6.0 ALTERNATIVE SCREENING PROCESS

Numerous alternatives exist that would provide adequate wastewater treatment for the District's new system. The purpose of this alternative screening process is to scrutinize the available alternatives, and determine which ones are the most viable for Seeley Lake Sewer District. The alternatives deemed most viable are detailed in the next Chapter.

6.1 Collection System Alternatives

The proposed centralized wastewater system for Seeley Lake Sewer District is an entirely new system, so the collection system layout alternatives are relatively straightforward. The alternatives in this section are evaluated based on general knowledge of the site and are subject to modification during the design stages of the project when more accurate topographical information is available and a thorough assessment of other existing buried utilities is complete. In general, the collection system for this project can either be operated by gravity or pressurized systems with various alignment options that depend on availability of land and efficiency of the system.

6.1.1 Gravity Collection System

This alternative is a complete gravity system with the main lines located in the existing street right-of-ways, and typically located directly underneath the street itself. This is probably the most common system layout in municipalities. For this project, easements will be most obtainable with this option and there is plenty of grade to work with, so this alternative will be evaluated further in this report.

6.1.2 Pressurized Collection System

This alternative is a network of smaller diameter piping that utilizes pressure to transport effluent verses gravity. These systems are less common than gravity, but can be effective in areas with less grade to work with, and often work well in rural communities and/or residential areas with tight soils and long distances to treatment sites. This type of system is commonly referred to as a STEP system, which is an acronym for Septic Tank Effluent Pumping. The use of this type of system can be beneficial in areas where many existing homes already have septic tanks, and it is easier to install pressurized pipe in already developed areas because the construction parameters are more flexible. The downside of these systems in a community application is that the individual owners are typically responsible for the operation and maintenance of each septic tank and pumping station.

In Seeley Lake, it is unknown how many residences have pre existing useable septic tanks. In fact, many of the septic systems may not have septic tanks at all, so the advantage mentioned above is not clear with this application. Additionally, the ease of construction is far outweighed by the additional operation and maintenance and burden on the individual owner. This is a viable option for Seeley Lake due to the existing topography. This alternative will be evaluated further.

6.1.3 Gravity / Pressurized Hybrid System

This alternative can have many different combinations of gravity and pressure piping depending on the specific objective of the system. For this project, the thought with this alternative would be to utilize gravity wherever practical, and individual grinder pumps only for service connections that would require excessive lengths of gravity main to collect a small flow. Individual grinder pumps can be feasible in combination with primary gravity systems, but each pump needs to be evaluated on a case by case basis during the design of the system. For this reason, this alternative will be further evaluated in combination with the gravity systems mentioned above.

6.2 Lift Station Alternatives

Lift station(s) will be necessary for this project since the only suitable locations for treatment are up gradient from the majority of the collection system. Below are three general alternatives considered to transport raw wastewater to a treatment and disposal site? It should be noted that *lift stations* are commonly referred to as *pump stations*, and these terms are used interchangeably throughout this report.

6.2.1 Construction of a New Suction Lift Station

Suction lift stations typically consist of centrifugal solids handling pumps constructed on-grade within an above ground structure. They have suction lines which drop into a wet well located below the structure. The pumps are designed to provide the necessary suction head and reprime themselves automatically after each cycle. There are several advantages to suction lift stations. The pumps, valves and control equipment are easily accessed within an above ground ventilated structure. This improves the quality of maintenance performed on the station. Also, since the structure is above ground and ventilated it does not need to be treated as an OSHA-confined space. Solids handling centrifugal pumps are available for the peak flows anticipated for the community; however, site conditions may require installation of two or more pumps in series to obtain the head necessary.

6.2.2 Construction of a New Wet Well/Dry Well Lift Station

Wet well/dry well lift stations were the most common lift station design for many years until package stations became widely accepted. These stations can be designed with either submersible or centrifugal pumps. The wet well is where wastewater is stored for pumping. When submersible pumps are used, the pumps are in the wet well. The forcemain leaves the wet well and enters the dry well. The dry well houses and valves and control equipment. Both the wet well and dry well are below ground structures typically constructed of concrete. When centrifugal pumps are used, the pumps are in the dry well with the valves and control equipment. The suction line typically goes through the wall of the wet well into the dry well. These stations are typically more expensive than package submersible stations because they require an additional below ground structure (the dry well). Also, the dry well needs to be entered on a regular basis to perform regular operations and maintenance duties. The dry well needs to be treated as a confined space and entry should be conducted in accordance with OSHA regulations. Due to the higher costs of this option and the concerns associated with entering the dry well for O&M, this alternative is not the recommended option for Seeley Lake.

6.2.3 Construction of a New Submersible Package Lift Station

Package submersible lift stations typically consist of two submersible pumps placed within a wet well. The discharge lines (forcemains) extend up into an above ground structure which sits on top of the wet well. The above ground structure houses the valves and control equipment for the station. The forcemains then go back through the floor and pumps are attached to guide rails which allow the pumps to be pulled for maintenance without entering the wet well. These stations are economical and have relatively low operation and maintenance requirements. Another advantage is that the operator should rarely need to enter the wet well; therefore, standard operation and maintenance tasks can be completed without entering a confined space. Again, submersible solids handling pumps are available for the flows; however, series pumping may be necessary to obtain the required head at the main lift station. Alternatively, a second packaged lift station could be installed midway on a forcemain to divide the head requirements each station would have to face.

New submersible package lift stations have proven to be reliable, safe and more cost effective than other lift station alternatives for small communities. For planning purposes, construction of new submersible package lift stations will be used in this PER. Alternative lift station designs and configurations will be evaluated, as needed, during pre design phase.

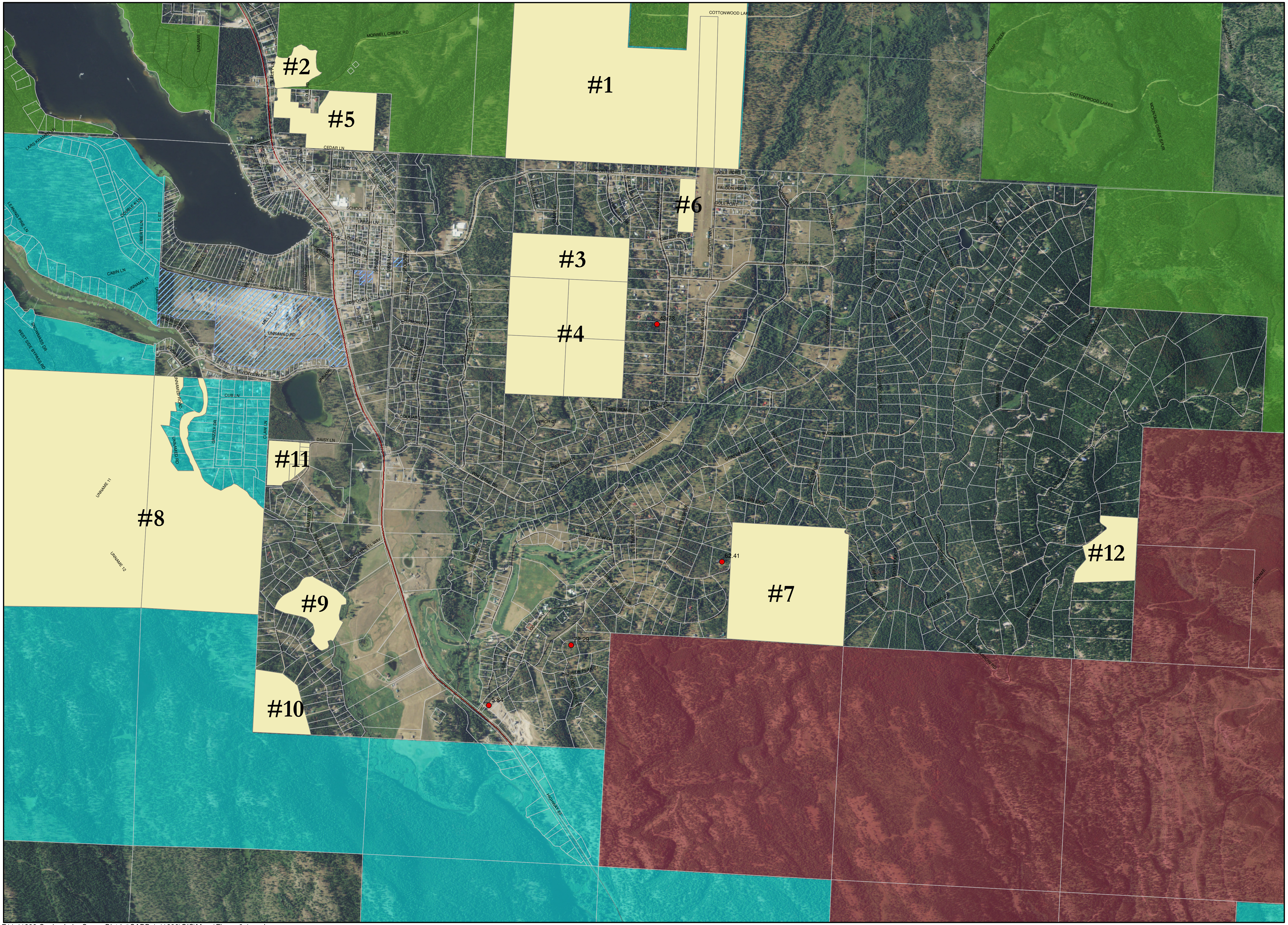
6.3 Treatment Sites

The first step in the evaluation of wastewater treatment alternatives is to identify potential treatment sites. Initial sites were identified in the original PER and addendum. These sites were either rejected by the property owners or determined not suitable based on the soils, depth to groundwater and other site specific parameters.

During this PER investigation, all potential sites were investigated. These sites were looked at based on the following criteria: land use, land ownership, wastewater treatment type, population density, daily flow, lay of the land, environmental concerns, historical sites, wetlands, endangered species, constructability, aesthetics, ordinances, available utilities, rights-of-way, groundwater quality, depth to groundwater, soil conditions, district priorities, public opinion, topography, slope and others. The parcels on Figure 6-1 were identified through consideration of the above criteria. After these sites were identified, Missoula County officials contacted the property owners to see if the possibility of utilizing each of these properties for the treatment facilities.

David Guelff was contacted about the possibility of utilizing his properties. David Guelff was initially agreeable to allowing the District to do some site testing of his property, but has since retracted that offer. Missoula County also contacted DNRC about the potential of utilizing their property in the area. The DNRC has been responsive and is currently working with the District on the potential of using their sites. Sites #1 and #8 have been deemed the most feasible and will be discussed in the next Chapter.

Site #2 has been identified as a possible site and is owned by the USFS. The District has submitted an Application for Purchase of Forest Service Lands under the Forest Service Townsite Act (Appendix AA). This application has been accepted by the Forest Service and an environmental review is the next step in this process. One of the criteria in this application is exhausting all other potential site locations. The analysis in this PER and subsequent recommendations for further analysis will complete this requirement. There are no additional sites adjacent the District that can be utilized.



GreatWest engineering

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Feet

Legend

- County Static Water Levels
- Potential Sites
- Pyramid Mountain Lumber Inc
- Parcel Bndys

Public Lands Selection

- Montana Fish, Wildlife, and Parks
- Montana State Trust Lands
- The Nature Conservancy
- US Forest Service

Road System

- NHS INTERSTATE
- NHS HIGHWAY
- PRIMARY HIGHWAY
- SECONDARY HIGHWAY
- URBAN HIGHWAY
- CITY-COUNTY ROADS
- RailRoads

FIGURE 6-1

SEELEY LAKE MONTANA

POTENTIAL SITE LOCATIONS

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6.4 Treatment Alternatives

There are numerous treatment alternatives available for consideration for the District's wastewater project. Below is a summary of the most applicable alternatives discussed in this section, and either dismissed or recommended for further evaluation. Multiple variations exist with many of these alternatives.

1. No Action
2. Naturally Aerated Facultative Lagoons
3. Mechanically Aerated Lagoons
4. Total Retention Ponds (Evaporation)
5. Activated Sludge Mechanical Treatment Plant
6. Biological Nutrient Removal – Mechanical Plants
7. Storage and Irrigation (Low Rate Land Application)
8. Subsurface Flow Constructed Wetlands
9. Septic Tank/Dosed Drainfield
10. Septic Tank, Sandfilter and Dosed Drainfield

6.4.1 No Action Alternative

The No Action Alternative means no improvements would be made to the existing method of wastewater treatment and disposal. Individual residences and businesses would continue to utilize on-site septic tanks and drainfield systems. Locating sufficient areas for drainfield replacement would be difficult and it seems likely that more seepage pits would be constructed in the future to allow for continuation of the existing facilities. Both residential and commercial facilities will find it increasingly difficult to satisfy the County on-site wastewater regulations. New development within the community would be very unlikely and economic growth would be stifled. Degradation of the groundwater resources in the area would continue, as would impacts to Seeley Lake from improperly treated septic tank effluent. Eutrophication of the lake could have impacts to this tourist community from both an environmental and economic perspective. It should also be noted that the community currently obtains its water supply from Seeley Lake. Several lakeside residents also obtain drinking water from the lake or nearby groundwater wells. Based on the continued degradation of groundwater and surface water resources in the area the No Action Alternative will not be considered further in this PER.

6.4.2 Naturally Aerated Facultative Lagoons

Facultative lagoons are medium depth ponds (typically 6 feet) that have both aerobic and anaerobic zones. These lagoons depend on natural biological, chemical and physical processes to stabilize the wastewater. Oxygen for biological stabilization is provided by natural aeration at the water surface and by algae through photosynthesis.

The treatment process is entirely natural and requires no mechanical aeration equipment. The only operation required is to direct flow from series to parallel operation should odors become a problem and to watch the pond level to ensure adequate storage is available should spring turnover temporarily suspend discharge. As with all wastewater ponds, the operator must periodically mow embankment vegetation, monitor effluent quality and exercise valves. Sludge removal is required every 10 to 20 years. Operation and maintenance of this technology is very simple and inexpensive.

This type of treatment process disposes of treated effluent by discharging to surface water, ground water, or land application. A discharge permit is required for discharge to surface water or ground water. The permit establishes contaminant concentration and load limits that cannot be exceeded. Monthly wastewater effluent samples are required. The operator that takes the samples must be properly licensed by the State of Montana and the samples must be analyzed by a certified lab in order to provide results to DEQ for review.

The biggest disadvantage with this process is the large pond area and volume required. Large pond area is required to provide sufficient oxygen by surface re-aeration. Also, the rate of organic decomposition is slower than other treatment processes because of poor mixing characteristics and the slower rate of oxygenation. This slower rate requires more detention time and therefore more volume. In addition, ice and snow cover can limit sunlight penetration needed for photosynthesis and the cold winter temperatures can greatly inhibit treatment capacity. The winter performance of facultative ponds is marginal and state design standards require sufficient storage for 180 days of detention and also require that the system have a 3-cell configuration.

The simplicity of operation makes this treatment alternative attractive to small communities and subdivisions that have limited resources for operation and maintenance. However, the District currently does not have a surface water or ground water discharge permit. The required land area is not feasible for the District. Therefore, this alternative will no longer be considered.

6.4.3 Mechanically Aerated Lagoons with Discharge

This lagoon technology uses some mechanical means for diffusing air into the wastewater. The upper zone of the pond is aerated and therefore in an aerobic environment and the lower portion is in an anaerobic environment. This process is known as a partial mix mechanically aerated facultative lagoon. Mechanical aeration may be accomplished by blowers and subsurface diffusers or by mechanical agitation at the surface using various forms of surface aerators. Pond depths vary between 10 and 15 ft. The operator must maintain the blower and aerators, monitor dissolved oxygen in the ponds, periodically mow embankment vegetation, and monitor effluent quality and exercise valves. Sludge removal is required every 10 to 20 years.

This type of treatment process often disposes of treated effluent by discharging to a nearby stream or lake. A MPDES discharge permit from DEQ is required for surface water discharge. The permit establishes contaminant concentration and load limits that cannot be exceeded. Monthly wastewater effluent samples are required. The operator that takes the samples must be properly licensed by the State of Montana and the samples must be analyzed by a certified lab in order to provide results to DEQ for review. This technology would typically be used when secondary standards only must be satisfied for discharge. This technology is not designed to remove ammonia, nitrogen and phosphorous and would not be used when the permit requires the removal of these parameters.

Aerated ponds could be used for groundwater disposal, but only in those situations with a high level of groundwater dilution. Using this technology for groundwater disposal is not likely in most situations. Mechanically aerated ponds provide better mixing of organics and oxygen than shallow naturally aerated facultative lagoons. Also, the mechanical equipment provides oxygen at a greater rate and to a greater depth than their naturally aerated counter parts. These process improvements increase the rate of decomposition of organics and allow for shorter detention times and smaller ponds when compared to naturally aerated ponds. The state design standards require 20 days of detention time and the systems are often designed with 30 days of detention time. Pond volumes may be 1/6 to 1/10 the size of the naturally aerated facultative ponds.

Capital cost savings are often realized with the smaller ponds. The primary disadvantage is the need for mechanical equipment to accomplish these process improvements and the associated increase in operation and maintenance time and expense. As mentioned previously, mechanically aerated ponds are designed to meet traditional secondary standards and are not designed to meet more stringent standards for nitrogen and phosphorous. Because discharge permit limits will include ammonia (surface water), nitrogen (surface/ground water) and phosphorous (surface/ground water) limits, this technology will not be evaluated further in this report for surface water disposal or groundwater disposal. However, this technology can be used in conjunction with crop irrigation of wastewater effluent, and will therefore be evaluated further in conjunction with the Storage and Irrigation Alternative mentioned below.

6.4.4 Non-Discharging Treatment Lagoons (Total Retention)

The total retention treatment system consists of large shallow ponds (4 - 6 feet deep) that rely on evaporation to eliminate the wastewater effluent. Solids are periodically removed and properly disposed of via land farming or licensed solid waste facilities. These systems require considerably more land area than a non-aerated discharging facultative or aerated lagoon systems due to their reliance on evaporation for effluent disposal. An arid climate and high evaporation rate is needed to successfully apply this technology.

The ponds must be lined to prevent wastewater seepage into the groundwater. The ponds should provide sufficient control structures and piping to allow some redirection of flows to prevent odors. Treated effluent is disposed by evaporation so no discharge permit is required. The ponds are extremely simple to operate and maintain, they are reliable, and are not heavily regulated because they do not require a discharge permit. For these reasons they are very good for small communities but less practical for larger communities due to the extensive size. Total retention lagoons are not technically feasible for this area because the 10-year wet precipitation (27.04 inches) exceeds the annual evaporation (23.81 inches); therefore, this technology will not be evaluated further.

6.4.5 Activated Sludge Mechanical Treatment Plant

Activated sludge is a biological treatment process that takes place in aerobic and anaerobic atmospheres whereby waste is stabilized by aerobic microorganisms. The aerobic environment is achieved by means of diffused or mechanical aeration in a concrete basin. After being aerated, the biological mass is separated from the liquid in a clarifier (settling tank). A portion of the settled biological mass is then recirculated to the aeration basin to maintain a continuous colony of microorganisms for treatment. The liquid stream coming off the clarifier is typically disinfected and discharged to nearby surface water or groundwater.

There are a number of variations of the activated sludge treatment process, including but not limited to, extended aeration (high introduction of oxygen and long detention times), contact stabilization (raw wastewater contacted with activated sludge), complete mix-activated sludge (homogeneous mixing with uniform organic loadings), oxidation ditches, sequencing batch reactors (SBR), and others. Treatment plants are complex mechanically and require power and operator skill. Systems may be provided as pre-manufactured package plants for smaller flows and as custom designed and constructed facilities for the larger flows.

A portion of the settled biological mass is wasted where it is further treated and disposed. The wasted sludge may be thickened and then sent to a digester for stabilization. Stabilized biomass may be further thickened prior to disposal. Activated sludge plants were initially designed for secondary treatment and have traditionally been applied to surface water discharge. They may also provide nitrification to satisfy ammonia standards. Because this technology cannot remove high levels of nitrogen and phosphorous; it will not be able to address possible permit limits due to TMDLs and numeric nutrient standards. Traditional activated sludge plants will not be considered further. Over time, the demand for the removal of nutrients such as nitrogen and phosphorous has resulted in adaptations of the activated sludge process to accomplish biological nutrient removal.

6.4.6 Biological Nutrient Removal – Mechanical Plants

As mentioned previously, the activated sludge process has been modified to accomplish biological nutrient removal (BNR). The simplest adaptation is to add an anoxic reactor in front of the traditional activated sludge process and a recycle stream back to the anoxic basin from the aeration basin. The amount of air and the size of the reactors must also be adjusted to accomplish the conversion from traditional activated sludge to biological nutrient removal. This BNR revision is referred to as the Modified Ludzack-Ettinger (MLE) process and is designed for nitrogen removal. This process is basic to all nitrogen removal processes in that all nitrogen removal requires oxic and anoxic conditions. The total nitrogen in raw wastewater must be converted to nitrates in oxic conditions and the nitrates must then be converted to nitrogen gas in anoxic conditions. The MLE process can be expected to achieve effluent limits of approximately 7.5 to 10 mg/l total nitrogen.

The MLE process has been enhanced to accomplish a higher degree of treatment by adding a second stage and an outside source of carbon. Such adaptation may achieve 5mg/l total nitrogen; in some cases a post denitrification filter of some type has been added. These numerous process modifications can improve performance of biological nutrient removal plants. They include such processes as the 4 stage Bardenpho process and others. These process modifications can result in effluent permit limits as low as 3 mg/l total nitrogen. This is generally considered the limits of technology for biological removal of nitrogen.

Phosphorous removal is accomplished by adding an anaerobic basin in front of the MLE process. This process is referred to as the A2O process and is basic to phosphorous removal. Like nitrogen removal, several process adaptations have been made to improve phosphorous removal.

Aeromod is a package BNR plant. This plant utilizes a different reactor basin for each treatment process, aeration nitrification, denitrification, and clarification. The influent flows into a selector tank where it is combined with returned activated sludge from the clarifiers. This returned activated sludge is from the previous treatment cycle. The mixture of raw influent and returned activated sludge then flows into continuously aerated first stage aeration tanks where adequate retention time is provided to achieve BOD and ammonia removal (nitrification). The flow then continues into the second stage aeration tanks where aeration is sequenced on and off in several different zones for approximately two hours. This results in denitrification without turning the blowers on and off. The mixture then enters the clarifier where biomass is settled and returned to the selector tank. The clarified effluent is discharged and solids are automatically wasted to the sludge digester. Digested sludge is dewatered and stored until it can be disposed of through land application or in a landfill. In the final step, the treated wastewater will be disinfected with UV disinfection and discharged to surface water or ground water. The treatment efficiency is also very high. Some of these package systems have been able to consistently produce 5 mg/l total nitrogen in northern climates.

Membrane bioreactors (MBRs) typically utilize the MLE process prior solids removal by a membrane filter. The membrane filter simply replaces the need for a clarifier to separate solids and will result in better nitrogen removal than the traditional MLE process because the TSS removal is very good. Both nitrogen and phosphorous are part of the cell mass removed with TSS removal. The bulk of the nitrogen and phosphorous removal however is still dependent on the biological process (MLE or A2O) preceding the membrane unit. The advantage of the MBR is that it will result in slightly higher level of nitrogen removal than the traditional MLE process. MBR require addition RAS recycle power and permeate pump power. This will result in higher O&M costs, but may be worth it if the higher level of treatment achieved is required and justifies the increased cost. There is a space savings with the MBR, depending on how it is configured, because the clarifier is eliminated and the reactor may be smaller. However, it is important to remember that the rest of the plant facilities are still needed such as headworks, digesters, labs, disinfection, solids handling, etc. In this sense, the overall plant space savings may be more modest than that often reported when only a direct comparison of reactor size is made to other processes. Some manufacturers have placed batch reactors in front of membrane units to provide the biological nutrient removal necessary.

The oxidation ditch reactor was traditionally designed as an extended aeration activated sludge process. This extended aeration process resulted in a system that was very forgiving and operator friendly. The reactor can be modified in a couple of ways to result in the creation of oxic and anoxic conditions. The reactor can be used as an anoxic reactor proceeded by the addition of an anoxic reactor to create an MLE process. Or the reactor can be designed to create internal oxic and anoxic conditions.

An SBR is a batch process that has been used extensively in wastewater treatment. A single reactor is used for all treatment processes including aeration, biologic treatment, and clarification. Since the SBR treats wastewater in batches, a minimum of two tanks are required. The tanks operate 180 degrees out of phase, so while one tank is filling, the second tank is going through the aeration, clarification, and decanting cycles. The operational cycles of each tank are switched after each batch. When treatment is complete the treated effluent is decanted via floating decanters to an equalization basin for follow up treatment. An equalization basin allows any downstream process units, like disinfection, to be sized for system design flows rather than the higher flow rate of the decanter. Also after each batch, some of the sludge must be wasted from the SBR tank and sent to a sludge digester. Digested sludge is dewatered and stored until it can be disposed of through land application or in a landfill. In the final step, the treated wastewater will be disinfected with UV disinfection and discharged to surface water or ground water. This system has the advantage of no recycle, which makes it simple for small communities to operate. The treatment efficiency is also very high. Some systems have been able to consistently produce 5 mg/l total nitrogen in northern climates.

Great West Engineering has completed detailed analysis for other projects that directly compared the above technologies and has typically found them to be competitive with each other. A few common advantages and disadvantages seem to emerge based on the inherent design of each. However, there is no one technology that is superior to the other. Each has its proper place in application. Which one is preferable is dependent on the site and the desires of the community. When compared, life cycle costs for each alternative have typically been pretty close, within 10 to 20% of each other. The oxidation ditch treatment system is typically more expensive with a larger foot print than the SBR. The MBR is often more expensive form both capital and O&M costs than the SBR. MBR utilize a smaller foot print than the SBR, which may be important at sites where land limitations are severe. The MBR will result in slightly better nitrogen and phosphorous removal due to the higher removal of TSS from the membrane when compared to those technologies relying on clarification.

The space advantages of an MBR technology are overwhelmed by the significant space needs associated with ancillary facilities and higher levels of treatment may be required, MBRs will be evaluated further in the planning stages of this project. The oxidation ditch does not appear to offer any obvious advantage at this stage, nor do other technologies such as Bio-Wheel. For these reasons, an SBR plant and an MBR plant are thought to be the most appropriate mechanical treatment technologies for the Seeley Lake Sewer District at this stage of planning. During the design stage each of the above technologies will be investigated again prior to finalizing the design concept.

6.4.7 Storage and Irrigation (Low Rate Land Application)

Low-rate systems (irrigation) apply wastewater to the soil much less intensively than high rate systems (rapid infiltration ponds) and require much more land area. Typically, the wastewater is treated in primary cells, stored in 4 - 8 feet deep storage cells during the winter months, and then applied to cropland or pasture during the summer months using sprinkler irrigation equipment. Secondary treatment must be achieved prior to irrigation so lagoon technologies prior to irrigation are adequate. The wastewater must also be disinfected and filtered prior to irrigation if the public will utilize the irrigated site (golf course or park). When the irrigation site is not public (cropland or pasture), disinfection is not required, but a 200 foot buffer area is required around the irrigated acreage to minimize public access. Disinfection is required if the 200 foot buffer zone requirement cannot be satisfied. Remote locations are preferred.

In northern climates, where the growing season is limited, sufficient storage (180 to 230 days) is required during the non-growing season. This treatment technology has been excluded from the nondegradation rules if the system is designed for 100 percent nitrogen uptake by the irrigated crops. A groundwater discharge permit would not be required. This technology is feasible and will be evaluated in more detail in the next Chapter.

6.4.8 Subsurface Flow Constructed Wetlands

Constructed wetlands are emerging as an easily operated, efficient alternative to conventional treatment systems. The most common uses are municipal wastewater and acid mine drainage. This technology is relatively new (mid-1980s), but has been applied to several municipal facilities throughout North America and Europe. Europe tends to use the technology more for primary treatment. In North America wetlands often follow some form of primary treatment such as lagoons and septic tanks.

Constructed wetlands are artificially created wetlands using either subsurface or surface flow. Surface flow constructed wetlands consist of a basin or channels with some type of lining to prevent seepage. Soil is added to the bottom of these basins or channels to support emergent vegetation. The wastewater in these systems is exposed to the surface and therefore called free water surface wetlands.

Subsurface wetlands are basins or channels that are lined to prevent seepage and are filled with coarse grained material such as sand and gravels. These coarse grained materials allow wastewater to flow through the system, but below the free surface. The coarse grained material also supports the aquatic vegetation planted throughout the basin or channels. Typical vegetation planted in constructed wetlands include cattails, bulrushes, and reeds.

These systems rely on both aerobic and anaerobic biological processes to remove nutrients. The flow path through these systems is horizontal and the final effluent is generally collected at the end by an effluent manifold. These systems may discharge to groundwater or surface water. However, this technology is not feasible for discharge to surface waters based on the discharge permit requirements discussed in Section 5. Given the significant pretreatment and storage requirements, this technology has generally been more expensive than many of the other technologies. Additionally, there is less data available to support this type of treatment in our climate. Due to these facts, this technology will not be evaluated further in this report.

6.4.9 Septic Tank/Pressure Dosed Drainfield

The standard septic tank/drainfield type of treatment system is typically applied to individual residences or small subdivisions, but is occasionally applied to very small communities. This system consists of two primary components; the septic tank and the drainfield. Wastewater is delivered to the septic tank from the collection system. The septic tank size is based on the amount of flow generated by the users. The septic tank is typically made of concrete with a baffled inlet and outlet. The function of the septic tank is to separate solids from liquids and provide anaerobic treatment of the solids.

The partially treated liquid wastewater is then pumped from the septic tank to the drainfield. The drainfield consists of a series of distribution pipes with holes through which the wastewater is uniformly distributed. The distribution pipes discharge the wastewater into buried seepage trenches or beds designed to spread the wastewater out and facilitate seepage into the subsoil. The sewage is only partially treated in the septic tank, and the system relies on the soil to provide both treatment and disposal. The treatment is accomplished by the formation of a biomat at the interface of the trench bottom and existing ground surface and is largely aerobic in nature. Experience has shown that 4 feet of soil depth under unsaturated flow conditions is necessary for proper treatment.

The soil can be neither too coarse such that a biomat is not formed or too fine such that the wastewater will not drain. With the majority of wastewater treatment and disposal taking place together in the soil matrix, there is potential for insufficient treatment prior to disposal. Therefore careful consideration must be given to site conditions including soil texture, groundwater depth and bedrock depth, groundwater flow direction, and potential contamination impacts. Properly sited, designed, constructed and maintained, the standard septic tank/drainfield type of treatment system can provide adequate wastewater treatment and is an accepted wastewater management method.

This technology does not provide significant nitrogen removal and may have difficulty in some cases satisfying the nitrate requirements of the nondegradation regulations in aquifers with low hydraulic conductivities. This process would require the community to obtain a groundwater discharge permit. It is not practically feasible to satisfy the nondegradation requirements for this type of treatment in the Seeley Lake area; therefore, the standard septic tank and drainfield treatment alternative will not be considered further.

6.4.10 Septic Tank/Sandfilter/Pressure Dosed Drainfield

A sandfilter is a treatment unit included in the design of the standard septic tank/pressure distribution drainfield system previously described. The purpose of the sandfilter is to improve the quality of the effluent discharged to the pressure distribution drainfield. This will provide the additional treatment necessary prior to disposal when site conditions are marginal. A sandfilter will also provide some nitrogen removal and will improve the treatment systems ability to satisfy the more stringent nondegradation regulatory requirements.

Wastewater from the collection system is delivered to a large septic tank. The septic tank includes an effluent pump or a separate dosing chamber to pump effluent to the sandfilter's distribution piping or rock distribution system. The sandfilter distributions system is situated on top of the sand layer and the function is to uniformly distribute effluent across the sandfilter surface area.

Wastewater effluent then trickles through a sand layer in an unsaturated flow condition where it is biologically treated in an aerobic environment. At the bottom of the sandfilter the wastewater is collected and discharged to a drainfield for disposal into the subsoil.

There are several variations of sandfilter design concepts; however, they generally fall into two categories: single pass sandfilters (intermittent) and multiple pass sandfilters (recirculating). The process discussed above was the single pass or intermittent sand filter. The multiple pass or recirculating sandfilter design employs a recirculating mixing/pumping tank between the septic tank and the sandfilter and piping between all of the treatment units. This allows the septic tank effluent to be mixed with the treated effluent from the sandfilter. A portion of this mixture is recirculated to the sandfilter and another portion is discharged to the drainfield. The recirculating design is more complicated with additional pumps, piping, valves and controls but allows for a higher loading rate and therefore a smaller sandfilter. The recirculating design does not produce as high a quality effluent as the intermittent design and is more complex, but the smaller size filter has economic and space advantages for the larger central systems.

Sandfilters have the advantage of providing better effluent quality and more control over the treatment process when compared to the septic tank and drainfield systems but are more expensive. Table 3-5 indicates that this type of system will only satisfy the nondegradation regulations if the hydraulic conductivity of the area aquifer is greater than 50 ft/day and requires a drainfield width of 10,000 feet. Previous discussion of the area's geology and well log data indicates that hydraulic conductivities higher than 10 ft/day are not likely. The table in Chapter 3 has demonstrated that it is not practically feasible to satisfy the nondegradation requirements for this type of treatment in the Seeley Lake area; therefore, the this alternative will not be considered further.