:

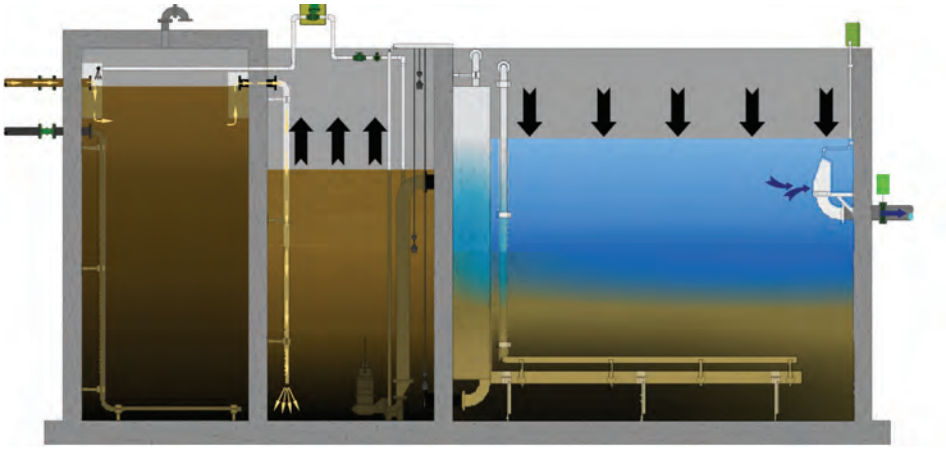


When the level in the SBR reaches TWL, nitrified mixed liquor overflows the surge chamber weir and is returned to the SAM™ chamber to mix and react with the raw influent. Aeration is cycled on and off to provide the required oxygen. Denitrification is reliable and complete. Scum is also removed from the SBR basin.



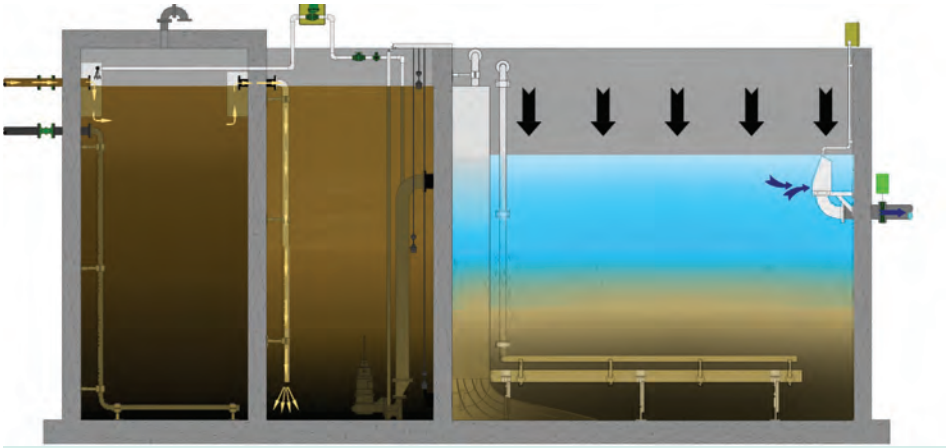
Settle Phase:

When the level in the SAM™ reactor again reaches “control level” aeration is discontinued and the SBR basin settles under perfect quiescent conditions.



Decant Phase:

When the settle timer expires, the decant valve is open and treated effluent is withdrawn from the upper portion of the SBR basin by means of a fixed solids excluding decanter.



Filled Decant Phase:

If, during peak flow events, the SAM™ reactor reaches TWL before the decant phase ends, influent flows in a reverse direction through the surge return line and overflows the surge chamber secondary weir and is diffused into the settled sludge at very low velocity as the decant phase continues.

FLUIDYNE

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THE EXPERIENCED LEADER IN WASTEWATER TREATMENT TECHOLOGY

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FLUIDYNECORP.COM

GROUND
ENGINEERING

Geotechnical Evaluation
Argo Upper Landing
Wastewater Treatment Plant
Idaho Springs, Colorado

Prepared For:

The Mighty Argo Cable Car, LLC

29025 A Upper Bear Creek Road
Evergreen, Colorado 80439

Attention: Mr. Bryan McFarland

Job Number: 20-3071 **December 15, 2020**

41 Inverness Drive East | Englewood, CO 80112 | (303) 289-1989 | **www.groundeng.com**
ENGLEWOOD | COMMERCE CITY | LOVELAND | GRANBY | GYPSUM

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical evaluation performed by GROUND Engineering Consultants, Inc. (GROUND) for the proposed wastewater treatment plant at the Argo Upper Landing near Idaho Springs, Colorado. Our study was conducted in general accordance with GROUND's Proposal No. 2010-1955 Revised, dated October 20, 2020.

A field exploration program was conducted to obtain information about the subsurface conditions. Material samples obtained during the subsurface exploration were tested in the laboratory to provide data on the engineering characteristics of the on-site soils. The results of the field exploration and laboratory testing are presented herein.

In addition to the information subsurface exploration program, information from prior reports for the Argo Mill Redevelopment project was used in the development this report. Specifically, data from our initial geotechnical parameters report for the upper landing dated February 11, 2020[1] and our geologic hazard evaluation dated September 22, 2020.[2]

This report has been prepared to summarize the data obtained and to present our findings and conclusions based on the proposed development/improvements and the subsurface conditions encountered. Design parameters and a discussion of engineering considerations related to the proposed improvements are included herein. This report should be understood and utilized in its entirety; specific sections of the text, drawings, graphs, tables, and other information contained within this report are intended to be understood in the context of the entire report. This includes the *Closure* section of the report which outlines important limitations on the information contained herein.

This report was prepared for design purposes of The Mighty Argo Cable Car, LLC, based on our understanding of the project at the time of preparation of this report. The data, conclusions, opinions, and geotechnical parameters provided herein should not be construed to be sufficient for other purposes, including the use by contractors, or any other parties for any reason not specifically related to the design of the project. Furthermore,

[1] GROUND Engineering, Inc., 2020, *Initial Geotechnical Parameters, Argo Mine Redevelopment, Upper Landing, Idaho Springs, Colorado*, Job Number: 19-3068 B, prepared for Mighty Argo Denali Holdings, LLC dated February 11.
[2] GROUND Engineering, Inc., 2020, *Argo Mill Redevelopment, Aerial Tramway Alignment, Idaho Springs, Colorado*, Job Number: 19-3070, prepared for Mighty Argo Cable Car, LLC, dated September 22.

the information provided in this report was based on the exploration and testing methods described below. Deviations between what was reported herein and the actual surface and/or subsurface conditions may exist, and in some cases, those deviations may be significant.

PROPOSED CONSTRUCTION

We understand that proposed construction will include the construction of two, approximately 33-foot diameter, water storage tanks and one, approximately 900-square foot water treatment building. We anticipate that structural loads will be relatively moderate to high, and that a ring foundation with a steel bottom is planned for the tanks. Additionally, we understand that portions of the tanks and/or the treatment building may be at least partially below grade and that grade changes will be on the order of on the order of 5 to 10 feet to achieve project lines and grades. Some of this grading was being performed under the direction of The Mighty Argo Cable Car, LLC during our subsurface exploration.

If the proposed construction differs significantly from that described above, GROUND should be notified to re-evaluate our conclusions and parameters.

Performance Expectations Based on our experience with similar facilities in the project area, we assume that post-construction, tank foundation movements on the order of 1 to 2 inches are acceptable to, and anticipated by the owner, as are the resultant distress and maintenance measures. GROUND will be available to discuss the risks and remedial approaches outlined in this report, as well as other potential approaches, upon request, if post-construction movements of these magnitudes are not acceptable and anticipated.

SITE CONDITIONS

At the time of our subsurface exploration, the site was a largely undeveloped hillslope with about 25 feet of relief across the project area. The grades at the site ranged from relatively gentle to somewhat steep with some of the temporary cuts of the earthwork operations being vertical or near vertical. Relatively large boulders, up to about 3 to 5 feet in diameter, were observed on the hillslope and in the project cuts though larger boulder may be present at the site. The hillslope was relatively well vegetated with mature trees, grasses, shrubs, and weeds. Gneiss, felsic intrusions, and colluvial and residual soils were observed in the site cuts.

The surrounding area was largely undeveloped, though former and current mine workings were observed in the greater project area.

SUBSURFACE EXPLORATION

Subsurface exploration for the project was conducted in November of 2020. A total of 2 test holes were drilled with a conventional, buggy-mounted drilling rig advancing 6-inch outer diameter, hollow stem auger and NX wireline coring equipment to evaluate the subsurface conditions as well as to retrieve samples for laboratory testing and analysis for this scope. The test holes were advanced within or near the approximate future water tanks and treatment plant footprints. The test holes were advanced to depths of approximately 20 and 21 feet below existing grade. A GROUND engineer directed the subsurface exploration, logged the borings in the field, and prepared the samples for transport to our laboratory.

Samples of the subsurface materials were retrieved with a 1⅜-inch I.D. Standard Penetration Test sampler and NX wireline coring equipment. The Standard Penetration Test sampler was driven into the substrata with blows from a 140-pound hammer falling 30 inches, in general accordance with the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values, when properly evaluated, indicate the relative density or consistency of soils. Depths at which the samples were obtained and associated penetration resistance values are shown on the test hole logs.

The approximate locations of the test holes are shown in Figure 1. Summary logs of the test holes are provided in Figure 2. A legend and notes are provided in Figure 3. Detailed logs of test holes are provided in Appendix A. Detailed logs of the core runs are presented in Appendix B.

LABORATORY TESTING

Samples retrieved from our borings were examined and visually classified in the laboratory by the project engineer. Laboratory testing of soil samples included standard property tests, such as natural moisture contents, grain size analyses, and Atterberg limits. Unconfined compressive strength and water-soluble sulfate tests were completed on selected samples, as well. Laboratory tests were performed in general accordance with applicable ASTM protocols. Results of the laboratory testing program are summarized in Tables 1 and 2. Gradation plots are provided in Figures 4 through 7.

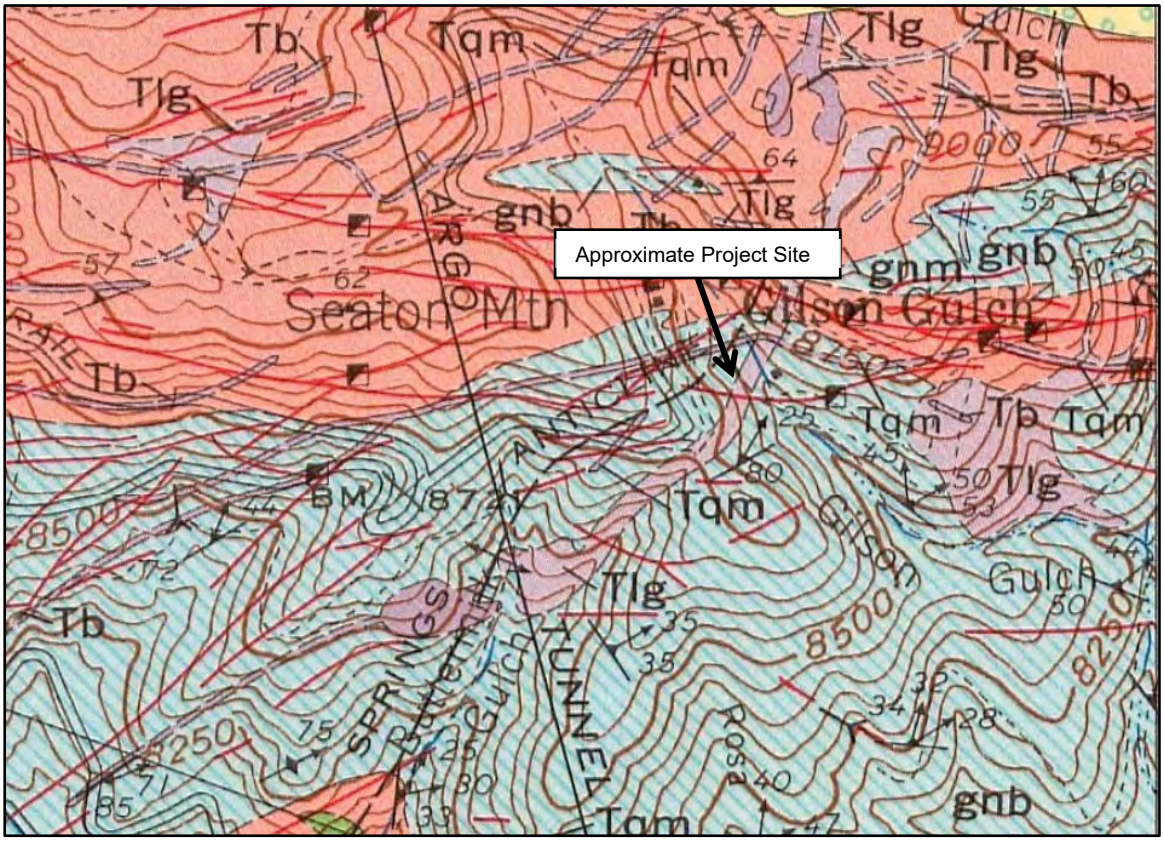
SUBSURFACE CONDITIONS

Geologic Setting Published geologic maps, e.g., Sims (1964)[3] depict the site as underlain by Tertiary Leucocratic Granodiorite Group (**Tlg**) and Precambrian Biotite Gneiss (**gnb**). A portion of that map showing the site and its vicinity is provided below.

The Leucocratic Granodiorite Group is described as including alkali syenite porphyry, albite granodiorite porphyry, and leucocratic granodiorite porphyry. These units are part of the rocks referred to collective as felsic intrusions in other reports such as the September 22, 2020 geologic hazard evaluation. The size (width) of these intrusions

[3] Sims, P.K., 1964, *Geology of the Central City quadrangle, Colorado*: U.S. Geological Survey, Geologic Quadrangle Map GQ-267, scale 1:24,000

varies locally from about ¼ inch or less to 10s of feet in the greater project area. The intrusions also include fine to very coarse grained rocks (including pegmatite).



The Sims 1964 geologic map identifies the gneiss near the project site as biotite gneiss, although other varieties of metamorphic rocks mapped including quartz feldspar gneiss, and microcline-quartz-plagioclases-biotite gneiss are also mapped in the greater project area. Gneiss is a heavily metamorphosed (deformed) rock characterized by foliation and mafic / felsic banding. The banding can be on various scales, ranging from about ¼ inch or smaller up to several feet. The foliations can create planes of weakness were relatively weaker minerals are layered together in a preferential orientation.

For the purposes of the report, the metamorphic rock underlying the project site and alignment will be referred to collectively as “gneiss.” The various intrusion will be referred to collectively as “felsic intrusions.”

As the upper several feet of these rock weather, they often develop into residuum or grus. Locally, these materials are largely similar of the alluvial and colluvial material present in the project area, and generally consisted of fine to coarse sands and gravels with varying fractions of silts and clays. These materials were commonly present at the ground surface in the project area.

Site Subsurface Conditions In general, the test holes at the tank site penetrated fill placed during the ongoing site earthwork operations. These fill soils were recognized to depths of about 3 to 4 feet below existing grade. Beneath the fill, native sands and gravels were encountered and extended to depths of about 5 and 7 feet. Beneath the sands and gravels, felsic intrusive rocks were encountered and extended to the depths explored. The upper several feet of the rock was heavily fractured and weathered.

We interpret the native soils to be colluvium and residuum (grus). We interpret the bedrock materials at the site to be felsic intrusions.

Fill soils were recognized in the test holes, near the tank locations and are likely present elsewhere on the site. Delineation of the complete lateral and vertical extents of the fills at the site and their compositions was beyond our present scope of services. If more detailed information regarding fill extents and compositions at the site are of significance, they should be evaluated using test pits.

Cobbles and boulders were present in the site excavations, fills, and natural hillslope. The cobbles and boulders generally appeared to be about 1 to 4 feet in diameter. Even larger boulders and “corestones” could be present locally in the fill and native soils and should be anticipated by the contractor and project team.

Fill consisted of silty and clayey, fine to coarse sands, gravels, and cobbles with local boulders. The fill was dry to moist, non- to slightly plastic, loose to medium dense, and light brown to brown in color.

Sands and Gravels consisted primarily of fine to coarse, clean to silty and clayey sands, gravels, and cobbles with boulders, silts, and clays. They were dry to moist, non- to slightly plastic, dense to very dense and light brown to brown in color.

Boulders about 3 to 5 feet in diameter were observed on site, and larger boulders could be encountered in project excavations.

Weathered Felsic Intrusion consisted primarily of fine to coarse grained felsic rock. It was very hard and resistant, moderately to highly fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.

Felsic Intrusion consisted primarily of fine to coarse grained felsic rock. It was very hard and resistant, slightly to moderately fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.

Groundwater was not encountered in the test holes at the time of drilling at the depths explored. The test holes were immediately backfilled due to safety concerns. Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, land use, and the development of transient, perched water conditions.

Geologic Hazards Geologic hazards and available mitigation methods were identified and discussed in our September 22, 2020 report and associated correspondences.

SEISMIC CLASSIFICATION

Based on extrapolation of available data to depth and our experience in the project area, we consider the area of the proposed addition likely to meet the criteria for a Seismic Site Classification of **C** according to the ASCE 7-16 (Table 20.3-1). (Exploration and/or shear wave velocity testing to a depth of 100 feet or more was not part of our present scope of services.) If, however, a quantitative assessment of the site seismic properties is desired, then shear wave velocity testing should be performed. GROUND can provide a fee estimate for shear wave velocity testing upon request. We consider the likelihood of achieving a Site Class B to be moderate.

Using longitude and latitude coordinates obtained from Google Earth and the Applied Technology Council's Hazard By Location Tool (https://hazards.atcouncil.org/#), the project area is indicated to possess an S_{DS} value of **0.205** and an S_{D1} value of **0.065** for the site latitude and longitude and a Site Class of C.

GEOTECHNICAL CONSIDERATIONS FOR DESIGN

The conclusions and parameters provided in this report were based on the data presented herein, our experience in the general project area with similar structures, and our engineering judgment with regard to the applicability of the data and methods of forecasting future performance. A variety of engineering parameters were considered as indicators of potential future soil movements. Our parameters and conclusions were based on our judgment of "likely movement potentials," (i.e., the amount of movement likely to be realized if site drainage is generally effective, estimated to a reasonable degree of engineering certainty) as well as our assumptions about the owner's willingness to accept geotechnical risk. "Maximum possible" movement estimates necessarily will be larger than those presented herein. They also have a significantly lower likelihood of being realized in our opinion, and generally require more expensive measures to address. We encourage The Mighty Argo Cable Car, LLC, upon receipt of this report, to discuss these risks and the geotechnical alternatives with us.

General Foundation and Floor/Bottom Types We understand that at the time of report preparation, ring foundations with a steel tank bottoms are being considered for the proposed tanks, and that a mat foundation is being considers for the proposed wastewater treatment plant. These foundation and floor/bottom systems appear to be geotechnically feasible at this site. We estimate that post-construction movements on the order 1 to 2 inches are likely were such systems to bear directly on the site earth materials. Where fill soils; loose, native soils; loose, highly fractured rock; or other unsuitable materials are exposed at foundation bearing elevation, then those materials should be removed and replaced with a section of **CDOT Class 5 or 6 Aggregate Base Course extending to a depth of 2 feet below the foundation bearing elevation or with dental concrete.** If this approach is implemented effectively, then we estimate that likely-post-construction foundation movements will be on the order of 1 inch or less, with differential movements of about ½ inch across a tank.

Where a ring foundation is used, then the tank bottom should bear on a leveling section of **6 to 12 inches of CDOT Class 5 or 6 Aggregate Base Course**, depending on the irregularity of the excavated surface.

It is important that each tank and the wastewater treatment plant have uniform support conditions across its entire diameter / width and beyond. For example, where a portion of a structure is supported directly on the rock (or dental concrete placed on rock) unless bearing elevation can be lowered so that all of the foundation bears directly on the rock (or dental concrete) then all of the foundation should bear on 2 feet of properly compacted aggregate base course, even this requires excavation of rock beneath portions of the foundation.

If the proposed post-construction movements, are not acceptable, then the proposed structures should bear completely on bedrock or utilize a micropile foundation system. Where the proposed improvement bear direction on the bedrock or utilize a micropile foundation, we estimate that post-construction movements will be on the order of ½ inch or possibly less in the case of micropiles.

SHALLOW TANK FOUNDATIONS

The geotechnical parameters below may be used for design of shallow foundations for the proposed tanks.

Geotechnical Parameters for Shallow Foundation Design

1) As discussed in the *Geotechnical Considerations for Design* section of this report a shallow foundation should bear entire on one of:

   a. Firm undisturbed native soils.

      OR

   b. A properly compacted fill section consisting of CDOT Class 5 or 6 Aggregate Base Course. The aggregate base course section should extend at full depth at least 4 feet laterally beyond the tank foundation perimeter.

      OR

   c. On firm, intact bedrock and/or “dental” concrete.

Where loose, soft, severely fractured or otherwise unsuitable materials are exposed at foundation bearing elevation, they should be excavated and replaced with 'dental' concrete.

Likewise, where the excavated surface is irregular or deepened due to removal of a coarse fragment of bedrock, the material should be replaced with 'dental' concrete.

The contractor should provide survey data of the excavation beneath the tank indicating the depth and lateral extents of the remedial excavation.

A professional geologist or professional engineer should be retained to observe the surfaces on which the footings will bear. The exposed surfaces should be approved prior to placement of reinforcing steel or footing concrete.

2) A ring foundation bearing on firm, native soils; a fill section consisting CDOT Class 5 or 6 Aggregate Base Course; firm, or intact bedrock or 'dental' concrete may be designed for an allowable soil bearing pressure of **5,000 psf** for footings up to **8 feet in width**.

A mat foundation bearing on firm, native soils; a fill section consisting CDOT Class 5 or 6 Aggregate Base Course; firm, or intact bedrock or 'dental' concrete may be designed for an allowable soil bearing pressure of **2,500 psf.**

This value may be increased by ⅓ for transient loads such as wind or seismic loading. For larger footings, a lower allowable bearing pressure may be appropriate.

To reduce differential settlements between footings or along continuous footings, footing loads should be as uniform as possible. Differentially loaded footings will settle differentially.

If foundation soils are subjected to an increase/fluctuation in moisture content, however, the effective bearing capacity will be reduced and greater post-construction movements than those estimated above may result.

3) An allowable vertical modulus of subgrade reaction (**Kv**) of **160 tcf** (185 pci) may be used for design of a concrete, mat foundation bearing on or firm, native soils or properly compacted section of CDOT Class 5 or 6 Aggregate Base Course.

   An allowable vertical modulus of subgrade reaction (**Kv**) of **500 tcf** (578 pci) may be used for design of a concrete, mat foundation bearing on firm, intact bedrock or 'dental' concrete.

   These values are for a 1-foot x 1-foot plate; they should be adjusted for slab dimension.

4) Spread footings should have a minimum lateral dimension of **16 or more inches** for linear strip footings including ring footings. Actual footing dimensions should be determined by the structural engineer.

5) Footings should bear at an elevation **4 or more feet** below the lowest adjacent exterior finish grades to have adequate soil cover for frost protection.

6) Foundations should be set back **at least 10 feet** horizontally from all slopes faces.

7) Continuous foundation walls should be reinforced as designed by a structural engineer to span an unsupported length of at least **10 feet**.

8) Geotechnical parameters for lateral resistance to foundation loads are provided in the *Lateral Loads* section of this report.

9) Connections of all types must be flexible and/or adjustable to accommodate the anticipated, post-construction movements of the structure.

Shallow Foundation Construction

10) The contractor should take adequate care when making excavations not to compromise the bearing or lateral support for nearby improvements.

11) Care should be taken when excavating the foundations to avoid disturbing the supporting materials particularly in excavating the last few inches.

12) Footing excavation bottoms may expose loose, organic, or otherwise deleterious materials, including debris. Firm materials may become disturbed by the excavation process. All such unsuitable materials should be excavated and replaced with properly compacted fill or the foundation deepened.

13) Foundation-supporting soils may be disturbed or deform excessively under the wheel loads of heavy construction vehicles as the excavations approach footing bearing levels. Construction equipment should be as light as possible to limit development of this condition. The movement of vehicles over proposed foundation areas should be restricted.

14) All foundation subgrade should be compacted prior to placement of concrete.

15) Fill placed against the sides of the footings should consist of CDOT Class 5 or 6 Aggregate Base Course, placed and compacted in accordance with the *Project Earthwork* section of this report.

TANK BOTTOM SYSTEMS

If the tank will be supported on a shallow, ring foundation, then the following geotechnical parameters may be used for design of a steel or concrete tank bottom:

1) The tank bottom should bear on a leveling course of at least **6 to 12 inches** of properly compacted CDOT Class 6 Aggregate Base Course. Parameters for fill placement and compaction are provided in the *Project Earthwork* section of this report.

2) An allowable vertical modulus of subgrade reaction (**Kv**) of **160 tcf** (185 pci) may be used for design of a tank bottom bearing on a properly compacted section of CDOT Class Aggregate Base Course, as discussed in the *Geotechnical Considerations for Design* section of this report.

   These values are for a 1-foot x 1-foot plate; they should be adjusted for slab dimension.

LATERAL LOADS

Shallow Foundations Resisting Lateral Loads Values for equivalent fluid pressures and the coefficient for frictional resistance to sliding are provided below. These values were based on a moist unit weight (γ') of 130 pcf and an angle of internal friction (ϕ) of 33 degrees for site soils, and a γ' of 140 pcf and a ϕ of 36 degrees for CDOT Class 5 or 6 Aggregate Base Course, and are unfactored. Appropriate factors of safety should be included in design calculations.

EQUIVALENT FLUID WEIGHTS (DRAINED CONDITION)

Backfill Material	Condition			Friction Coefficient
	Active	At-Rest	Passive	
Native Soils and Fill Re-Worked as Properly Compacted Fill	**39 pcf**	**59 pcf**	**400 psf** (to a maximum of 4,000 psf)	**0.43**
Select Granular Fill (CDOT 5 or 6 Aggregate Base Course)	**37 pcf**	**58 pcf**	**500 psf** (to a maximum of 5,000 psf **-**	**0.48**

WATER-SOLUBLE SULFATES

The concentrations of water-soluble sulfates measured in a selected sample of site soils was approximately 0.01 percent. (See Table 1.) Such concentrations of soluble sulfates represent a **negligible** environment for sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the “Design and Control of Concrete Mixtures,” published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding scale with four classes of severity of sulfate exposure (Class 0 to Class 3) as described in the table below.

REQUIREMENTS TO PROTECT AGAINST DAMAGE TO
CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE

Severity of Sulfate Exposure	**Water-Soluble Sulfate ($SO_4^=$) In Dry Soil** *(%)*	**Sulfate (SO_4) In Water** *(ppm)*	**Water Cementitious Ratio** *(maximum)*	**Cementitious Material Requirements**
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Our test result does not meet PCA and CDOT guidelines for the use of sulfate-resistant cement concrete exposed to site soil. However, elevated concentrations, up to about 2.2 percent by weight have been, been measured in the greater project area. Therefore, sulfate resistant cement, conforming to one of the following Class 3 requirements, should be considered for project cement, especially were waste rock is used as fill.

(1) A blend of Portland cement meeting ASTM C 150 Type II, III, or V with a minimum of a 20 percent substitution of Class F fly ash by weight, where the blend has less than 0.10 percent expansion at 18 months when tested according to ASTM C 1012.

(2) ASTM C 1157 Type HS having less than 0.10 percent expansion at 18 months when tested according to ASTM C 1012. Class C fly ash shall not be substituted for cement.

(3) ASTM C 1157 Type MS or HS plus Class F fly ash where the blend has less than 0.10 percent expansion at 18 months when tested according to ASTM C 1012.

(4) ASTM C 595 Type IP(HS) having less than 0.10 percent expansion at 18 months when tested according to ASTM C 1012. Class C fly ash shall not be substituted for cement.

When fly ash is used to enhance sulfate resistance, it shall be used in a proportion greater than or equal to the proportion tested in accordance to ASTM C 1012, shall be the same

source and it shall have a calcium oxide content no more than 2.0 percent greater than the fly ash tested according to ASTM C 1012.

All concrete used should have a minimum compressive strength of 5,000 psi.

The contractor should be aware that certain concrete mix components affecting sulfate resistance including, but not limited to, the cement, entrained air, and fly ash, can affect workability, set time, and other characteristics during placement, finishing and curing. The contractor should develop mix(es) for use in for project concrete which are suitable with regard to these construction factors, as well as sulfate resistance. A reduced, but still significant, sulfate resistance may be acceptable to the owner, in exchange for desired construction characteristics.

PROJECT EARTHWORK

The earthwork criteria below are based on our interpretation of the geotechnical conditions encountered in the borings and prior test holes. Where these criteria differ from applicable municipal specifications, e.g., for trench backfill compaction along a public utility line, the latter should be considered to take precedence.

General Considerations Project grading should be performed as early as possible in the construction sequence to allow settlement of fills and surcharged ground to be realized to the greatest extent prior to subsequent construction.

Prior to earthwork construction, existing construction debris, vegetation, and other deleterious materials should be removed and disposed of off-site. Relic underground utilities should be abandoned in accordance with applicable regulations, removed as necessary, and properly capped.

Use of Existing Fill Soils Fill materials were not encountered in the test holes during subsurface exploration. Should fill soils be encountered during project excavations, they should be sampled and tested with regard to reuse. Some fill soils that could be encountered may not be suitable for re-use as compacted fill, due to the presence of deleterious materials such as trash, organic material, coarse cobbles and boulders, or construction debris. Excavated fill materials should be evaluated and tested, as appropriate, with regard to re-use.

Use of Existing Native Soils Based on the samples retrieved from the test holes, we anticipate that the existing site soils free of organic materials, coarse cobbles, boulders (boulders up to about 7 feet in diameter were observed at the site), or other deleterious materials will be suitable, in general, for re-use as compacted fill for general fills. (They are not suitable as fill to support the tank, however.)

Fragments of rock and cobbles, (as well as inert construction debris, e.g., concrete or asphalt) up to **6 inches** in maximum dimension may be included in project fills, in general. Such materials should be evaluated on a case-by-case basis where identified during earthwork.

Imported Fill Materials Materials imported to the site as (common) fill should be free of organic material, and other deleterious materials. Imported material should exhibit **less than 15 percent** passing the No. 200 Sieve, a maximum particle size of 6 inches, and a plasticity index of **10 or less**.

Fill imported as aggregate base course should meet the criteria for **CDOT Class 5 or 6 Aggregate Base Course**.

Materials proposed for import should be approved prior to transport to the site.

Fill Platform Preparation Prior to filling, the top **12 inches** of in-place materials on which fill soils will be placed (except for utility trench bottoms where bedding will be placed) should be scarified, moisture conditioned and properly compacted in accordance with the criteria below to provide a uniform base for fill placement.

If surfaces to receive fill expose loose, wet, soft, or otherwise deleterious material, additional material should be excavated, or other measures taken to establish a firm platform for filling. A surface to receive fill must be effectively stable prior to placement of fill, including trench bottoms prior to placement of bedding.

General Considerations for Fill Placement Fill soils should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted.

No fill materials should be placed, worked, rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Where soils on which foundation elements will be placed are exposed to freezing temperatures or repeated freeze – thaw cycling during construction – commonly due to water ponding in foundation excavations – bearing capacity typically is reduced and/or settlements increased due to the loss of density in the supporting soils. After periods of freezing conditions, the contractor should re-work areas affected by the formation of ice to re-establish adequate bearing support.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. Materials that are not properly moisture conditioned may exhibit significant pumping, rutting, and deflection at moisture contents near optimum and above. The contractor should be prepared to handle soils of this type, including the use of chemical stabilization, if necessary.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the specified ranges are obtained.

Compaction Criteria All soils placed as fill should be compacted to **95 or more percent** of the maximum dry density at moisture contents **within 2 percent** of the optimum moisture content as determined by ASTM D1557, the 'modified Proctor.'

Use of Squeegee Relatively uniformly graded fine gravel or coarse sand, i.e., "squeegee," or similar materials commonly are proposed for backfilling foundation excavations, utility trenches (excluding approved pipe bedding), and other areas where employing compaction equipment is difficult. In general, this procedure should not be followed for the following reasons.

Although commonly considered "self-compacting," uniformly graded granular materials require densification after placement, typically by vibration. The equipment to densify these materials is not available on many job-sites.

Even when properly densified, uniformly graded granular materials are permeable and allow water to reach and collect in the lower portions of the excavations backfilled with

those materials. This leads to wetting of the underlying soils and resultant potential loss of bearing support as well as increased local heave or settlement.

Wherever possible, excavations should be backfilled with approved, on-site soils placed as properly compacted fill. Where achieving adequate compaction is difficult, then Controlled Low Strength Material" (CLSM), i.e., a lean, sand-cement slurry ("flowable fill") or a similar material should be used for backfilling.

Where "squeegee" or similar materials are proposed for use by the Contractor, the design team should be notified by means of a Request for Information (RFI), so that the proposed use can be considered on a case-by-case basis. Where "squeegee" meets the project requirements for pipe bedding material, however, it is acceptable for that use.

Settlements Settlements will occur in newly filled ground, typically on the order of 1 to 2 percent of the fill depth. This is separate from settlement of the existing soils left in place. For a 6-foot fill, for example, that corresponds to a total settlement of about 1 inch. If fill placement is performed properly and is tightly controlled, in GROUND's experience the majority (on the order of 60 to 80 percent) of that settlement typically will take place during earthwork construction, provided the contractor achieves the compaction levels indicated herein. The remaining potential settlements likely will take several months or longer to be realized, and may be exacerbated if these fills are subjected to changes in moisture content.

Cut and Filled Slopes Permanent, graded slopes supported by local soils up to **10 feet** in height should be constructed no steeper than **2 : 1** (horizontal : vertical) without slope-specific stability analyses. (The existing slopes at steeper angles exhibited relatively low factors of safety.) Minor raveling or surficial sloughing should be anticipated on slopes cut at this angle until vegetation is well re-established. Surface drainage should be designed to direct water away from slope faces into designed drainage pathways or structures.

Steeper slope angles and heights may be possible but will require detailed slope stability analysis based on final proposed grading plans. A geotechnical engineer should be retained to evaluate this on a case-by-case basis.

EXCAVATION CONSIDERATIONS

Excavation Difficulty Test holes for the subsurface exploration were advanced to the depths indicated on the boring and test hole logs by means of conventional, track-mounted, geotechnical drilling equipment continuous flight augers and wireline coring techniques. As noted elsewhere in the report very large boulders, up to about 5 feet in diameter, were noted on the hillslope at the site and boulders, about 5 feet in diameter, were noted in the project cuts and fills. Very high penetration resistance values, e.g., 50 blows for 2 inches, 50 blows for 0 inches of penetration, etc., were logged in as well. The contractor and project team should be prepared to handle and process very large cobbles and boulders. Some of these materials may not be suitable to for use in some project fills. Additionally, very hard and resistant masses of crystalline rock appear to be present at the tank site and the contractor should be prepared to excavate, handle, process, and export such materials, as necessary. The use of specialized, very heavy duty excavation equipment may be cost-effective.

Temporary Excavations and Personnel Safety Excavations in which personnel will be working must comply with all applicable OSHA Standards and Regulations, particularly CFR 29 Part 1926, OSHA Standards-Excavations, adopted March 5, 1990. The contractor's "responsible person" should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. GROUND has provided the information in this report solely as a service to The Mighty Argo Cable Car, LLC and is not assuming responsibility for construction site safety or the contractor's activities.

The contractor should take care when making excavations not to compromise the bearing or lateral support for any adjacent, existing improvements.

Temporary, un-shored excavation slopes, up to **15 feet** in height, in general, should be cut no steeper than **1¾ : 1** (horizontal : vertical) in the on-site soils in the absence of seepage. Some surface sloughing may occur on the slope faces at these angles. Should site constraints prohibit the use of the above-indicated slope angle, temporary shoring should be used. GROUND is available to provide shoring design upon request.

Groundwater and Surface Water Groundwater was not encountered in the test holes at the time of drilling. Therefore, based on conditions at the time of this subsurface

exploration, shallow excavations at the site appear unlikely to encounter groundwater except, limited volumes of perched groundwater. However, significant volumes of groundwater may be encountered seasonally, during periods of seasonal snow melt and after large precipitation events.

Should seepage or flowing groundwater be encountered in project excavations, the slopes should be flattened as necessary to maintain stability or a geotechnical engineer should be retained to evaluate the conditions. The risk of slope instability will be significantly increased in areas of seepage along excavation slopes.

The contractor should take pro-active measures to control surface waters during construction and maintain good surface drainage conditions to direct waters away from excavations and into appropriate drainage structures. A properly designed drainage swale should be provided at the tops of the excavation slopes. In no case should water be allowed to pond near project excavations.

Temporary slopes should also be protected against erosion. Erosion along the slopes will result in sloughing and could lead to a slope failure.

DRAIN/FILL PIPING INSTALLATION

The measures and criteria below are based on GROUND's evaluation of the local, geotechnical conditions. Where the parameters herein differ from applicable municipal requirements, the latter should be considered to govern.

Pipe Support The bearing capacity of the site soils appeared adequate, in general, for support of typical utility lines. The pipes + contents are less dense than the soils which will be displaced for installation. Therefore, in general GROUND anticipates no significant pipe settlements in these materials where properly bedded from loading alone.

Trench bottoms may expose existing fill soils, or soft, loose, or otherwise deleterious materials. Firm materials may be disturbed by the excavation process. All such unsuitable materials should be excavated and replaced with properly compacted fill. Where existing fill soils are left in place, locally greater pipe settlements may result, causing "bellies" in the pipes. (In the case of a pressurized water line, such deflections may be of less consequence.)

Areas allowed to pond water will require excavation and replacement with properly compacted fill. The contractor should take particular care to ensure adequate support near pipe joints which are less tolerant of extensional strains.

Where thrust blocks are needed, the parameters provided in the *Lateral Loads* section of this report may be used for design.

Trench Backfilling Some settlement of compacted soil trench backfill materials should be anticipated, even where all the backfill is placed and compacted correctly. Typical settlements are on the order of 1 to 2 percent of fill thickness. However, the need to compact to the lowest portion of the backfill must be balanced against the need to protect the pipe from damage from the compaction process. Some thickness of backfill may need to be placed at compaction levels lower than specified (or smaller compaction equipment used together with thinner lifts) to avoid damaging the pipe. Protecting the pipe in this manner can result in somewhat greater surface settlements. Therefore, although other alternatives may be available, the following options are presented for consideration:

Controlled Low Strength Material Because of these limitations, a conservative approach consists of backfilling the entire depth of the trench (both bedding and common backfill zones) with "controlled low strength material" (CLSM), i.e., a lean, sand-cement slurry, "flowable fill," or similar material along all trench alignment reaches with low tolerances for surface settlements.

CLSM used as pipe bedding and trench backfill should exhibit a 28-day unconfined compressive strength between **50 to 150 psi** so that re-excavation is not unusually difficult.

Placement of the CLSM in several lifts or other measures likely will be necessary to avoid 'floating' the pipe. Measures also should be taken to maintain pipe alignment during CLSM placement.

Compacted Soil Backfilling Where compacted soil backfilling is employed, using the site soils or similar materials as backfill, the risk of backfill settlements entailed in the selection of this higher risk alternative must be anticipated and accepted by The Mighty Argo Cable Car, LLC.

We anticipate that the on-site soils excavated from trenches will be suitable, in general, for use as common trench backfill within the above-described limitations. Backfill soils should be free of vegetation, organic debris and other deleterious materials. Fragments of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) coarser than 3 inches in maximum dimension should not be incorporated into trench backfills.

Soils placed for compaction as trench backfill should be conditioned to a relatively uniform moisture content, placed and compacted in accordance with the parameters in the *Project Earthwork* section of this report.

Pipe Bedding Pipe bedding materials, placement and compaction should meet the specifications of the pipe manufacturer and applicable municipal standards. Bedding should be brought up uniformly on both sides of the pipe to reduce differential loadings.

As discussed above, the use of CLSM or similar material in lieu of granular bedding and compacted soil backfill should be considered where the tolerance for surface settlement is low. (Placement of CLSM as bedding to at least 12 inches above the pipe can protect the pipe and assist construction of a well-compacted conventional backfill, although possibly at an increased cost relative to the use of conventional bedding.)

If granular bedding is specified, the contractor should not anticipate that significant volumes of on-site soils will be suitable for that use without significant processing. Materials proposed for use as pipe bedding should be tested for suitability prior to use.

With regard to potential migration of fines into granular pipe bedding, design and installation should follow ASTM D2321, Appendix X1.8. If the granular bedding does not meet filter criteria for the enclosing soils, then non-woven filter fabric (e.g., Mirafi® 140N, or the equivalent) should be placed around the bedding to reduce migration of fines into the bedding which can result in severe, local surface settlements. Where this protection is not provided, settlements can develop/continue several months or years after completion of the project. In addition, clay or concrete cut-off walls should be installed to interrupt the granular bedding section to reduce the rates and volumes of water transmitted along the sewer alignment which can contribute to migration of fines.

SURFACE DRAINAGE

The site soils are relatively stable with regard to moisture content – volume relationships at their existing moisture contents. Other than the anticipated, post-placement settlement of fills, post-construction soil movements will result primarily from the introduction of water into the soils underlying the proposed structure, hardscaping and pavements. Based on the site surface and subsurface conditions encountered in this study, we do not anticipate a rise in the local water table sufficient to approach grade beam or floor elevations. Therefore, wetting of the soils likely will result from infiltrating surface waters (precipitation, irrigation, etc.), and water flowing along constructed pathways such as bedding in utility pipe trenches.

The following drainage measures should be followed both for during construction and as part of project design. The facility should be observed periodically to evaluate the surface drainage and identify areas where drainage is ineffective. Routine maintenance of site drainage should be undertaken throughout the design life of the proposed facility – routine maintenance may include local fine grading or other measures so that proper drainage may be re-established. If these measures are not implemented and maintained effectively, the movement estimates provided in this report could be exceeded.

1) Wetting or drying of the under-tank and under mat foundation areas should be avoided during and after construction. Permitting increases/variations in moisture to the adjacent or supporting soils may result in increased total and/or differential movements.

2) Positive surface drainage measures away from the tank should be provided and maintained to reduce water infiltration into foundation soils. As discussed in the *Geotechnical Considerations for Design* section of this report, improved surface drainage may be important for longer-term stability of the fill slope descending from the tank pad. Underdrains should not be relied upon in surface drainage design to collect and discharge surface waters.

   A minimum slope of **12 inches in the first 10 feet** in the areas not covered with pavement or concrete slabs should be established. For areas covered with asphalt pavement or concrete slabs, slopes **should comply with ADA requirements**

where required. Increasing slopes to **a minimum of 3 percent in the first 10 feet** in the areas covered with pavement or concrete slabs will reduce, but not eliminate, the potential for moisture infiltration and subsequent volume change of the underling soils.

In no case should water be allowed to pond near or adjacent to foundation elements, hardscaping, etc.

3) Drainage also should be established and maintained to direct water away from any hardscaping as well as drain/fill pipe trench alignments which are not tolerant of increased post-construction movements.

The ground surface near foundation elements should be able to convey water away readily. Cobbles or other materials that tend to act as baffles and restrict surface flow should not be used to cover the ground surface near the foundations.

Where the ground surface does not convey water away readily, additional post-construction movements and distress should be anticipated.

SUBSURFACE DRAINAGE

As a component of project civil design, properly functioning, subsurface drain systems ("underdrains") can be beneficial for collecting and discharging saturated subsurface waters. Underdrains will not collect water infiltrating under unsaturated (vadose) conditions, or moving via capillarity, however. In addition, if not properly constructed and maintained, underdrains can transfer water into foundation soils, rather than remove it. This will tend to induce settlement of the subsurface soils, and may result in distress. Underdrains can, however, provide an added level of protection against relatively severe post-construction movements by draining saturated conditions near individual structures should they arise, and limiting the volume of wetted soil.

GROUND is available to discuss the above options and as well as other underdrain alternatives upon request.

Geotechnical Parameters for Underdrain Design Where an underdrain system is included in project drainage design, design should incorporate the parameters below. The

actual underdrain layout, outlets, and locations should be developed by a civil engineer. A typical, cross-section details of an underdrain for this project is provided in Figure 8.

An underdrain system should be tested by the contractor after installation and after placement and compaction of the overlying backfill to verify that the system functions properly.

1) An underdrain system for the tank should consist of perforated, rigid, PVC collection pipe at least **4 inches** in diameter, non-perforated, rigid, PVC discharge pipe at least **4 inches** in diameter, free-draining gravel, and filter fabric.

2) The free-draining gravel should be naturally occurring (not recycled) material with **5 percent or less** passing the No. 200 Sieve and **50 percent or more** retained on the No. 4 Sieve, and have a maximum particle size of **2 inches**.

3) Each collection pipe should be surrounded on the sides and top (only) with **6 or more inches** of free-draining gravel.

   The gravel surrounding the collection pipe(s) should be wrapped with filter fabric (Mirafi 140N® or the equivalent) to reduce the migration of fines into the drain system.

4) The underdrain system should be designed to discharge **20 gallons per minute or more** of collected water.

5) The high point(s) for the collection pipe flow lines should be below the grade beam or shallow foundation bearing elevation as shown on the detail. Multiple high points can be beneficial to reducing the depths to which the system would be installed.

   The collection and discharge pipe for the underdrain system should be laid on a slope as determined by the underdrain designer.

   Underdrain ‘clean-outs’ should be provided at intervals of no more than **150 feet** to facilitate maintenance of the underdrains. Clean-outs also should be provided at collection and discharge pipe elbows of **60 degrees or more**.

6) The underdrain discharge pipes should be connected to one or more sumps from which water can be removed by pumping, or to outlet(s) for gravity discharge. We suggest that collected waters be discharged directly into the storm sewer system, if possible.

7) Regular maintenance of the underdrain systems should be performed to insure that the system continues work properly.

CLOSURE

Geotechnical Review The author of this report or a GROUND principal should be retained to review project plans and specifications to evaluate whether they comply with the intent of the measures discussed in this report. The review should be requested in writing.

The geotechnical conclusions and parameters presented in this report are contingent upon observation and testing of project earthwork by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the parameters in this report, or by providing alternative parameters.

Materials Testing The Mighty Argo Cable Car, LLC should consider retaining a geotechnical engineer to perform materials testing during construction. The performance of such testing or lack thereof, however, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of his work; furthermore, testing by the geotechnical engineer does not preclude the contractor from obtaining or providing whatever services that he deems necessary to complete the project in accordance with applicable documents.

Limitations This report has been prepared for The Mighty Argo Cable Car, LLC as it pertains to design of the proposed wastewater treatment plant as described herein. It should not be assumed to contain sufficient information for other parties or other purposes, such as the development of the other buildings of the upper landing facility. The Mighty

Argo Cable Car, LLC has agreed to the terms, conditions, and liability limitations outlined in the proposal between The Mighty Argo Cable Car, LLC and GROUND. Reliance upon our report is not granted to any other potential owner, contractor, or lender. Requests for third-party reliance should be directed to GROUND in writing; granting reliance by GROUND is not guaranteed.

In addition, GROUND has assumed that project construction will commence by fall 2021. Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical conclusions in this report may be re-evaluated and, as necessary, modified.

The geotechnical conclusions in this report were based on subsurface information from a limited number of exploration points, as shown in Figure 1, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration. In addition, a contractor who obtains information from this report for development of his scope of work or cost estimates does so solely at his own risk and may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor should obtain the additional geotechnical information that is necessary to develop his workscope or cost estimates with sufficient precision. This includes, but is not limited to, information regarding excavation conditions, earth material usage, current depths to groundwater, etc. Because of the necessarily limited nature of the subsurface exploration performed for this study, the contractor should be allowed to evaluate the site using test pits or other means to obtain additional subsurface information to prepare his bid.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, a geotechnical engineer should be retained at once, so that our conclusions for this site may be reevaluated in a timely manner and dependent aspects of project design can be modified, as necessary.

The materials encountered on-site were stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content.

Performance of the proposed structure and pavement will depend on implementation of the measures outlined in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by the The Mighty Argo Cable Car, LLC.

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this report, as well as the estimated performance (and limitations with any such estimations) of proposed improvements are understood by The Mighty Argo Cable Car, LLC. Utilizing the geotechnical parameters and measures herein for planning, design, and/or construction constitutes understanding and acceptance of the conclusions with regard to risk and other information provided herein, associated improvement performance, as well as the limitations inherent within such estimates. Ensuring correct interpretation of the contents of this report by others is not the responsibility of GROUND. If any information referred to herein is not well understood, it is imperative that The Mighty Argo Cable Car, LLC contact the author or a GROUND principal immediately. We will be available to meet to discuss the risks and remedial approaches presented in this report, as well as other potential approaches, upon request.

This report was prepared in accordance with generally accepted soil and foundation engineering practice in the State of Colorado at the date of preparation. Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity.

GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or conclusions contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect.

This document, together with the concepts and conclusions presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Re-use of, or improper reliance on this document without written authorization

and adaption by GROUND Engineering Consultants, Inc., shall be without liability to GROUND Engineering Consultants, Inc.

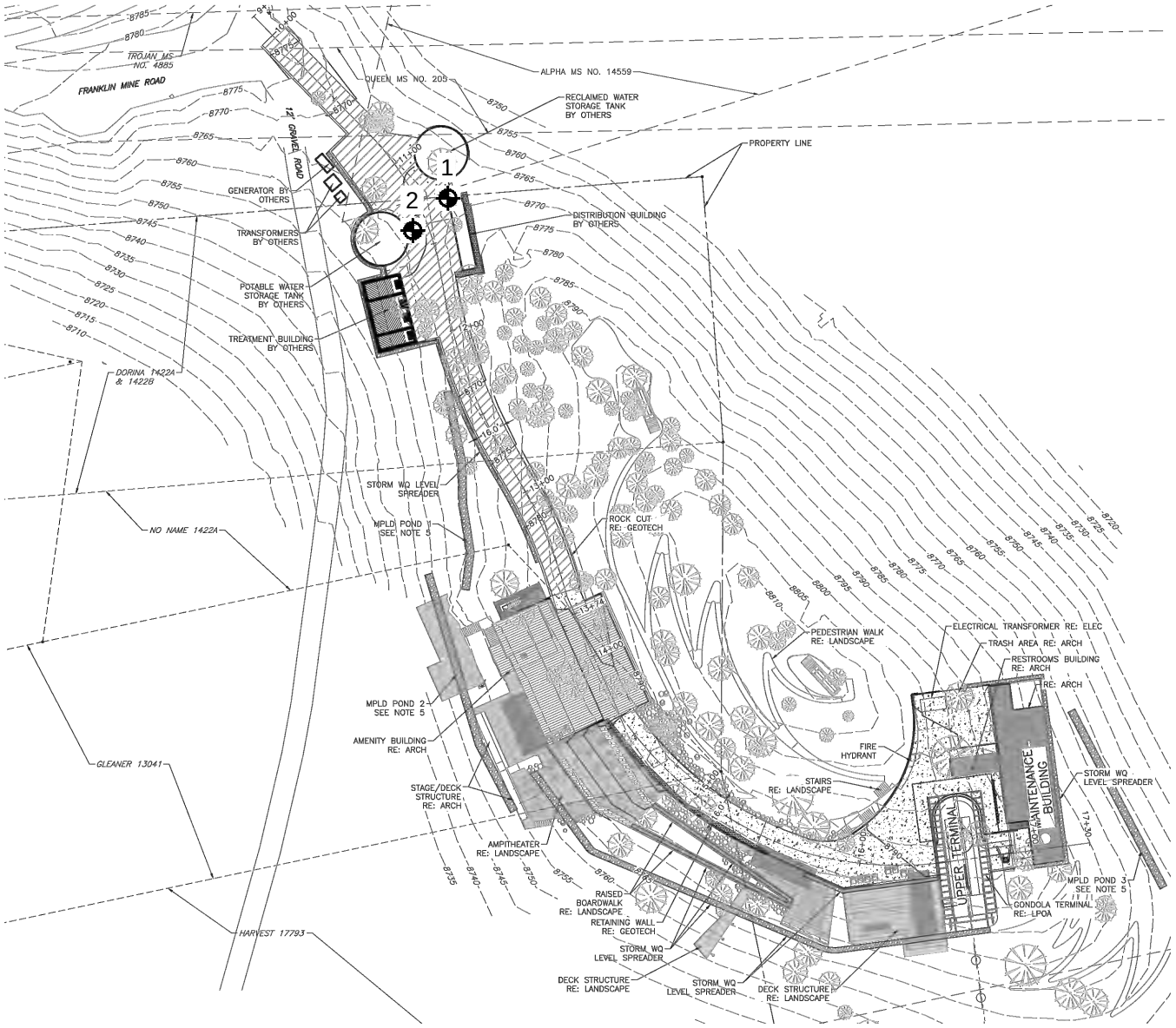
GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide The Mighty Argo Cable Car, LLC with a proposal for construction observation and materials testing.

Sincerely,

GROUND Engineering Consultants, Inc.

Ben Fellbaum, P.G., E.I.

Reviewed by Brian H. Reck, P.G., C.E.G., P.E.



SITE PLAN PROVIDED BY CLIENT

1 Indicates test hole number and approximate location.

NOT TO SCALE

GROUND ENGINEERING

JOB NO.: 20-3071

FIGURE: 1

LOCATION OF TEST HOLES

GROUND ENGINEERING

LOGS OF THE TEST HOLES

CLIENT: The Mighty Argo Cable Car, LLC

JOB NO: 20-3071

PROJECT NAME: Argo Upper Landing Wastewater Treatment Plant

PROJECT LOCATION: Idaho Springs, CO

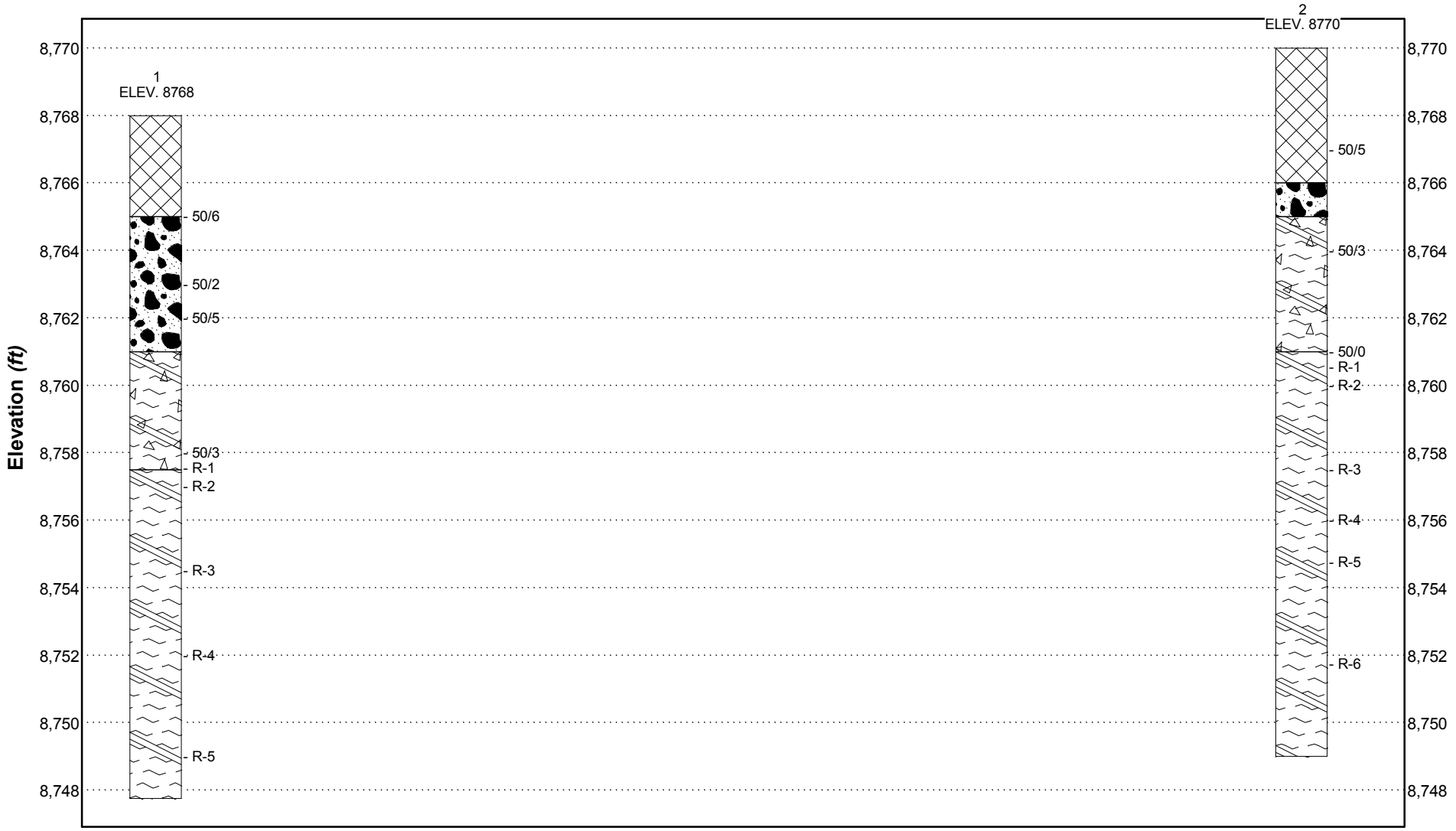


Figure 2

LEGEND AND NOTES

CLIENT: The Mighty Argo Cable Car, LLC
PROJECT NAME: Argo Upper Landing Wastewater Treatment Plant
JOB NO: 20-3071
PROJECT LOCATION: Idaho Springs, CO

MATERIAL SYMBOLS


FILL


SAND AND GRAVEL


WEATHERED FELSIC INTRUSION


FELSIC INTRUSION

NOTE: See Detailed Logs for Material descriptions.

SAMPLER SYMBOLS


Core


Standard Penetration Test Sampler
20-25-30 Drive sample blow count, indicates 20, 25, and 30 blows of a 140 pound hammer falling 30 inches were required to drive the sampler 18 inches in three 6 inch increments.

NOTES

1. Test holes were drilled on 11/17/2020 with 6" hollow stem auger.

2. Locations of the test holes were determined approximately by pacing from features shown on the site plan provided.

3. Elevations of test holes were estimated from client provided documents.

4. The test hole locations and elevations should be considered accurate only to the degree implied by the method used.

5. The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.

6. Groundwater level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.

7. The material descriptions on these logs are for general classification purposes only. See full text of this report for descriptions of the site materials & related information.

8. All test holes were immediately backfilled upon completion of drilling, unless otherwise specified in this report.

ABBREVIATIONS

▽ Water Level at Time of Drilling, or as Shown

▼ Water Level at End of Drilling, or as Shown

▼ Water Level After 24 Hours, or as Shown

NV	No Value
NP	Non-Plastic

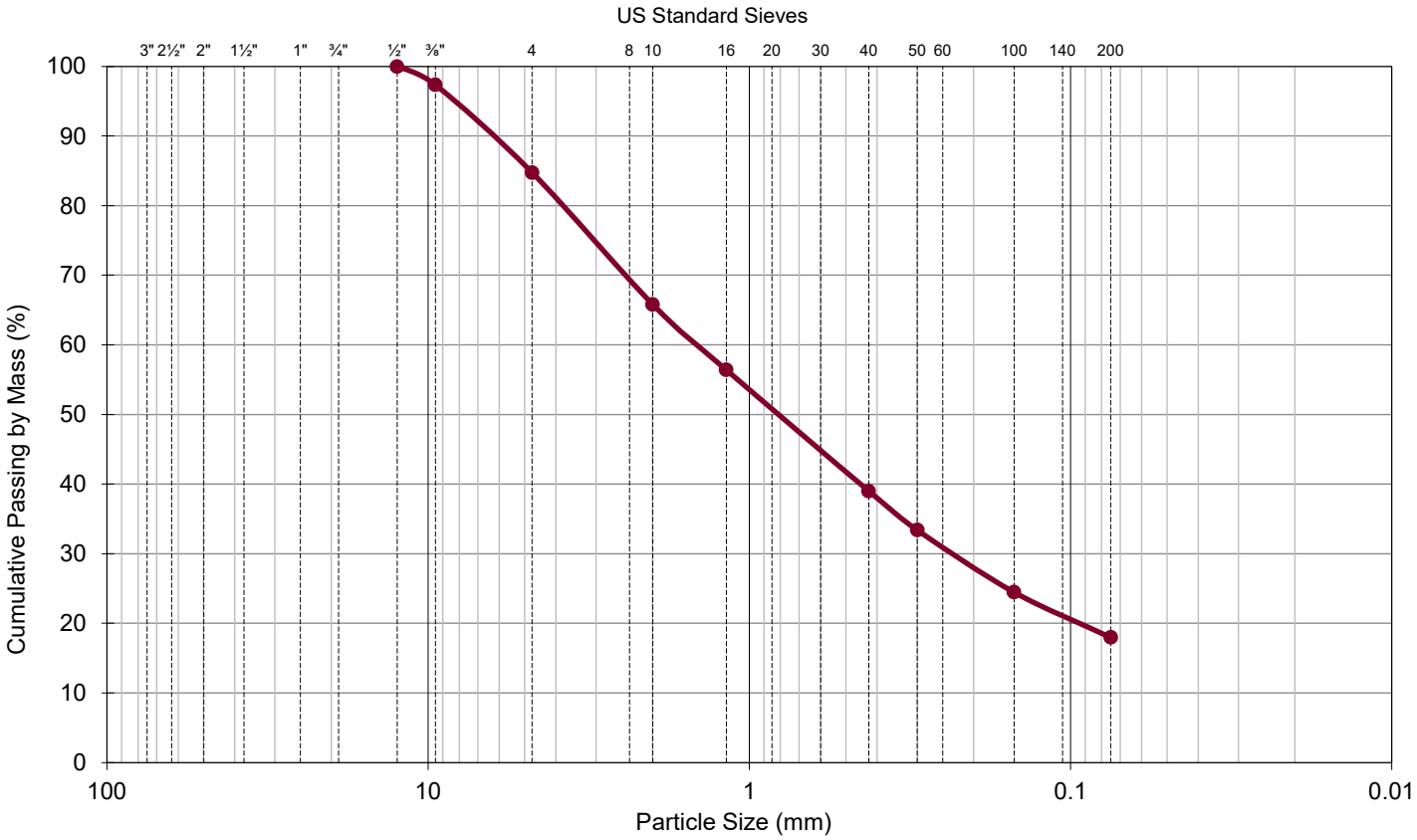
Figure 3

GROUND ENGINEERING

Project No.: 20-3071

Argo Upper Landing
Wastewater Treatment Plant

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	85	D90	6.335
5 in	125	-	No. 8	2.36	-	D85	4.811
4 in	100	-	No. 10	2.00	66	D80	3.821
3 in	75	-	No. 16	1.18	56	D60	1.443
2.5 in	63	-	No. 20	0.85	-	D50	0.810
2 in	50	-	No. 30	0.60	-	D40	0.450
1.5 in	37.5	-	No. 40	0.425	39	D30	0.230
1 in	25.0	-	No. 50	0.300	33	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	100	No. 100	0.150	24	D05	-
3/8 in	9.5	97	No. 140	0.106	-	Cu	-
No. 4	4.75	85	No. 200	0.075	18.0	Cc	-

Location: 1 at 3 feet
Description: Silty SAND with Gravel

Classification: (SM)g / A-1-b (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 15
Sand (%): 67
Silt/Clay (%): 18

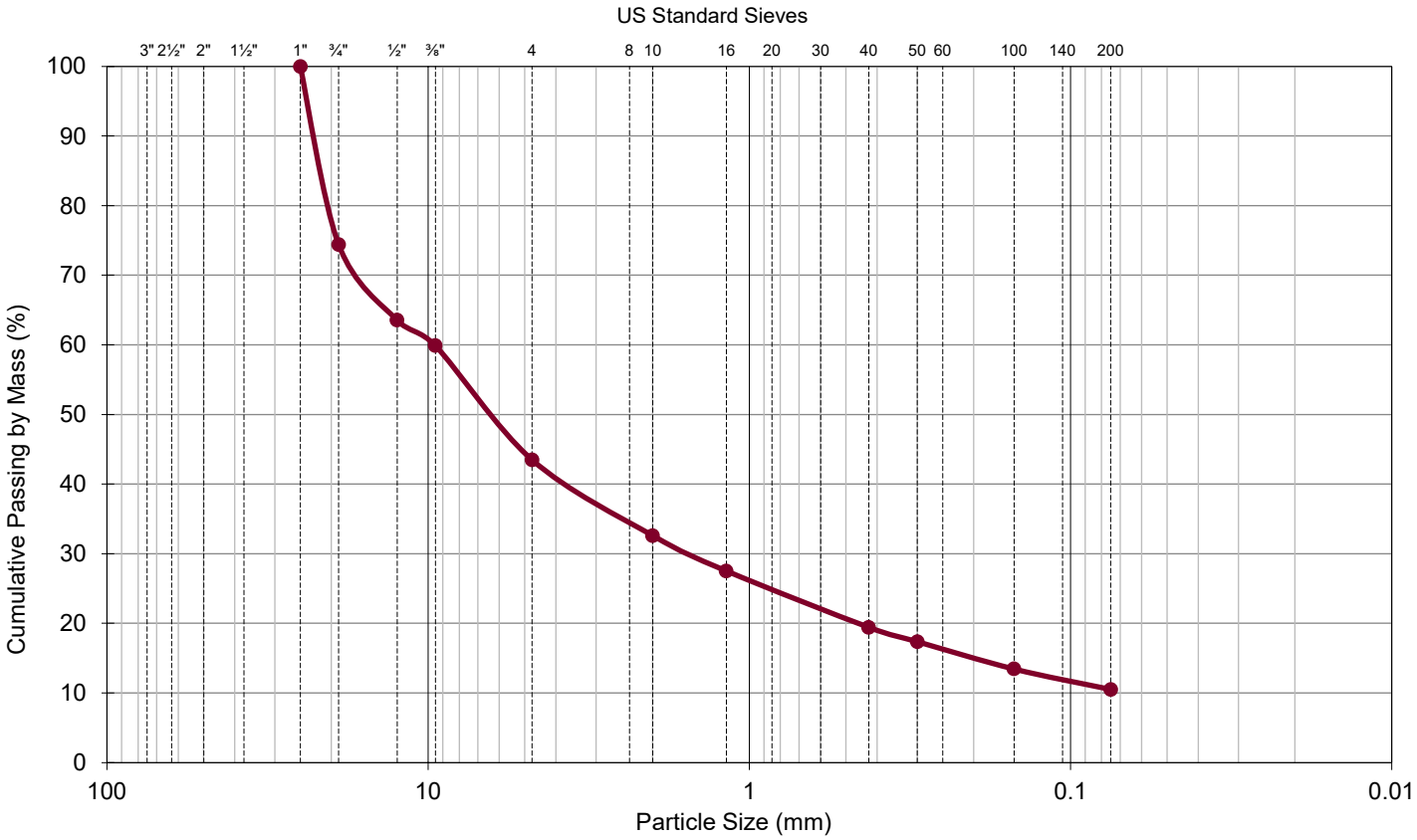
FIGURE: 4

GROUND ENGINEERING

Project No.: 20-3071

Argo Upper Landing
Wastewater Treatment Plant

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	43	D90	22.457
5 in	125	-	No. 8	2.36	-	D85	21.284
4 in	100	-	No. 10	2.00	33	D80	20.172
3 in	75	-	No. 16	1.18	28	D60	9.577
2.5 in	63	-	No. 20	0.85	-	D50	6.254
2 in	50	-	No. 30	0.60	-	D40	3.597
1.5 in	37.5	-	No. 40	0.425	19	D30	1.523
1 in	25.0	100	No. 50	0.300	17	D15	0.197
3/4 in	19.0	74	No. 60	0.250	-	D10	-
1/2 in	12.5	64	No. 100	0.150	13	D05	-
3/8 in	9.5	60	No. 140	0.106	-	Cu	-
No. 4	4.75	43	No. 200	0.075	10.5	Cc	-

Location: 1 at 10 feet
Description: Weathered FELSIC INTRUSION

Classification: (GP-GM)s / A-1-a (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 57
Sand (%): 32
Silt/Clay (%): 11

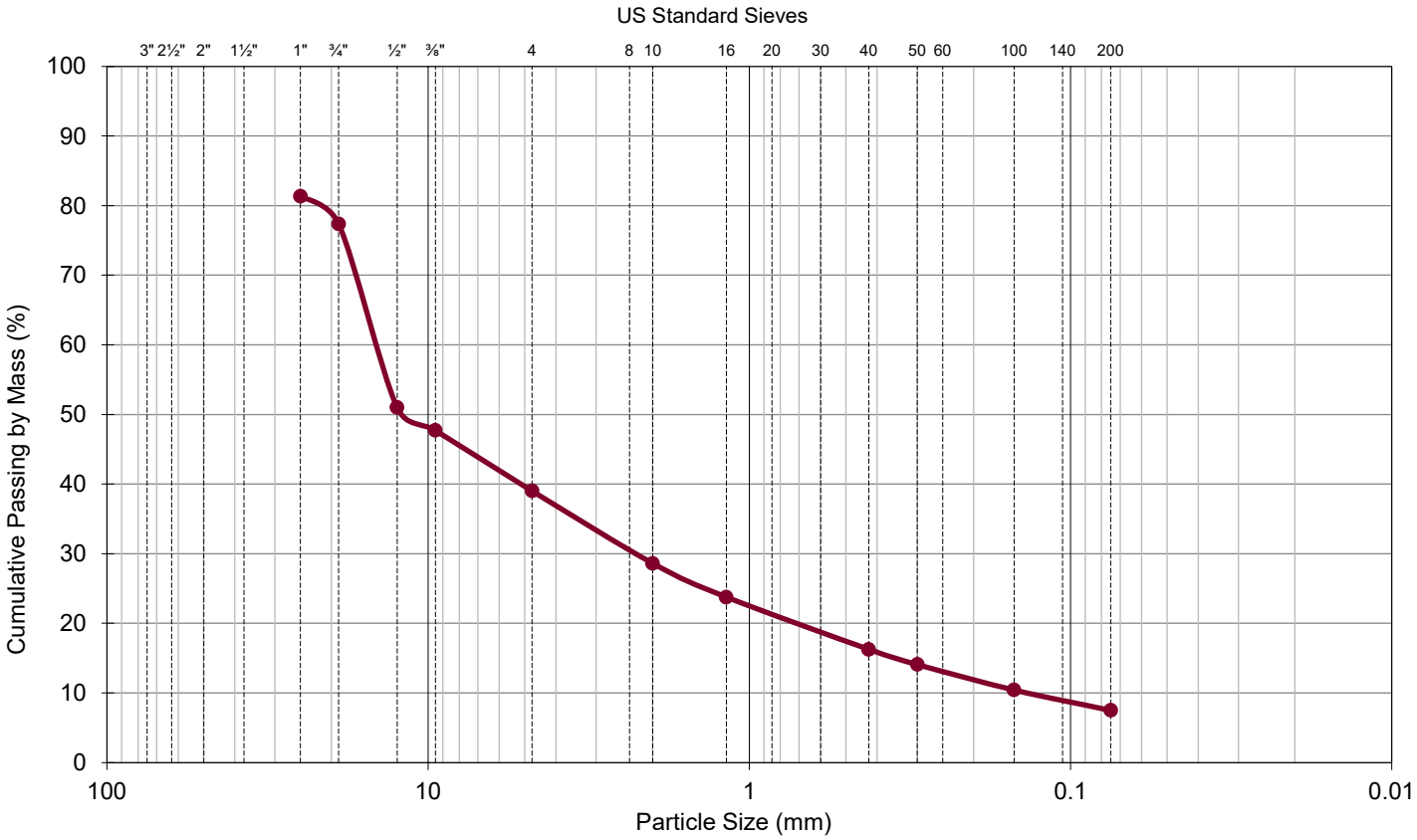
FIGURE: 5

GROUND ENGINEERING

Project No.: 20-3071

Argo Upper Landing
Wastewater Treatment Plant

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	39	D90	#N/A
5 in	125	-	No. 8	2.36	-	D85	#N/A
4 in	100	-	No. 10	2.00	29	D80	22.755
3 in	75	-	No. 16	1.18	24	D60	14.414
2.5 in	63	-	No. 20	0.85	-	D50	11.473
2 in	50	-	No. 30	0.60	-	D40	5.131
1.5 in	37.5	-	No. 40	0.425	16	D30	2.241
1 in	25.0	81	No. 50	0.300	14	D15	0.346
3/4 in	19.0	77	No. 60	0.250	-	D10	0.135
1/2 in	12.5	51	No. 100	0.150	10	D05	-
3/8 in	9.5	48	No. 140	0.106	-	Cu	106.946
No. 4	4.75	39	No. 200	0.075	7.5	Cc	2.586

Location: 2 at 3 feet
Description: FILL: GRAVEL with Sand and Silt

Classification: (GP-GM)s / A-1-a (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 61
Sand (%): 31
Silt/Clay (%): 8

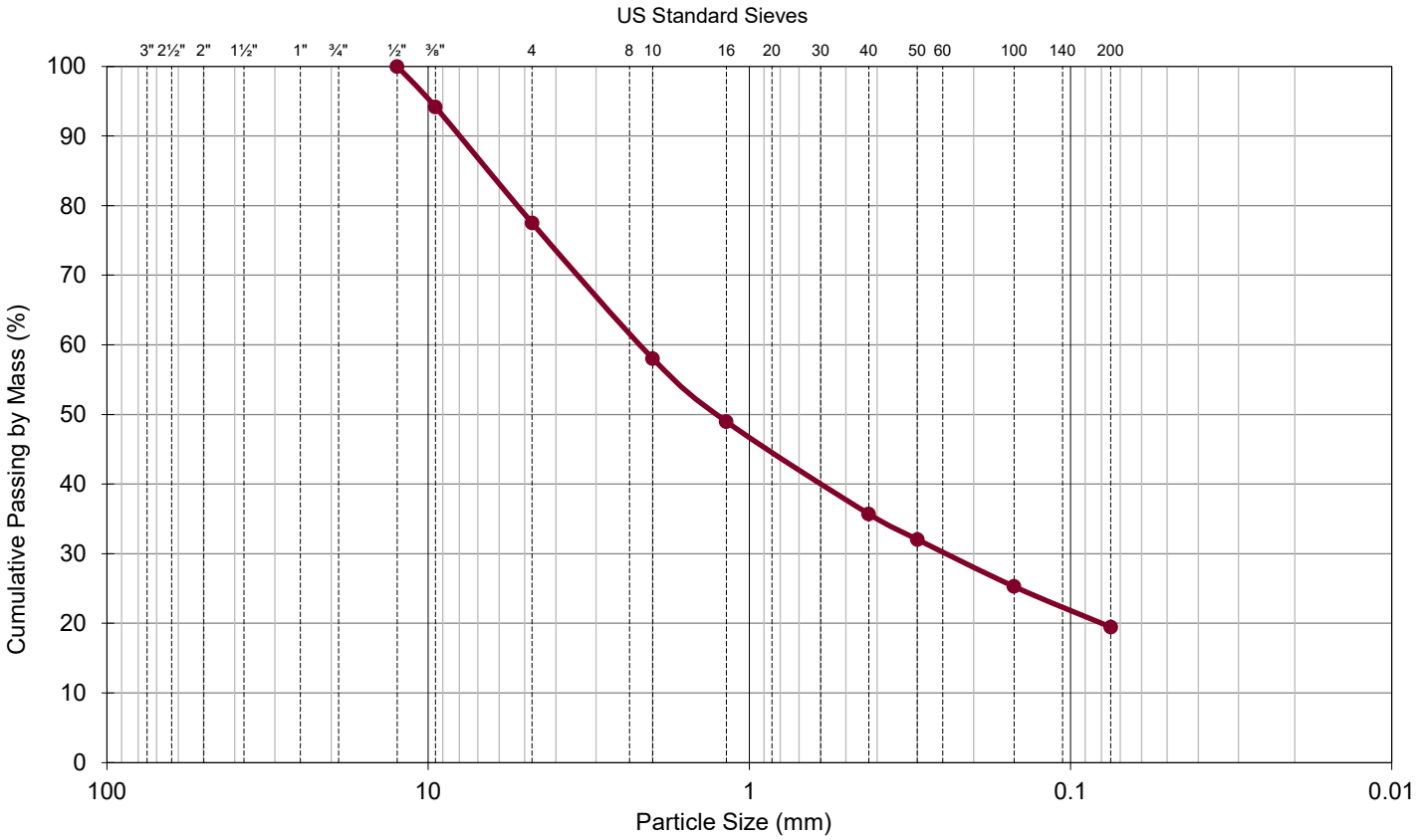
FIGURE: 6

GROUND ENGINEERING

Project No.: 20-3071

Argo Upper Landing
Wastewater Treatment Plant

Gradation (ASTM D422-63[2007])



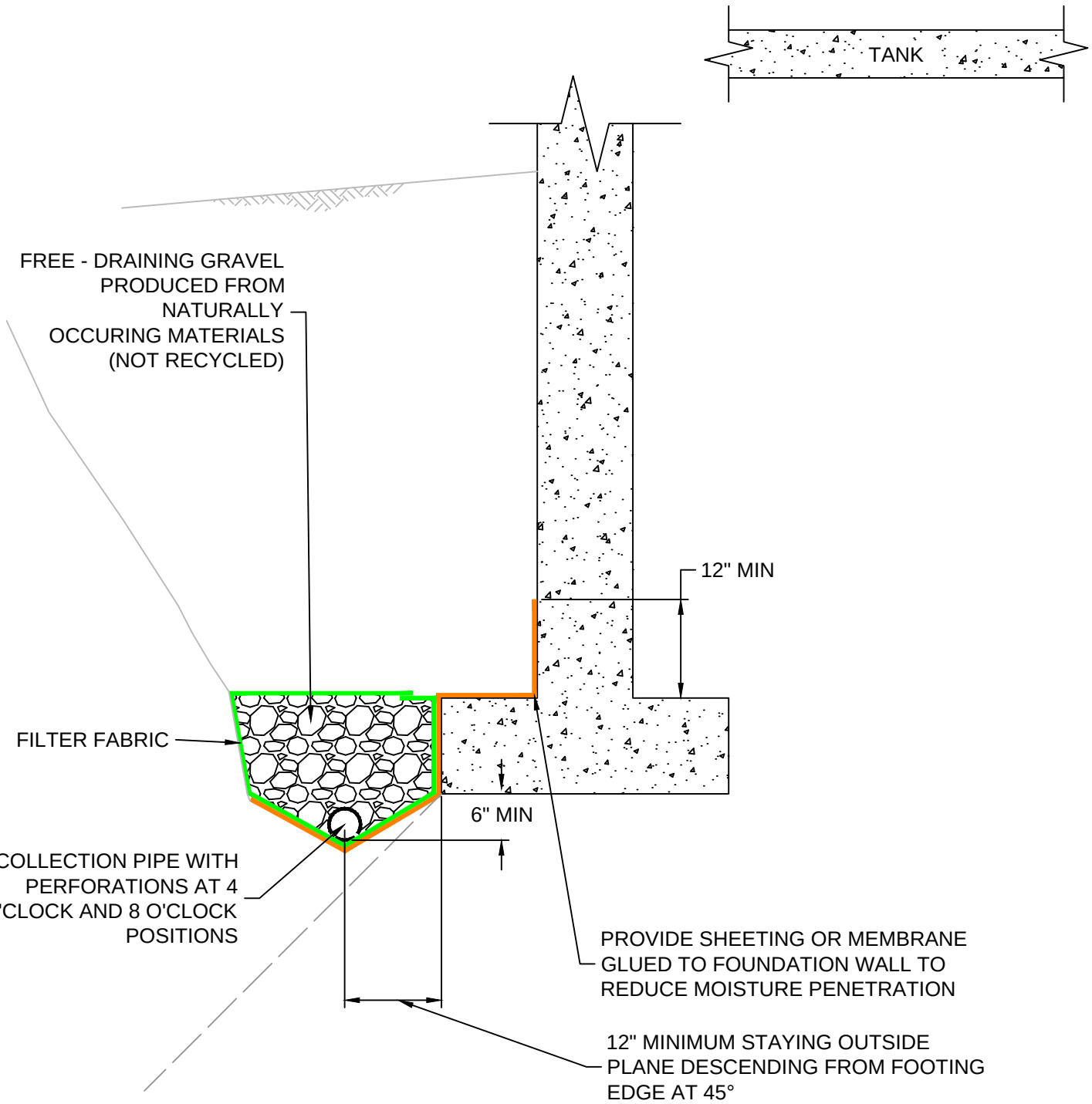
Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	78	D90	7.982
5 in	125	-	No. 8	2.36	-	D85	6.481
4 in	100	-	No. 10	2.00	58	D80	5.263
3 in	75	-	No. 16	1.18	49	D60	2.181
2.5 in	63	-	No. 20	0.85	-	D50	1.252
2 in	50	-	No. 30	0.60	-	D40	0.591
1.5 in	37.5	-	No. 40	0.425	36	D30	0.243
1 in	25.0	-	No. 50	0.300	32	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	100	No. 100	0.150	25	D05	-
3/8 in	9.5	94	No. 140	0.106	-	Cu	-
No. 4	4.75	78	No. 200	0.075	19.5	Cc	-

Location: 2 at 6 feet
Description: Weathered FELSIC INTRUSION

Classification: (SM)g / A-1-b (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 22
Sand (%): 59
Silt/Clay (%): 19

FIGURE: 7



NOTES:

1. This is NOT a design - level drawing. it should be used solely for general information purposes only. Actual Underdrain design should be completed by others.
2. The underdrain system must be tested by the contractor after installation and backfilling to verify that it functions properly.
3. Inclusion of this figure in construction documents is done so at the document preparer's risk.
4. Reproduction of this document should be in color.

NOT TO SCLE
SEE TEXT FOR ADDITIONAL INFORMATION

GROUND ENGINEERING

JOB NO.: 20-3071

FIGURE: 8

TYPICAL UNDERDRAIN DETAIL

GROUND ENGINEERING

Argo Upper Landing
Wastewater Treatment Plant

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Gradation			Atterberg Limits		Water Soluble Sulfates	Unconfined Compressive Strength		USCS Equivalent Classification	AASHTO Equivalent Classification (Group Index)	Sample Description
Test Hole No.	Depth (feet)	Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index	(%)	(psi)	(ksf)			
1	3	15	67	18	NV	NP	-	-	-	(SM)g	A-1-b (0)	Silty SAND with Gravel
1	6	-	-	-	-	-	0.01	-	-	-	-	Silty SAND with Gravel
1	10	57	33	11	NV	NP	-	-	-	(GP-GM)s	A-1-a (0)	Weathered FELSIC INTRUSION
2	3	61	32	8	NV	NP	-	-	-	(GP-GM)s	A-1-a (0)	FILL: GRAVEL with Sand and Silt
2	6	22	59	20	NV	NP	-	-	-	(SM)g	A-1-b (0)	Weathered FELSIC INTRUSION
2	10	-	-	-	-	-	-	16,243	2,339	-	-	FELSIC INTRUSION

SD = Sample disturbed, NV = No value, NP = Non-plastic

Appendix A

Detail Logs of Test Holes

GROUND ENGINEERING

TEST HOLE 1

CLIENT: The Mighty Argo Cable Car, LLC

PROJECT NAME: Argo Upper Landing Wastewater Treatment Plant

JOB NO: 20-3071

PROJECT LOCATION: Idaho Springs, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
8768	0		**FILL:** Silty and clayey, fine to coarse sands, gravels, and cobbles with local boulders. The fill was dry to moist, non- to slightly plastic, loose to medium dense, and light brown to brown in color.										
			SANDS and GRAVELS: Fine to coarse, clean to silty and clayey sands, gravels, and cobbles with boulders, silts, and clays. They were dry to moist, non- to slightly plastic, dense to very dense and light brown to brown in color.		50/6			18	NV	NP			(SM)g
8763	5		*Boulders about 3 to 5 feet in diameter were observed on site, and larger boulders could be encountered in* project excavations.		50/2								
					50/5								
			WEATHERED FELSIC INTRUSION: Fine to coarse grained felsic rock. It was very hard and resistant, moderately to highly fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.										
8758	10				50/3			11	NV	NP			(GP-GM)s
			FELSIC INTRUSION: Fine to coarse grained felsic rock. It was very hard and resistant, slightly to moderately fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.		R-1								
					R-2								
8753	15				R-3								
					R-4								
8748	20				R-5								

Bottom of borehole at Approx. 20.25 feet.

GROUND ENGINEERING

TEST HOLE 2

CLIENT: The Mighty Argo Cable Car, LLC

PROJECT NAME: Argo Upper Landing Wastewater Treatment Plant

JOB NO: 20-3071

PROJECT LOCATION: Idaho Springs, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Percent Passing No. 200 Sieve	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	Swell/Consolidation (%) at Surcharge Pressure (psf)	Unconfined Compressive Strength (ksf)	USCS Equivalent Classification
8770	0		**FILL:** Silty and clayey, fine to coarse sands, gravels, and cobbles with local boulders. The fill was dry to moist, non- to slightly plastic, loose to medium dense, and light brown to brown in color.										
					50/5			8	NV	NP			(GP-GM)s
8765	5		**SANDS and GRAVELS:** Fine to coarse, clean to silty and clayey sands, gravels, and cobbles with boulders, silts, and clays. They were dry to moist, non- to slightly plastic, dense to very dense and light brown to brown in color. *Boulders about 3 to 5 feet in diameter were observed on site, and larger boulders could be encountered in* project excavations.										
					50/3			20	NV	NP			(SM)g
			WEATHERED FELSIC INTRUSION: Fine to coarse grained felsic rock. It was very hard and resistant, moderately to highly fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.										
					50/0								
8760	10		**FELSIC INTRUSION:** Fine to coarse grained felsic rock. It was very hard and resistant, slightly to moderately fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.		R-1								
					R-2							2339	
					R-3								
8755	15				R-4								
					R-5								
8750	20				R-6								

Bottom of borehole at Approx. 21 feet.

Appendix B

Detail Logs of Coring

GROUND ENGINEERING

Job Number: 20-3071	Test Hole: 1	Project Name: Argo Upper Landing Wastewater Treatment Plant	Elevation: 8768 Ft ±
Logged By: GM	Page: 1 of 1	Project Location: Idaho Springs, CO	Bedrock Depth: 7 Ft ±
Date Drilled: 11/17/2020	Hole Diameter: 6"	Client: The Mighty Argo Cable Car, LLC	Total Depth: 20.25 Ft ±
		File Name: 3071CL.DWG	Plunge: 90°

Legend:
M - Mechanical Break
S - Stepped Fracture

Planarity Index:
P1 - Planar
P2 - Somewhat Planar
P3 - Somewhat Irregular
P4 - Irregular

Roughness Index:
R1 - Smooth
R2 - Fairly Smooth
R3 - Fairly Rough
R4 - Rough

DEPTH (FEET)	SAMPLE DATA TYPE	SAMPLE DATA BLOW COUNT	CORE DATA PERCENT RECOVERY	CORE DATA RQD	FRACTURES DESCRIPTION	FRACTURES LOG	GRAPHIC LOG	LITHOLOGIC DESCRIPTIONS	DRILLING CONDITIONS NOTES
0								**FILL:** Silty and clayey, fine to coarse sands, gravels, and cobbles with local boulders. The fill was dry to moist, non- to slightly plastic, loose to medium dense, and light brown to brown in color.	Begin 6" Drilling
	SS	50/6						**SANDS and GRAVELS:** Fine to coarse, clean to silty and clayey sands, gravels, and cobbles with boulders, silts, and clays. They were dry to moist, non- to slightly plastic, dense to very dense and light brown to brown in color. *Boulders about 3 to 5 feet in diameter were observed on site, and larger boulders could be encountered in project excavations.*	
5	SS	50/2							
	SS	50/5							
								WEATHERED FELSIC INTRUSION: Fine to coarse grained felsic rock. It was very hard and resistant, moderately to highly fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.	End 6" Drilling
10	SS	50/3							Begin NX Wireline Coring
			67%	58%	M M M M				Begin Run 1
									End Run 1
					P1, R2, 65° P1, R2, 85° M M P1, R2, 70° M P1, R2, 90°			**FELSIC INTRUSION:** Fine to coarse grained felsic rock. It was very hard and resistant, slightly to moderately fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.	Begin Run 2
			97%	0%					End Run 2
									Begin Run 3
15			100%	13%	P1, R1				End Run 3
									Begin Run 4
			100%	0%	P1, R2, 90° M P1, R2, 90° M P2, R2, 90° M P1, R2, 85° P1, R2, 65° P1, R2, 75°				End Run 4
			100%	0%					Begin Run 5 End Run 5 End Test Hole
20					M				

GROUND ENGINEERING

Job Number: 20-3071	Test Hole: 2	Project Name: Argo Upper Landing Wastewater Treatment Plant	Elevation: 8770 Ft ±
Logged By: GM	Page: 1 of 2	Project Location: Idaho Springs, CO	Bedrock Depth: 5 Ft ±
Date Drilled: 11/17/2020	Hole Diameter: 6"	Client: The Mighty Argo Cable Car, LLC	Total Depth: 21 Ft ±
		File Name: 3071CL.DWG	Plunge: 90°

Legend:
M - Mechanical Break
S - Stepped Fracture

Planarity Index:
P1 - Planar
P2 - Somewhat Planar
P3 - Somewhat Irregular
P4 - Irregular

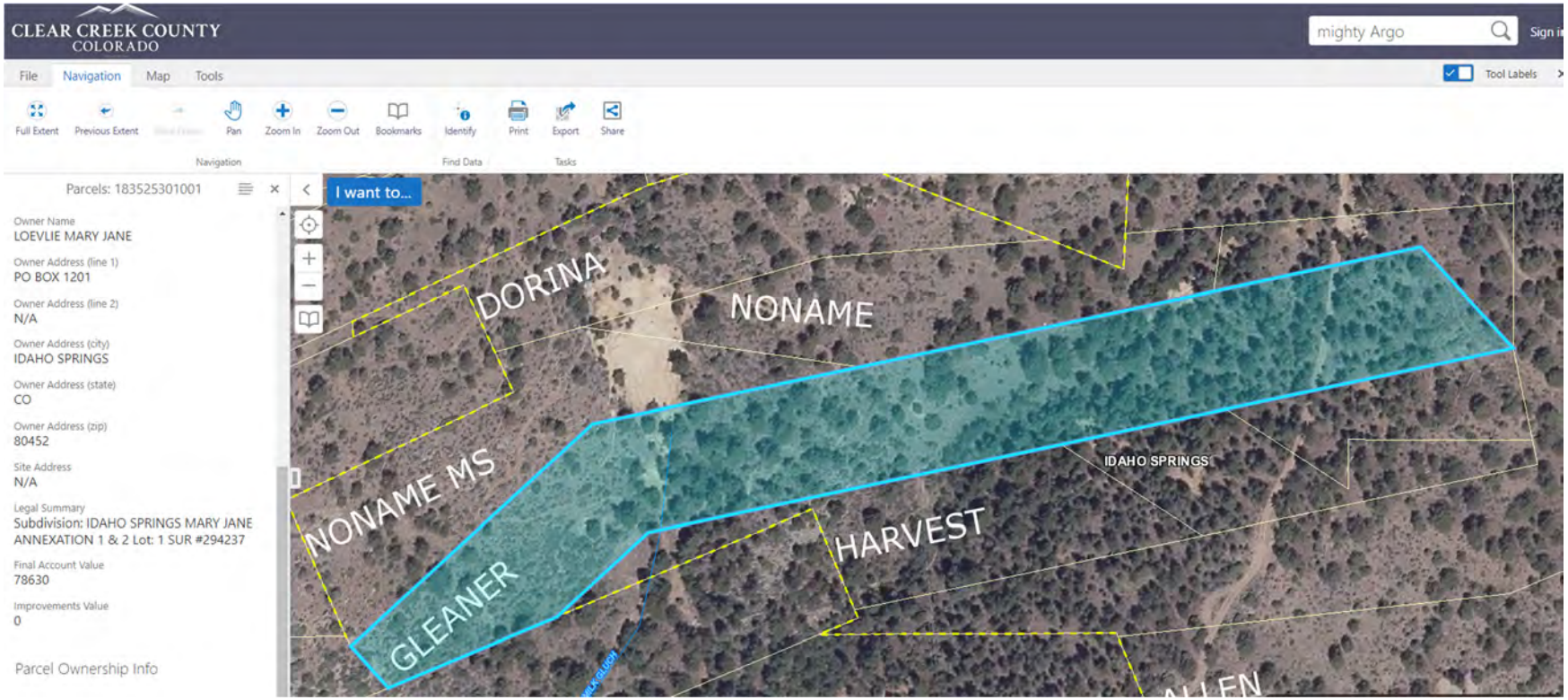
Roughness Index:
R1 - Smooth
R2 - Fairly Smooth
R3 - Fairly Rough
R4 - Rough

DEPTH (FEET)	SAMPLE DATA TYPE	SAMPLE DATA BLOW COUNT	CORE DATA PERCENT RECOVERY	CORE DATA RQD	FRACTURES DESCRIPTION	FRACTURES LOG	GRAPHIC LOG	LITHOLOGIC DESCRIPTIONS	DRILLING CONDITIONS NOTES
0								**FILL:** Silty and clayey, fine to coarse sands, gravels, and cobbles with local boulders. The fill was dry to moist, non- to slightly plastic, loose to medium dense, and light brown to brown in color.	XXX
	SS	50/5							
5								**SANDS and GRAVELS:** Fine to coarse, clean to silty and clayey sands, gravels, and cobbles with boulders, silts, and clays. They were dry to moist, non- to slightly plastic, dense to very dense and light brown to brown in color. *Boulders about 3 to 5 feet in diameter were observed on site, and larger boulders could be encountered in project excavations.*	
	SS	50/3							
	SS	50/0						**WEATHERED FELSIC INTRUSION:** Fine to coarse grained felsic rock. It was very hard and resistant, moderately to highly fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.	End 6" Drilling Begin NX Wireline Coring Begin Run 1
			100%	42%	M P1, R1, 30° M P1, R1, 40° P1, R2, 45° P1, R1, 60°				End Run 1 Begin Run 2
10			90%	13%	P1, R4, 90° P1, R2, 30° P1, R1 P1, R3, 30° P1, R1, 30° P1, R1, 35°			**FELSIC INTRUSION:** Fine to coarse grained felsic rock. It was very hard and resistant, slightly to moderately fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.	End Run 2 Begin Run 3
			67%	0%	P1, R2, 45° P1, R2, 45°				End Run 3
			100%	0%	P1, R2, 60° P1, R2, 30° P1, R2, 75° P2, R3, 60°				Begin Run 4 End Run 4
15			97%	28%	P2, R3, 25° P2, R3, 25° M P1, R2, 20° P1, R3, 40° P3, R4 P1, R2, 60° M P1, R2, 90° P2, R2, 30°				Begin Run 5 End Run 5
			91%	39%	M M P1, R2, 45° P1, R3, 30° P1, R1, 60° P1, R2, 60° P1, R2, 75° P3, R4 P1, R2, 90° P1, R2, 45° P1, R2, 80° P1, R2, 70° P1, R2, 30°				Begin Run 6
20									

GROUND ENGINEERING

Project Name:	Job Number:	Test Hole:
Argo Upper Landing Wastewater Treatment Plant	20-3071	2

DEPTH (FEET)	SAMPLE DATA: TYPE	SAMPLE DATA: BLOW COUNT	CORE DATA: PERCENT RECOVERY	CORE DATA: RQD	CORE DATA: FRACTURES: DESCRIPTION	CORE DATA: FRACTURES: LOG	GRAPHIC LOG	LITHOLOGIC DESCRIPTIONS	DRILLING CONDITIONS NOTES
			91%	39%				**FELSIC INTRUSION:** Fine to coarse grained felsic rock. It was very hard and resistant, slightly to moderately fractured, and pale gray to gray to in color. Iron staining was noted commonly on fracture faces.	End Run 6 End Test Hole
25									
30									
35									
40									
45									


CLEAR CREEK COUNTY
COLORADO
mighty Argo
Sign in
File
Navigation
Map
Tools
Tool Labels
Full Extent
Previous Extent
Pan
Zoom In
Zoom Out
Bookmarks
Identify
Print
Export
Share
Navigation
Find Data
Tasks
Parcels: 183525301001
I want to...
Owner Name
LOEVLIE MARY JANE
Owner Address (line 1)
PO BOX 1201
Owner Address (line 2)
N/A
Owner Address (city)
IDAHO SPRINGS
Owner Address (state)
CO
Owner Address (zip)
80452
Site Address
N/A
Legal Summary
Subdivision: IDAHO SPRINGS MARY JANE ANNEXATION 1 & 2 Lot: 1 SUR #294237
Final Account Value
78630
Improvements Value
0
Parcel Ownership Info
DORINA
NONAME
NONAME MS
GLEANER
HARVEST
IDAHO SPRINGS

U.S. Fish and Wildlife Service
National Wetlands Inventory

Argo WWTP Wetlands

January 30, 2020

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

National Flood Hazard Layer FIRMette

FEMA

105°30'59"W 39°45'40"N

105°30'21"W 39°45'13"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/20/2023 at 11:24 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Section 1.
System Information

Keep this basic information easily accessible to authorized staff for emergency responders, repair people, and the news media.

System information

System Discharge Number		
System Name and Address		
Directions to the System		
Basic Description and Location of System Facilities		
Location/Town		
Population Served and Service Connections	_____ people	_____ connections
System Owner		
Name, Title, and Phone Number of Person Responsible for Maintaining and Implementing the Emergency Plan		_____ Phone _____ Cell _____ Pager

Section 2.
Chain of Command – Lines of Authority

The first response step in any emergency is to inform the person at the top of this list, who is responsible for managing the emergency and making key decisions.

Chain of command – lines of authority

Name and Title	Responsibilities During an Emergency	Contact Numbers

Section 3.
Events that Cause Emergencies

The events listed below may cause wastewater system emergencies. They are arranged from highest to lowest probable risk.

Events that cause emergencies

Type of Event	Probability or Risk (High-Med-Low)	Comments

Section 4.
Emergency Notification

Notification call-up lists - Use these lists to notify first responders of an emergency.

Emergency Notification List				
Organization or Department	**Name & Position**	**Telephone**	**Night or Cell Phone**	**Email**
Local Law Enforcement				
Fire Department				
Emergency Medical Services				
Wastewater Operator (if contractor)				
Primacy Agency Contact				
Hazmat Hotline				
Interconnected Wastewater System				
Neighboring Wastewater System (not connected)				
RCAP Contact				

Priority Customers				
Organization or Department	**Name & Position**	**Telephone**	**Night or Cell Phone**	**Email**
Hospitals or Clinic(s)				
Public or Private Schools				
Public Water System				
Adult Care Facility				

State, Federal or Tribal Notification List

Organization or Department	Name & Position	Telephone	Night or Cell Phone	Email
State or Tribal Police				
Regulatory Agency State/Federal/Tribal				
Authorized Testing Laboratory				

Service / Repair Notifications

Organization or Department	Name & Position	Telephone	Night or Cell Phone	Email
Electric Utility Co.				
Electrician				
Gas/Propane Supplier				
Water Testing Lab.				
Sewer Utility Co.				
Telephone Co.				
Plumber				
Pump Supplier				
"Call Before You Dig"				
Rental Equipment Supplier				
Chlorine Supplier				
Pipe Supplier				

Media Notification List				
Organization or Department	**Name & Position**	**Telephone**	**Night or Cell Phone**	**Email**
Newspaper - Local				
Newspaper – Regional/State/Tribal				
Radio				
Radio				
TV Station				

Notification procedures

Notify wastewater system customers

Who is Responsible:	
Procedures:	

Alert local law enforcement, state, federal or tribal regulatory officials, and local health agencies

Who is Responsible:	
Procedures:	

Contact service and repair contractors

Who is Responsible:	
Procedures:	

Contact neighboring wastewater systems, if necessary

Who is Responsible:	
Procedures:	

Contact downstream water systems, if necessary

Who is Responsible:	
Procedures:	

Procedures for issuing a health advisory

Who is Responsible:	
Procedures:	

Other procedures, as necessary

Who is Responsible:	
Procedures:	

Section 5.
Effective Communication

Communication with customers, the news media, and the general public is a critical part of emergency response.

Designated public spokesperson

Designate a spokesperson (and alternate) and contact regulatory agency for delivering messages to the news media and the public.

Designate a spokesperson and alternates

Spokesperson	Alternate

Section 6.
The Vulnerability Assessment

This is an evaluation of each wastewater system component to identify weaknesses or deficiencies that may make them susceptible to damage or failure during an emergency. It also assesses facilities for security enhancements that may guard against unauthorized entry, vandalism, or terrorism.

Facility vulnerability assessment and improvements identification

System Component	Description and Condition	Vulnerability	Improvements or Mitigating Actions	Security Improvements
Collection System				
Sewage Pumping				
Treatment				
Effluent Disposal				
Computer and Telemetry System				
Other Consider-ations				

Section 7.
Response Actions for Specific Events

In any event there are a series of general steps to take:

1. Analyze the type and severity of the emergency;
2. Take immediate actions to save lives;
3. Take action to reduce injuries and system damage;
4. Make repairs based on priority demand; and
5. Return the system to normal operation.

The following tables identify the assessment, set forth immediate response actions, define what notifications need to be made, and describe important follow-up actions.

A. Power outage

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

B. Collection system blockage or line break

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

C. Collection system pumping facilities failure

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

D. Treatment system failure

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

E. Effluent disposal failure

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

F. Chemical contamination

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

G. Vandalism or terrorist attack

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

H. Flood

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

I. Earthquake

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

J. Hazardous materials spill into collection system

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

K. Electronic equipment failure

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

L. Cyber attack

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

M. Other

Assessment	
Immediate Actions	
Notifications	
Follow-up Actions	

Section 8.
Returning to Normal Operation

Returning to normal operations

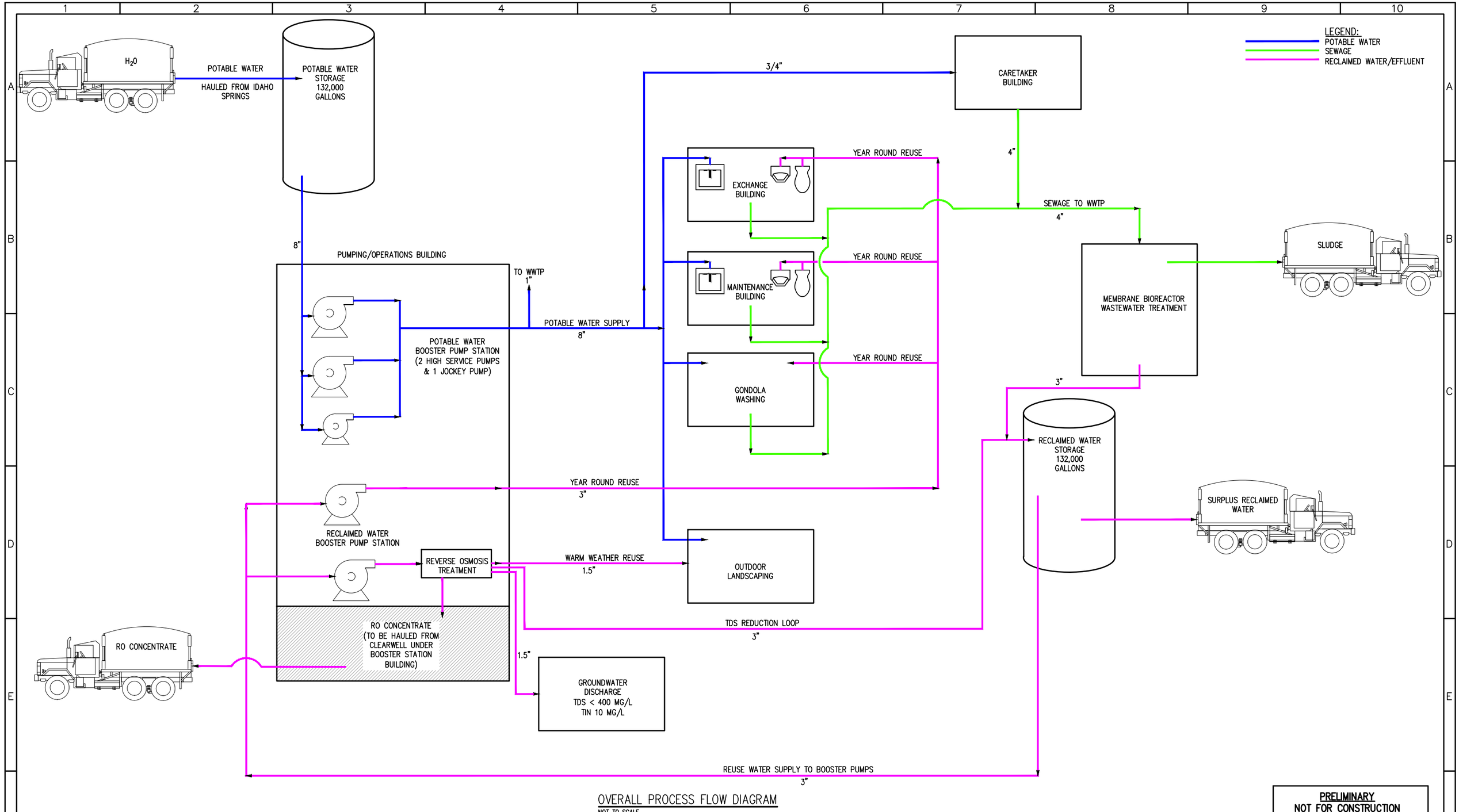
Action	Description and Actions

Section 9.
Plan Approval

Plan approval

This plan is officially in effect when reviewed, approved, and signed by the following people:

Name/Title	Signature	Date



OVERALL PROCESS FLOW DIAGRAM
NOT TO SCALE

PRELIMINARY
NOT FOR CONSTRUCTION

REV. No:	DATE:	BY:	REVISION DESCRIPTION:

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DESIGNED BY: AS
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AquaWorks DBO INC
DESIGN BUILD OPERATE

PROJECT: THE MIGHTY ARGO CABLE CAR COMPANY
POTABLE WATER & WASTEWATER SYSTEMS
CLEAR CREEK COUNTY, COLORADO

ENGINEER: AQUAWORKS DBO, INC.
3252 WILLIAMS STREET
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SHEET TITLE: OVERALL PROCESS FLOW DIAGRAM

PROJECT NUMBER:	SCALE:	SHEET:
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