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Jefferson Lake Drive Feasibility Study

Jefferson Lake Drive Area
Middle Jefferson Lake
Le Sueur County, Minnesota

Prepared for:

LE SUEUR COUNTY, MN

CLEAN WATER LAND & LEGACY AMENDMENT

Prepared by:

WENCK ASSOCIATES, INC.
1800 Pioneer Creek Center
P.O. Box 249
Maple Plain, Minnesota 55359-0249
(763) 479-4200

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1.0 Introduction

1.1 BACKGROUND

The Jefferson Lake Drive Feasibility Study Area is located in the southwest quarter of the southwest quarter of Section 35, Township 110N, Range 25W and in the northwest quarter of the northwest quarter of Section 2, Township 109N, Range 25W along the west shore of Middle Jefferson Lake in Le Sueur County, Minnesota (Figures 1 and 2). The community is unsewered, and resident wastewater needs are met by individual subsurface treatment systems (ISTS)[1]. Wenck Associates, Inc. (Wenck) was retained to assess the probable compliance status of any existing ISTS, and to provide soil-based subsurface sewage treatment system alternatives for viable long term infrastructure to collect and treat wastewater for the residents of the Jefferson Lake Drive neighborhood.

The Jefferson Lake Drive Feasibility Study is being produced by Wenck as an addition to a larger project, the Jefferson German Septic Inventory Project (JGSIP). The goal of the JGSIP was to complete as many ISTS compliance inspections within the German-Jefferson Subordinate Service District (District) as possible, in order to determine to what extent a septic system compliance problem exists within the District. Wenck was retained to assess the compliance status of existing ISTS in the project area with respect to Minnesota Rules Chapters 7080-7081, the Le Sueur County Zoning Ordinance: Section 17 Subsurface Sewage Treatment Systems, and the Interim ISTS Standards for the District.

[1] ISTS (a.k.a. septic system) is defined in Minnesota Rule Chapter 7080 as a type of Subsurface Sewage Treatment System (SSTS) that treats and disperses wastewater.

The JGSIP was funded through a Clean Water Legacy Grant from the Minnesota Board of Water and Soil Resources. The JGSIP was open and available to all property owners who have an ISTS in the District. The Le Sueur County Board decided to make participation in the project voluntary. In order to be included in the JGSIP, the homeowner was required to fill out a survey form and return it to Wenck with a signature affirming their participation in the program. Once the homeowner survey with permission signature was received, the property was placed within the active properties and the SSTS compliance inspection process began. All properties that did not choose to participate in the JGSIP were evaluated for likely septic system compliance via an Unsewered Area Needs Documentation (UAND)[2].

Upon completion of the JGSIP inspection process, it was decided by the County that select high-need areas within the District should also be evaluated for future wastewater infrastructure options. The Jefferson Lake Drive Area was one such area chosen for a Feasibility Study based on a low percentage of compliant soil treatment areas and the high number of small lots with very few future ISTS options outside of holding tanks. The findings presented in this report will aid homeowners in the Jefferson Lake Drive Area and the District as a whole in making decisions related to future wastewater infrastructure.

1.2 FEASIBILITY STUDY PURPOSE

This report is a planning document for possible long-term solutions for wastewater collection and treatment within the neighborhood of Jefferson Lake Drive. Within this report are developed concepts and a framework to provide sanitary sewer service to the existing residences in the area. A cluster system alternative has been developed in this report for long-term wastewater treatment infrastructure. This feasibility study and other similar Feasibility

[2] Unsewered Area Needs Documentation is an MPCA protocol for estimating community wastewater conditions. Permit and housing records, aerial imagery, soil survey data, knowledge and experience in the area, survey responses, conversations with local residents, and off-property field assessments are used to determine likely ISTS compliance status for properties when an on-site inspection is not possible.

Studies can be used by the District for overall wastewater management planning for the neighborhoods along the Jefferson German chain of lakes.

1.3 WORK PERFORMED

The baseline for the analysis was completed in 2011 and 2012 to as part of the JGSIP. The Feasibility Study went beyond this to evaluate future ISTS and cluster soil-based wastewater treatment options for residents. Useful background information regarding some different ISTS specifics (i.e., drain field trench vs. mound) produced by the University of Minnesota Onsite Sewage Treatment Program (OSTP)[3] is found in Appendix A.

Three alternatives have been evaluated to identify long-term wastewater infrastructure solutions.

Alternative 1: Existing homes install compliant ISTS

Alternative 2: Combination of ISTS and Cluster system

Alternative 3: Cluster system serving entire community

Within the Jefferson Lake Drive Feasibility Study Area, there are 24 residential properties with permanent wastewater generating structures, 12 of which participated in the JGSIP. One property is currently vacant and does not contain a septic system.

For Alternative 2, 13 selected properties were included in analysis of a Large Individual Subsurface Treatment System (LISTS) cluster system with 12 remaining properties to install compliant individual systems (ISTS) on their property (Figure 6). These 13 selected properties were included because their only likely future compliant ISTS option is a holding tank. For Alternative 3, All 25 properties were selected for inclusion in analysis of a Midsized Subsurface

[3] University of Minnesota Onsite Sewage Treatment Program is the organization that provides the technical training and continuing education for individuals who design, inspect, install, and maintain ISTS in Minnesota. Additional homeowner information regarding ISTS can be found at their website: http://septic.umn.edu/

Treatment System (MSTS) cluster system; parcels may be added or removed from the cluster system as a project develops (Figure 7). For the purpose of the Alternatives 2 and 3 analysis, the one vacant property was included. A potential two bedroom home was assumed for daily flow calculations. The cost for an individual property to install a compliant ISTS on their property (Alternative 1) is included in Appendix B.

2.0 Existing Conditions

2.1 INTRODUCTION

This section summarizes the findings of the existing condition of ISTS. All the properties evaluated are served by an ISTS, which includes holding tank systems. A determination of likely ISTS compliance status was made at each property. In addition, a determination was made as to whether it was feasible to replace the existing system with a new ISTS to provide compliant wastewater treatment. In the Jefferson Lake Drive Feasibility Study area, there are 31 distinct tax parcels. Several properties are composed of two or more tax parcels, but are being operated as one residence with one ISTS. For this reason, each distinct residence has been assigned a Feasibility Study ID Number to help represent situations where a single residence and septic system cover more than one tax parcel. There are 25 distinct residential properties, which are labeled by a Feasibility Study ID Number in applicable figures and in the parcel data spreadsheet in Appendix B.

Individual parcel information was provided by Le Sueur County. The neighborhood of Jefferson Lake Drive features 24 distinct residential properties with wastewater generating residences and onsite wastewater systems (including holding tanks) and one currently vacant property. Of the 24 residential properties, 12 participated in the JGSIP and received a full ISTS compliance inspection from an ISTS inspector licensed by the Minnesota Pollution Control Agency (MPCA). Likely compliance status for the non-participating parcels was determined through completion of the UAND process, which includes: examination of public records, conversations with local residents, compliance inspections of neighbors, knowledge of local soils, and roadside observation. See Appendix B for property details.

2.2 METHODS

Wenck was able to access all JGSIP participating properties to complete a visual site inspection of any existing ISTS with the intent of: documenting Imminent Threats to Public Health or Safety (ITPHS)[4]; assessing likelihood of ISTS protection of groundwater[5]; and evaluating future onsite ISTS options. The feasibility of a soil based treatment system naturally depends on local soil conditions. In addition to examining available Soil Survey data, Wenck performed soil borings to determine soil type and determine depth to seasonally saturated soils. Soil survey and field collected soil boring data were used to estimate likely soil conditions throughout the Jefferson Lake Drive Feasibility Study Area, including non-participating properties and potential cluster system soil treatment areas.

Prior to commencement of field work, Le Sueur County provided available past permitting/design/inspection records for individual properties as well as a GIS shape file of individual tax parcels, structures, and infrastructure. Homeowner surveys were collected by Wenck to gain further knowledge of the parcel occupancy status, water supply, and wastewater treatment infrastructure. The surveys were used to evaluate seasonal and parcel specific water usage and wastewater generation and to provide a baseline for parcel investigation and evaluation. Information gleaned from these surveys was incorporated into Appendix B.

Upon completion of compliance inspections performed during the JGSIP on the 12 participating properties, Wenck began the feasibility study by visiting the community to conduct a UAND of the remaining 13 properties. In addition, land for a potential cluster treatment area was visually

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[4] ITPHS is defined in 2011 MN Rules Chapter 7080.1500 Subp. 4A. "…a system that is an imminent threat to public health or safety is a system with a discharge of sewage or sewage effluent to the ground surface, drainage systems, ditches, or storm water drains or directly to surface water; systems that cause a reoccurring sewage backup into a dwelling or other establishment; systems with electrical hazards; or sewage tanks with unsecured, damaged, or weak maintenance hole covers."

[5] Failure to protect groundwater is defined in 2011 MN Rules Chapter 7080.1500 Subp. 4B. "…a system that is failing to protect groundwater is a system that is a seepage pit, cesspool, drywell, leaching pit, or other pit; a system with less than the required vertical separation distance described in items D and E; and a system not abandoned in accordance with part 7080.2500."

inspected from the public right of way for potential soil disturbance or other issues that would affect cluster design. Aerial photographs, soil survey information, and local topography were evaluated in concert to determine the most likely potential cluster treatment area locations. An evaluation was also made to determine if suitable area existed onsite for a future ISTS and what type of system would most likely be installed.

2.3 FINDINGS

Information collected related to individual properties included:

- information on source of drinking water,
- the type of dwelling or wastewater generator contained within the parcel,
- type of ISTS (if any) currently serving the residence,
- the likely compliance status of the ISTS, and
- the most likely next ISTS to serve the dwelling.

2.3.1 Drinking Water Source

All residences within the study area are served be eight shared wells. Each well was identified as a "deep" well, which means it is screened at greater than 50 feet below the ground surface. Well locations reported on homeowner surveys were identified and located via GPS in the field. Depth and location of wells must be taken into account when considering ISTS setback requirements. Drain fields and mounds must be set back at least 50 feet from a deep well. All currently known wells are shown on Figure 3.

2.3.2 Property Type

Table 1 shows the type of wastewater generating structures in the study area. The data in the table was collected via homeowner surveys and conversations with neighborhood residents. An important factor when considering the nature of wastewater generated by a given property is whether the home or business is occupied all year or seasonally. A seasonal residence can produce a different strength of waste, as well as a different pattern of wastewater flow than a full-time residential home. Of the 25 assessed Jefferson Lake Drive properties, 13 were identified as being seasonally occupied, while 11 are permanent residences. One property is vacant.

Table 1: Parcel Dwelling Type

Usage Pattern	Number	Percentage
Permanent Residential	11	44%
Seasonal Residential	13	52%

2.3.3 ISTS Types

Table 2 provides a breakdown of the ISTS types in the Feasibility Study area for all properties. The descriptions listed in this table are common names.

Table 2: Existing ISTS Types

ISTS Type	Number	Percent of Total
Holding Tank	8	32%
In-Ground Drainfield	11	44%
Mound	1	4%
Peat Filter	1	4%
Unknown	3	12%
No System	1	4%

2.3.4 ISTS Compliance Status

The JGSIP and the UAND process determined if the property's system is compliant or non-compliant with Minnesota Rules Chapter 7080 and Le Sueur County ordinance. Compliance inspections reports were submitted to Le Sueur County. The ISTS that are non-compliant were identified as such for Failure to Protect Groundwater (FTPG). Table 3 summarizes the ISTS compliance status data for the 24 evaluated properties with wastewater systems. Appendix B contains a table that shows the likely compliance status of the evaluated properties. See Figure 4 for a map of the each property's compliance status.

Table 3: ISTS Compliance Status

Status	Number	Percentage
Non-Compliant ITPHS	0	0
Non-Compliant FTPG	14	58%
Compliant	10	42%

2.3.5 Existing Septic Tank Compliance

Even though a property's ISTS soil treatment area may be non-compliant, a septic tank may exist at a property that meets current compliance requirements and could be used in a future ISTS or community cluster system. During field reconnaissance, tanks were evaluated (probed, pumped, and permit records reviewed) for water tightness below the outlet of the tank. Average costs for replacement of non-compliant tanks are accounted for in Appendix B. For estimating future costs, UAND assessed properties with non-complaint ISTS were assumed to also have non-compliant tanks that will need to be replaced. Table 4 summarizes the tank compliance status of the 24 evaluated properties with septic tanks.

Table 4: Tank Compliance Status of Evaluated Properties

Status	Number	Percentage
Compliant Tank	16	67%
Non-Compliant Tank	8	33%

3.0 Alternatives Analysis

3.1 INTRODUCTION

When considering alternatives for long term wastewater infrastructure, three components need to be evaluated. These components are:

1. Collection: The means in which wastewater leaves the individual structure and is conveyed to the primary treatment unit.
2. Treatment: Removal of pathogens and nutrients in primary and secondary processes.
3. Effluent Dispersal: Final distribution of treated effluent to surface waters, the ground surface, or subsurface soils.

With many ISTS, the treatment and effluent dispersal components occur with the same infrastructure – a drain field removes pathogens and viruses while dispersing the effluent. The two components are broken out separately, however, because a septic tank does provide a primary treatment mechanism. In addition, state rules require some cluster SSTS to employ additional "pre-treatment" methods prior to effluent dispersal. The following alternatives are available for long-term wastewater infrastructure:

Alternative 1: Existing homes install compliant ISTS
Alternative 2: Combination of ISTS and Cluster System
Alternative 3: Cluster System serving entire community

This section discusses the alternatives and highlights advantages and disadvantages. Cost estimates for the alternatives are discussed in Section 4.0.

3.2 INDIVIDUAL SEWAGE TREATMENT SYSTEMS (ALTERNATIVE 1)

There are two possible management/ownership options for utilizing ISTS for treatment of wastewater: community management/ownership and private management/ownership.

3.2.1 Community Managed ISTS Program

A Community Managed ISTS Program utilizing the best available onsite technologies and management can be effective in protecting public health and the environment. The District would be the financial and operational vehicle to assist property owners with ISTS upgrades. The District would oversee management of the systems through either employees or sub-contracts for financial and operational services.

In this scenario, once property owners upgrade their ISTS to a compliant status, all property owners would pay annual sewer treatment fees for ongoing operation, maintenance, pumping, and a repair reserve fund for their ISTS. The amount each pays may be proportional to the required annual maintenance expense incurred and/or requirements of the lender. All system types would require some level of annual maintenance expense; however, fees may vary based on the system type.

There are a few noted advantages to a community managed ISTS program. Individual property owners have fewer worries about management, as the community oversees maintenance, such as tank pumping. The community has the assurance that all systems are being properly managed. Finally, because the ISTS are owned and operated by a public entity, public funding is accessible.

3.2.2 Private ISTS Program

In this scenario, operation and management of ISTS would continue as is currently practiced. Individual property owners would be responsible for the installation, management, and operation and maintenance of their ISTS. Upgrade and operation and maintenance costs would be paid by the ISTS owner to the appropriate party with no District involvement. Management decisions regarding ISTS in this scenario are made by the property owner, not the community. Because ISTS would be owned by several individuals rather than one, a county-issued ISTS permit would be required for each ISTS. Typical life expectancy for a properly installed and maintained ISTS is 20-30 years, but varies by system depending on use patterns, construction, materials, and maintenance. Costs estimated in Section 4.0 for Alternative 1 assume a private ownership structure.

Advantages of private ISTS ownership include lower permitting requirements and lower overall costs for installation and operation and maintenance. Disadvantages include management by individuals rather than the community, which can lead to poor decision making and potential environmental concerns such as are being experienced now in the Jefferson Lake Drive neighborhood.

3.2.3 ISTS Upgrades

As stated in Section 2.3.4, 58% of ISTS in the Feasibility Study area are in non-compliance. The ISTS type needed at upgrade is significant as it directly influences the capital costs for the upgrade as well as long term operation and maintenance costs.

Figure 5, as well as the spreadsheet in Appendix B, shows each property's most likely future ISTS option. The type of future ISTS varies based on the lot size, soils at the site, and current land use. Soil was evaluated and confirmed at all properties inspected as part of the JGSIP, with depths to seasonally saturated soil at each lot recorded in Appendix B.

For a dwelling that does not have a suitable area for an ISTS, the next ISTS would likely need to be a holding tank because of the lack of space. Minnesota Rules, part 7080.2200 – 7080.2400 (March 2011) define different ISTS system types; a brief summary of system types is given below:

- **Type 1:** Standard systems including subsurface drain fields or mound systems on undisturbed soils with or without a pump system.
- **Type 2:** Holding tanks (tank with a sealed outlet requiring regular pumping), privies, and systems in floodplains.
- **Type 3:** Systems installed on problem soils, disturbed soils, or soils where high groundwater is within one foot of the ground surface.
- **Type 4 and 5:** Commonly referred to as "performance" systems. These systems offer a level of pre-treatment through a mechanical treatment unit or media filter prior to discharge to a drain field or mound. Also included in this category are systems installed with higher soil loading rates or reduced vertical separation distance to groundwater.

Type 1 systems meet all technical rule requirements, have adequate onsite soils, and are able to meet setbacks. Type 2 systems are holding tanks that need visual and/or audible alarms to notify the owner when pumping is required. The lack of an alarm on a holding tank or the neglect of a homeowner not to pump the tank when full can cause an ITPHS and fail to protect groundwater. Type 2 systems also include systems in floodplains. Type 3 systems require county approval, but can be installed on sites where disturbed soils exist or where a variance is required to install a system not meeting typical setbacks. Adding pretreatment (Type 4 or 5 systems) may allow wastewater effluent to be discharged to a reduced sized soil dispersal area.

ISTS rules dictate that systems that are not considered Type 1 may require an operating permit. Any system with an operating permit will require annual operation and maintenance of the system by a licensed Service Provider[6].

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[6] Service Provider is a license category under MN Rules Chapter 7083.0780. A Service Provider can assess, adjust, and service ISTS for proper operation.

Table 5 summarizes the most likely ISTS to be installed when the non-compliant systems are upgraded at participating properties, assuming a homeowner would not install a holding tank if another option exists.

Table 5: Next ISTS Replacing 14 Non-Compliant Systems by Property

ISTS Type	Number	Percentage
Type 1 Drainfield	1	7%
Type 2 Holding Tank	7	50%
Type 3 Drainfield	3	21%
Type 4 Pretreatment	3	21%

Type 2 systems (Holding Tanks) comprise the majority of likely future ISTS, and can become necessary on small lots, lots with high groundwater, lots with setback constraints, and/or lots with multiple structures with little usable land. These lot constraints can make the installation of any system that discharges to the soil not permittable.

County governments typically will only permit a holding tank system in situations where no other system type is feasible and will not allow them with the construction of new homes. Holding tanks require a higher level of oversight/management than a standard mound or trench system. The hesitation for permitting holding tank systems comes from experiences where homeowners take it upon themselves to empty the tank in an unapproved manner or do not pump the tank when full. Not pumping when the tank is full allows it to overflow out the top or through the seam along the top of the tank. Permitting of Type 2 systems would need to encompass the oversight and pumping frequency of holding tank systems to prevent these situations.

A disadvantage to a holding tank system for a homeowner is the ongoing operational expense of pumping the tank. A full-time residence with two bedrooms and 2-3 residents on average uses approximately 4,000 gallons per month. With a holding tank capacity of 1,000 gallons, pumping frequency would be approximately four times per month. Average tank pumping costs of $150/ 1000 gallons will yield an estimated annual pumping cost of approximately $7,200 (4 times per month*12 months per year*$150 per pump=$7,200 annually).

One non-compliant properties could likely upgrade to a standard mound or trench ISTS. A dwelling can achieve compliance with the installation of Type 1 system with three feet of vertical separation beneath the effluent dispersal area and the seasonally saturated condition. Type 1 systems have nominal operation and maintenance expenses of septic tank pumping on average once every three years and components such as pump replacement, when required. Average annual operating costs for a Type 1 are estimated at less than $100.

Three non-compliant property would likely be able to upgrade to a Type 3 system, which is a standard mound or in-ground trench system on a property with problem soils or that will require a county variance due to the system not meeting various setback requirements.

Three non-compliant properties would likely upgrade to a Type 4 ISTS. Type 4 systems feature active effluent treatment prior to discharging to the soil dispersal area and require annual operation and maintenance oversight and expenses, estimated at about $400 per system per year. Service Providers are trained on ISTS technologies and have the knowledge to operate and maintain Type 4 systems.

Table 6 summarizes what the make-up of the ISTS in the community will be after upgrades to all properties (including currently compliant properties, those choosing not to participate in the JGSIP, and currently vacant properties) if all properties stay on ISTS rather than choosing a cluster system. Even if a parcel has a currently compliant Type 1 ISTS, the future system type installed when the current ISTS no longer functions as designed may be a Type 2, 3, or 4. This same information is depicted on Figure 4.

Table 6: Community Makeup of Future ISTS by Property

ISTS Type	Number	Percentage
Type 1 Drainfield	2	8%
Type 2 Holding Tank	13	52%
Type 3 Drainfield	6	24%
Type 4 Pretreatment	4	16%

3.2.4 ISTS Alternatives Summary

- Community Owned/Managed ISTS Program Alternative
  - Advantages
    - Economy of scale for operation and maintenance expenses
    - Capital costs based on need, you pay for your problem and nobody else's
    - Public financing
  - Disadvantages
    - High operation and maintenance expenses for full-time residents on holding tanks
    - Holding tanks pose practical limitations for future use and development of a property
    - Type 1 or Type 3 mound systems are not desirable for some residents based on visual impact or planned property use preferences
- Private ISTS Program Alternative
  - Advantages
    - Capital and operation and maintenance costs based on need, you pay for your problem and nobody else's
  - Disadvantages
    - High operation and maintenance expenses for full-time residents on holding tanks

- Holding tanks pose practical limitations for future use and development of a property
- Type 1 or Type 3 mound systems are not desirable for some residents based on visual impact or planned property use preferences
- Individuals may choose to forgo proper operation and maintenance practices leading to ISTS failure and environmental degradation

3.3 CLUSTER SYSTEM (ALTERNATIVES 2 and 3)

When a series of homes, generally less than 100, are connected to a decentralized wastewater treatment system, it is commonly referred to as a cluster system (a.k.a. a big septic system). Cluster system ownership, operation, and management occur through a municipality, the formation of a special purpose district, or through private ownership. For the purpose of this report the assumption is made that any cluster system would fall under the ownership of the District to qualify for public funding. Private ownership is an option but presents legal challenges as it relates to land ownership/easements and fee collection.

Using 2011 Minnesota Rules, Part 7081.0120, an average daily flow for each system or wastewater generator is estimated using a formula specified in the rule. This formula calculates a flow based on the number of bedrooms in each of the residences, the treatment system type (individual or cluster), and the total number of wastewater generating parcels included in each system. Average daily flows for are as follows per 2011 Minnesota rules, Part 7080.1860:

- One or two bedroom: 300 gallons per day (gpd)
- Three bedroom: 450 gpd
- Four bedroom: 600 gpd
- Five bedroom: 750 gpd

Table 7 highlights the estimated daily flow to the potential treatment area (calculation in Appendix E). Figures 6 and 7 show the potential collection line routes and a potential cluster treatment area locations.

Table 7: Estimated Permitting Flow Rates

Treatment System Type	Properties Included	Total Daily Permitting Flow Gallons/Day*	Permit Type Required**
Alternative 1: ISTS	25	8,100	County ISTS
Alternative 2: LISTS Cluster + ISTS	25	7,791	County LISTS + County ISTS
Alternative 3: MSTS Cluster	25	6,334	County MSTS

*The permitting flow is not the actual flow, but rather is a design flow that dictates the level of permitting effort required for the system. The permitting flow takes into account allowed reduction in flow for cluster systems with over 10 dwellings and increases in flow for infiltration and inflow into the collection system.
**The permit type required for ISTS assumes that the individual property owners are the owners/managers of the ISTS. The permit type required for the cluster systems assumes the District is the owner of the collection and treatment systems. A midsized-SSTS (MSTS) is a cluster system with a daily permitting flow between 5,000 and 10,000 gallons per day. The LISTS Cluster in Alternative 2 has an estimated design flow of 4715 gallons per day

Design flows would impact permitting of any wastewater alternative. Average daily flow estimates dictate the level of treatment required and other permitting requirements. For average daily flows greater than 10,000 gallons per day within a ½ mile radius of each SSTS owned by one entity, permitting is completed through a Minnesota Pollution Control Agency SDS Permit. Future SSTS with an average daily flow under between 5,000-10,000 gallons per day would be permitted by Le Sueur County using Minnesota Rules Chapters 7080-7083 and would be considered a midsized SSTS (MSTS). In addition, any SSTS with an average daily flow greater than 2,500 gallons per day would be required to meet MPCA design guidance, including design guidance for nitrogen reduction. Greater permitting effort increases the overall cost of SSTS design, construction, and operation and maintenance as more research and investigation is required upfront and pretreatment of effluent may also be required. Table 7 also highlights permitting requirements for individual and cluster treatment options based on average daily flows for the system alternatives.

3.3.1 Collection System

Four collection system methods to convey wastewater or effluent to the cluster system treatment and dispersal sites are available:

- gravity collection via septic tank effluent gravity systems (STEG);
- gravity raw effluent collection to a large septic tank located near the cluster site;
- grinder pump basins at each home to a low pressure force main; and
- septic tank effluent pump (STEP) system at each residence to a small diameter force main.

Based on topography and depth to groundwater of the area and the cost of installing a lift station relative to the small population of the Feasibility Study area, pressure collection would likely be the least expensive collection method. The two pressure options employ similar technologies. A grinder basin sends solids to the treatment site. With a STEP system, solids are retained at all individual properties. STEP collection does not require the same level of hydraulic retention at the treatment site as solids remain at each parcel.

Onsite solids retention with a STEP system requires less capital cost at the treatment site. Other advantages of STEP systems over grinder basins include: utilizing existing septic tanks; greater reserve capacity during power outages or pump failures; less maintenance required on the force main; and longer pump life. For these reasons, the most cost effective collection of solids is within individual septic tanks at each residence. Existing septic tanks already in compliance at individual residences can still be used; a STEP system would just need to be installed in an adjacent tank. In cases where the property does not have an existing compliant septic tank, new tanks would need to be installed along with the STEP system. Appendix C illustrates a typical schematic of a STEP tank.

STEP systems connect to a small diameter pressurized force main installed in road right of ways and easements. The force main follows topography below frost line (6-9 feet) with air release manholes installed at high points in the line. Small diameter force main lines would only transfer effluent with solids management occurring at the individual septic tank. Force mains would discharge effluent into a stilling tank at the cluster site.

3.3.2 Treatment and Dispersal System

Cost estimates generated for this alternative assume that the residents on the proposed cluster systems would agree to be connected to a cluster system at the same time. Project development would likely re-define properties interested in connecting, which could have an impact on the estimated costs.

General locations for this alternative have been identified for the potential of a cluster treatment and dispersal system. The locations are being used for comparison purposes only to provide a preliminary cost estimate based on length of the collection system, type of dispersal system, etc. At the time of project development these locations, or different locations, would need to be further investigated. At this time the site chosen is assumed to have adequate characteristics for size and treatment.

With the cluster alternative, the District would own and operate the cluster systems, collection systems, and maintain the septic tanks with STEP on each property. Design of the cluster system(s) would need to follow applicable state rules based on the size (daily flow) of all SSTS owned and operated by the District within a ½ mile radius.

3.3.3 Cluster System Summary

- Advantages
  - Subsidized interest rate loans and grants for cluster system construction and STEP installation

- Lower operation and maintenance expenses for full time residential properties to replace holding tanks
- Dispersal of treated effluent away from surface waters
- Allows for more usable land on individual lots
- Increase in resale values above what a holding tank property provides
- Large parcel owners removed from dense development could be allowed to stay on individual ISTS, while dense and high need areas are allowed to connect to a cluster system

o Disadvantages

- Obtaining land in close proximity can be difficult based on landowner preferences
- More local involvement required for project development

3.4 SUMMARY

Three alternatives are being analyzed in this Feasibility Study to provide wastewater infrastructure:

Alternative 1: Existing homes install compliant ISTS

Alternative 2: Combination of ISTS and Cluster system

Alternative 3: Cluster system serving entire community

Each alternative has advantages and disadvantages and may be incorporated solely or in combination to best fit the needs of the residents. Section 4.0 incorporates the estimated costs from the alternatives.

4.0 Cost Comparison of Alternatives

Three wastewater infrastructure alternatives have been identified within the scope of this report. Side by side comparisons of capital and operation and maintenance costs have been provided for each alternative. This section gives cost comparisons, starting with capital costs, and ending with a present worth analysis for 25 years.

4.1 INDIVIDUAL SEWAGE TREATMENT SYSTEMS (ALTERNATIVE 1)

Table 8 reflects the average cost estimates to replace/upgrade each non-compliant property with an ISTS owned and operated by the individual homeowner.

Table 8: Capital Cost Estimates Private ISTS Program

	ISTS Treatment System	Contingency	Legal, Eng., Admin	Total Cost Estimate	Avg. Cost/ Residential Connection
14 Non-Compliant Properties	$ 111,000	$ 5,600	$ 28,000	$ 144,600	$ 10,400

This analysis of ISTS is an average over the entire Feasibility Study Area. Individual property costs for ISTS upgrades would vary by property. Each property can locate their estimated cost in Appendix B. The table has been created to allow for side by side comparisons with the other alternatives in the present worth analysis. Capital costs by system type that were used to create the table are as follows for a residential system (cost estimates for Type 1-3 systems based on Wenck experience):

- Type 1 Mound: $11,000-$13,000 including tank upgrade costs
- Type 2: $5,500 (new tank + alarm)
- Type 3: $15,000-$17,000 including tank upgrade costs
- Type 4: Approximately $18,000 costs including tank costs

What can be noted from Table 8 is there are no collection system costs as this component is already in place at each residence. On average, this alternative has the least capital cost. For properties not needing new tanks, $4,000 was subtracted from the above prices.

4.2 CLUSTER SYSTEM (ALTERNATIVES 2 and 3)

Table 9 provides the cost estimates for cluster systems with the installation of a STEP system at each cluster residence, collection system, and a treatment/dispersal system.

Table 9: 25-Year Capital Cost Estimates Cluster System Alternative

Alternative Number and Type of Treatment System	Cluster Treatment System	ISTS at Non-cluster Properties	Nitrogen Removal System	Land Acquisition **	Collection System	Contingency (10%)	Legal, Eng., Admin	Total Cost Estimate	Avg. Cost/ Cluster Dwelling	Avg. Cost/ ISTS Dwelling	Avg. Cost/ All Dwellings
2: Cluster LISTS	$ 119,200	$ 92,000	$ -	$ 24,000	$ 257,060	$ 23,413	$ 117,100	$ 632,773	$ 41,598	$ 7,666.67	$ 25,311
3: Cluster MSTS	$ 174,788	-	$ -	$ 30,000	$ 339,480	$ 25,713	$ 128,600	$ 698,581	$ 27,943	-	$ 27,943
3: Cluster MSTS w/ Nitrogen removal	$ 187,938	-	$ 259,300	$ 30,000	$ 339,480	$ 39,336	$ 196,700	$ 1,052,753	$ 42,110	-	$ 42,110
**Land cost estimated at $12,000/acre											

The replacement wastewater system Alternative 2 would qualify as a LISTS (2,500-5,000 gpd) and would likely require a nitrogen best management practice (BMP). A mound wastewater treatment and dispersal system placed on loamy or finer textured topsoil which has medium or high organic matter content would qualify as a nitrogen BMP. Phosphorus standards are not applied to LISTS. Figure 6 shows the potential LISTS cluster system and collection line locations. Properties not included in the LISTS cluster would continue with compliant individual systems.

The replacement wastewater system Alternative 3 would qualify as a MSTS (5,000-10,000 gpd) and may require nitrogen removal technology (depending upon results of a hydrogeological investigation[7] for nitrogen impacts to the aquifer). Table 9 reflects the difference in cost estimates if nitrogen removal is required. The MSTS may also have a phosphorus standard applied by the MPCA, as portions of the drain field may be placed within 500 feet of a surface

[7] A Soil and Site Investigation and Preliminary Groundwater Investigation are required by MN Rules Chapters 7081.150-7081.210 for all MSTS. Additionally, the MPCA's *Subsurface Sewage Treatment Systems Prescriptive Designs and Design Guidance for Advanced Designers (Version 2.4, 9/27/2011)* lays out procedures for evaluating nitrogen impacts to an aquifer, applying to all SSTS with flows between 2,500 gpd and 10,000 gpd.

water. If a phosphorus standard is applied to the proposed MSTS, an assessment must be made to determine if the system would meet the requirement. This assessment would be made during the hydrogeological investigation. Figure 7 shows the potential cluster system and collection line locations.

Treatment system costs were based on average daily flow estimates for all properties, including properties that chose not to participate in the JGSIP field evaluation. Adding bedrooms to residential properties would change the size requirement for the cluster system, as well as the overall cost and the cost per dwelling.

Collection system costs were based on cost estimates of force main installation on a lineal foot basis for both the mainline and laterals based on the routes shown in Figure 6 and 7.

STEP system costs were calculated as shown in Appendix F. The cost of the collection system takes into account compliant tanks and tank upgrade costs.

Costs assume ownership of the MSTS or LISTS cluster system by the District and ownership of any ISTS by the private resident. The LISTS alternative and the MSTS alternative assume a mound dispersal area consisting of 10 foot wide pressurized beds with a rock dispersal media. A detailed Hydrogeological Assessment at the proposed cluster site to determine if nitrogen removal technology will be required as part of the treatment system would be completed as part of project development. Costs for this assessment are included within engineering cost estimates in Table 9. The cost of the MSTS cluster system also takes into account constructing 1.5 times the amount of drainfield required to disperse the daily permitting flow, as required by MPCA design guidance.

4.3 SUMMARY OF CAPITAL COSTS

Sections 4.1 – 4.2 highlight the cost estimates for each of the wastewater infrastructure alternatives. The cost estimates for each alternative assume the entire area would be served by the alternative chosen. Table 10 is a side by side comparison of the average per unit capital cost for each of the alternatives.

Table 10: Summary of Capital Costs

	Alternative 1 Managed ISTS Program	Alternative 2 LISTS Cluster + ISTS	Alternative 3 MSTS Cluster	Alternative 3 MSTS Cluster with Nitrogen Removal
Total Assessed System Costs	$ 144,600	$ 632,773	$ 698,581	$ 1,052,753
Average Cost/Dwelling	$ 10,400	$ 25,400	$ 28,000	$ 42,200

Alternative 1 costs apply only to the 14 currently non-compliant ISTS. Alternatives 2 and 3 costs are applied to *all* 25 properties within the study area (including properties that currently have a compliant ISTS as well as the one vacant property). If the properties that opted out of the Feasibility Study field evaluation are removed from Alternative 2 or 3, the average cost per included property for the MSTS would go up. Section 3.0 identifies the necessary components, advantages, and disadvantages of the three alternatives. While an ISTS program is the least expensive alternative on an average per unit basis, other considerations such as operational costs and limited flexibility of lots (i.e. a drainfield in a small yard takes up space that could be used for parking, gardening, building, etc.) must be considered as well.

4.4 ANNUAL OPERATION AND MAINTENANCE COSTS

When comparing costs for a wastewater infrastructure alternative, all costs, capital and annual operation and maintenance (O&M) must be considered. Table 11 provides the average annual operation and maintenance cost estimates for each alternative.

Table 11: Annual Operation and Maintenance Costs

	Alternative 1 Managed ISTS Program	Alternative 2 LISTS Cluster with Nitrogen BMP + ISTS	Alternative 3 MSTS Cluster	Alternative 3 MSTS Cluster with Nitrogen Removal
Total All Properties	$ 56,001	$ 5,836	$ 7,616	$ 25,600
Residential Average Cost for All Properties/Year	$ 2,240	$ 233	$ 305	$ 1,024
Residential Average Cost for All Properties/Month	$ 187.00	$ 20.00	$ 26.00	$ 86.00
Residential Average Cost for ISTS Properties/Month	$ 186.67	$ 16.67	-	-
Residential Average Cost for Cluster Properties/Month	-	$ 23.00	$ 26.00	$ 86.00

* Assumes 90 days of use for seasonal properties

Tank pumping costs were assumed at $0.15/gallon (i.e. $150/1000 gallons). Annual operation and maintenance costs for Alternative 1 over the complete estimated 25-year life span that was used to create the table are as follows for a residential system:

- Type 1: $100
- Type 2: <u>Bedrooms/home * 50 gallons/day/bedroom * 365 days/year * ($0.15/gallon)</u>
Tank Size (Gallons)
- Type 3: $100
- Type 4: $400

Alternative 2 O & M costs include the costs for the cluster drainfield system and STEP collection system O & M (see Appendix F). The largest expense in O & M of Alternative 1 is the annual pumping costs for all of the holding tank systems. A typical Type 1 or 3 ISTS may have only a nominal $100 annual fee for maintenance, where as a Type II holding tank system can run into the thousands of dollars annually with full time occupancy. Of the 24 residences and one currently vacant lot assessed for future ISTS type, it is estimated that 13 have only a Type II holding tank as their future ISTS option. The average annual O & M costs for each of the holding tank properties are detailed in Appendix B. Alternative 3 costs with nitrogen removal technology included increase significantly over the cost of operation the MSTS mound without nitrogen removal technology.

4.5 PRESENT WORTH ANALYSIS

Alternatives discussed in this report require different capital costs and operation and maintenance costs. These options also realize the costs at different times during the life of the infrastructure. Certain options can require more infrastructure (capital) costs at the start of the project; while other options experience higher maintenance costs throughout the life of the project. Also, infrastructure components have different expected life spans requiring replacement costs at varying intervals. All of these variables can create misconceptions when trying to compare the costs of one alternative versus another.

A present worth analysis allows the direct comparison of alternatives by converting all future costs into present-day dollar amounts. Future expenditures including capital and operation and maintenance are converted into present-day dollar amounts by using standard financial calculations, an assumed time-frame for the expense to occur, and a discount rate. The timing for the expenses was based on typical recurrences for maintenance and average life spans for infrastructure. The discount rate is generally described as the difference between the available rate of return on an investment and the average inflation rate. A discount rate of 4% was utilized in this study in the conversion of future costs to a present worth. After converting future costs into a present worth, these costs were added to initial capital costs and used in comparing the alternatives.

Section 4.5 evaluated operation and maintenance costs of the alternatives, a present worth analysis also takes inflation and debt service into account. Table 12 summarizes a present worth analysis over a 25-year period showing the *average* present worth costs for the entire District based on the different cluster and ISTS scenarios proposed in the report.

Table 12: Present Worth Analysis (25-year) Average Costs FS Area-Wide by Alternative

	Alternative 1 Managed ISTS Program*	Alternative 2 LISTS Cluster + ISTS	Alternative 3 MSTS Cluster	Alternative 3 MSTS Cluster with Nitrogen Removal
Total System Costs	$ 144,600	$ 632,773	$ 698,581	$ 1,052,753
Annual Operation & Maintenance Costs (25 year present worth value)	$ 875,000	$ 92,000	$ 119,000	$ 400,000
Estimated Total Present Worth	$ 1,019,600	$ 724,773	$ 817,581	$ 1,452,753
Estimated Total Equivalent Annual Cost (annualized over a 25-year period, 2% interest)	$ 52,224	$ 37,123	$ 41,877	$ 74,411
Estimated Average Equivalent Annual Cost per Property	$ 2,090	$ 1,490	$ 1,680	$ 2,980
Estimated Average Equivalent Monthly Cost per Property	$ 174.17	$ 124.17	$ 140.00	$ 248.33

* Assumes 90 days of use for seasonal properties

The estimated Total Present Worth amounts (of the alternatives cost over a 25-year period) are tallied in Table 12 in the middle row. The estimated Total Equivalent Annual Cost represents the annual cost to pay the Total Present Worth Cost over a 25-year period assuming a 2% subsidized loan rate. The estimated Average Equivalent Annual Cost per Property is simply the total annual cost divided by the number of participating units (number of participating units varies by option).

The Estimated Average Equivalent Annual Cost per Unit shown in the last row of Table 12 is not the actual cost experienced by the property owner each year. The timing and magnitude of actual costs will vary including upfront capital costs (i.e., assessments, individual system repairs, etc.) and periodic operation and maintenance (fees, utility bills, pump replacements, etc.). The Present Worth Analysis serves as a method of comparison and does not reflect the timing of actual payment. Table 12 assumes that for Alternative 1 ISTS, the future ISTS type as shown in Appendix B is the ISTS in use at the residences during the present worth analysis period. In addition, as in other tables, actual cost per unit will vary-units with more wastewater volume will face larger costs while units with lower wastewater volume will likely have lower actual costs.

5.0 Summary and Recommendations

5.1 SUMMARY

This report estimates provides ISTS existing conditions and provides the side by side comparison of the alternatives for long-term wastewater infrastructure for properties in the Jefferson Lake Drive community. A summary of the findings:

- 14 of the 24 evaluated properties (58%) have a likely non-compliant ISTS that fails to protect groundwater.
- 1 of the 14 non-compliant properties (7%) have the option of installing a Type 1 ISTS to replace their current system in the future
- Estimated capital costs on average per property for the evaluated alternatives:
    - Alternative 1: ISTS = $10,400
    - Alternative 2: LISTS Cluster Mound with STEP Collection System serving 13 properties and ISTS at remaining 12 properties
        - LISTS Cluster system = $41,600
        - ISTS systems = $7,700
    - Alternative 3: MSTS Cluster Mound with STEP Collection System for 25 properties = $27,900
    - Alternative 3: MSTS Cluster Mound with STEP Collection System and Nitrogen Removal Technology for 25 properties = $42,100

5.2 RECOMMENDATIONS

This report will aid in making an informed decision on what steps to take as the alternatives are considered. It is our recommendation that the Jefferson Lake Drive area be treated by parcel, with the following recommendations based on Community values:

- If the Community values the lowest present worth cost alternative, then the following recommendations apply:
  - Currently compliant properties not included in cluster Alternative 2 continue with ISTS and explore private funding options for any future upgrades.
  - Currently non-compliant properties not included in cluster Alternative 2 suggested for ISTS; install compliant ISTS and explore private funding options.
  - Properties included in cluster Alternative 2, evaluate potential to obtain land in close proximity for placement of a cluster mound. Evaluate potential to attain public financing to fund systems owned and operated by District.
  - All systems (private ISTS and public cluster) be included in a future management plan.

- If the Community desires to own and manage all wastewater systems to ensure environmental stewardship, or if the Community desires to free up space on individual lots currently occupied by ISTS, with consideration to cost of the overall system applying secondarily, then the following recommendation applies:
  - Further evaluate Alternative 3, the MSTS cluster treatment system option. Evaluate potential to attain public financing to fund this option. Complete a hydrogeologic investigation to determine if nitrogen removal technology will be required.

- If the Community desires to continue with the status quo of individual system ownership and management, then the following recommendation applies:
  - Pursue Alternative 1: Private ISTS to serve each parcel.
  - Currently compliant parcels continue with ISTS and explore private funding options for any future upgrades.
  - Currently non-compliant parcels install compliant ISTS and explore private funding options.

5.3 NEXT STEPS

The following describes future actions that could be taken by the residents of Jefferson Lake Drive based on the Feasibility Study recommendations.

- Explore public financing grant options to reduce debt service for upgrades.
- Explore possibility of land acquisition for any cluster system.
- Further explore the suitability of the proposed cluster site(s) for wastewater treatment via a Hydrogeological Assessment using soil pits, and (where applicable) borings to groundwater, and groundwater mounding assessments.
- Le Sueur County would continue to enforce the ISTS regulations of Chapter 7080. Non-compliant systems will require upgrades in the near future. Homeowners would be on their own to ensure their ISTS remains in compliance.

6.0 Professional Certification

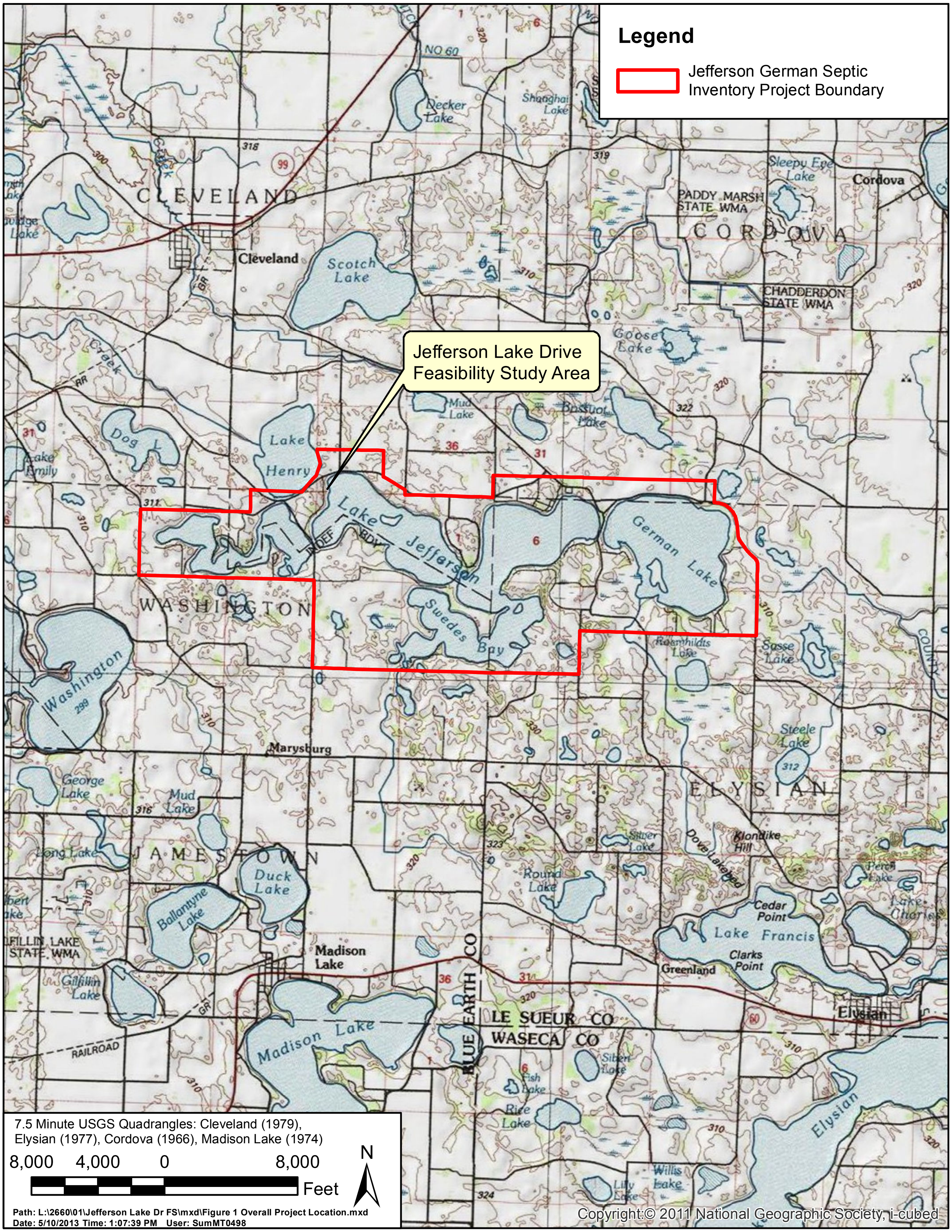
I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Soil Scientist and MPCA Advanced Designer/Inspector under the laws of the State of Minnesota.

Peter G. Miller, P.S.S. ***Registration No. 42636***

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer and MPCA Designer/Inspector under the laws of the State of Minnesota.

Eric M. Blasing, P.E. ***Registration No. 45781***

Figures



LE SUEUR COUNTY

Project Location: Jefferson Lake Drive Feasibility Study

Engineers - Scientists
Business Professionals
www.wenck.com

Wenck
1800 Pioneer Creek Center
Maple Plain, MN 55359-0429
1-800-472-2232

MAY 2013

Figure 1

LE SUEUR COUNTY

Jefferson Lake Drive Feasibility Study Area

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1-800-472-2232

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Figure 2

LE SUEUR COUNTY

Well Locations and Setbacks

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Figure 3

LE SUEUR COUNTY

Current ISTS Compliance Status

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Figure 4

LE SUEUR COUNTY

Most Likely Future ISTS

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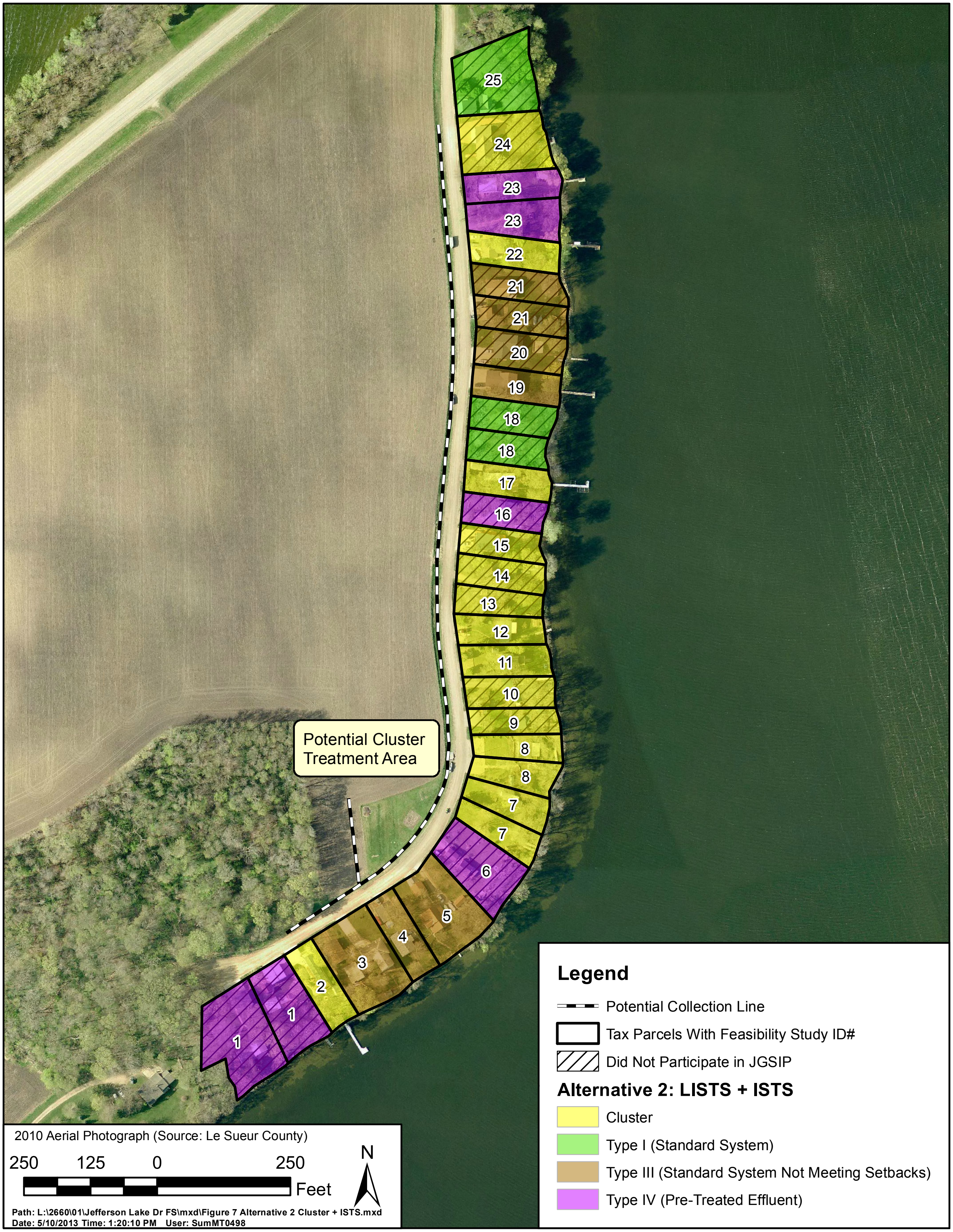
Figure 5



LE SUEUR COUNTY

Alternative 2: LISTS Cluster + ISTS

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Figure 6

LE SUEUR COUNTY

Alternative 3: MSTS Cluster

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Figure 7

Appendix A

U of M ISTS Information

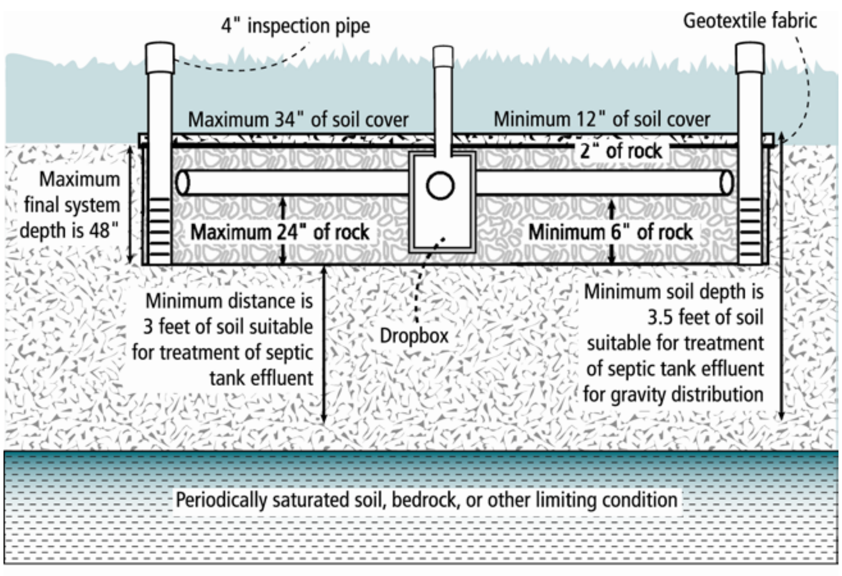
Below-Grade Systems

Below-grade systems are constructed in original soil with distribution of effluent occurring below the soil surface. With below grade systems the soil treatment area is designed and installed such that the infiltrative surface is below the original ground elevation and a final cover of topsoil stabilizes the completed installation, supports vegetative growth, and sheds runoff. It is the underlying soil that treats the many harmful components in the effluent before it reaches surface or ground waters. The two types of below-grade soil treatment systems commonly used are trenches and seepage beds.

Trenches have better oxygen transfer then beds and are recommended whenever the site conditions allow although seepage beds are often more attractive due to reduced land area requirements. In addition, the cost and time of construction, trenches are preferred because they have greater infiltrative surface for the same bottom area, and less damage typically occurs to the infiltrative surface during construction (Otis et al, 1977).

The figure below shows minimum depths and separation requirements for trenches or seepage beds. For systems without pretreatment, at least three feet of soil suitable for treatment should be located below the bottom of the distribution media. The minimum depth of distribution media is six inches, followed by a minimum soil cover of twelve inches, so that the total distance from the periodically saturated or other limiting condition to the final grade is approximately 4.5 feet. Note that this total could be made up of 3.5 feet of original soil and one foot of soil (7080.2150, Subp. 3) over the distribution media of the system.

Figure 1 - Trench and Bed Depth



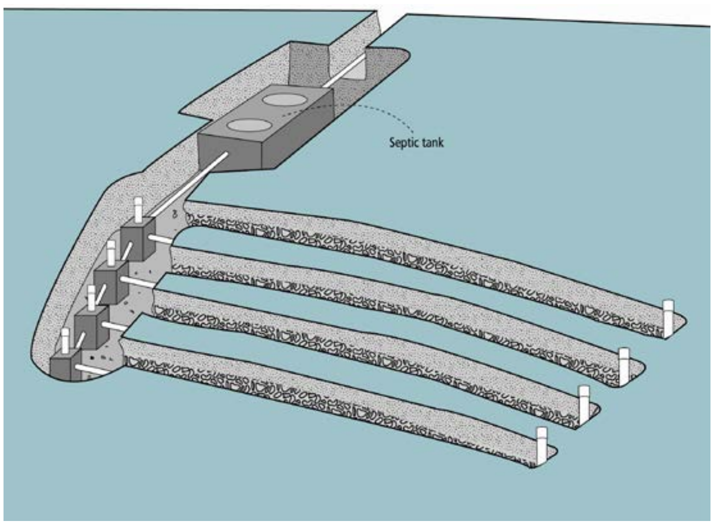
From MN Rules 7080.2260 Subp. 3. If the distribution media in a trench or a bed is in contact with soil texture group 2 through 4 (medium sand, fine sand, coarse and medium loamy sand) pressure distribution must be used.

Below-Grade Systems: Specifications

Trenches

The trench is the most common of the soil treatment systems. **According to MN Rules Chapter 7080.1100, Subp. 89 a trench is defined as a soil treatment and dispersal system, the absorption width of which is 36 inches or less.** Trenches are narrower than they are wide, no wider than three feet, and are laid out along the contours of the soil. A typical trench is constructed by making a level excavation 18 to 36 inches wide.The method of distributing the septic tank effluent can be either pressure or gravity. There are a number of different configurations by which the trenches can be connected with each other and with the septic tank: parallel, serial, and continual. A typical trench is constructed by making a level excavation 18 to 36 inches wide. A typical layout for a trench system is shown in Figure 2.

Figure 2 - Typical Trench Layout



The soil around and beneath the trench must be neither too coarse nor too fine. A coarse soil may not adequately filter pathogens, and a fine soil may be too tight to allow water to pass through. Soils with percolation rates between 0.1 and 60 mpi or soils with a listed loading rate on Table IX in Chapter 7080.2150 are suitable for treating sewage using a Type I below-grade design. **Trench media must never be placed in contact with soils having a percolation rate faster than 0.1 mpi or soil type 1 or slower than 60 mpi. For soils with percolation rates faster than 0.1 mpi and between 61 and 120 mpi, Type I below-grade systems may not be used (7080.2150, Subp. 3).**

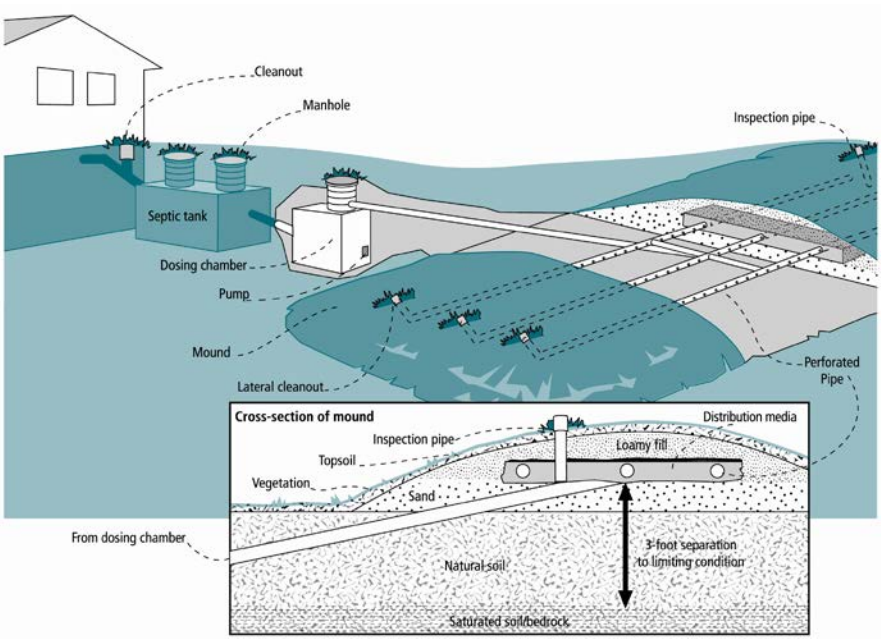
The trench soil treatment system consists of distribution media, covered with a minimum of 12 inches of soil and a close-growing and vigorous vegetation. Many trench systems utilize a pipe and gravel distribution system where effluent passes through the pipe and is stored within the media until it can be absorbed into the soil. Partial treatment is achieved as effluent passes through the biomat. The biomat also distributes effluent across the soil surfaces and maintains aerobic conditions outside the trench.

Mound Systems

Mound systems are defined in Chapter 7080.1100, Subp. 50, as "a soil treatment and dispersal system designed and installed such that all of the infiltrative surface is installed above grade, using clean sand between the bottom of the infiltrative surface and the original ground elevation, utilizing pressure distribution and capped with suitable soil material to stabilize the surface and encourage vegetative growth."

A sewage treatment mound is nothing more than a seepage bed elevated by clean sand fill to provide adequate separation between where sewage effluent is applied and a limiting soil layer as shown in the figure below. Mounds were developed in the early 1970s to overcome soil and site conditions, which limit the use of trenches and beds (Converse et al., 1977). Limiting conditions include high water tables, shallow soil depth to bedrock, slowly permeable soil, or soil too coarse for treatment.

Figure 1 - Mound System and Components



A mound system is a two-stage process involving both effluent treatment and dispersal. Treatment is accomplished predominately by physical and biochemical processes within the clean sand material and native soil. The physical characteristics of the influent wastewater, influent loading rate temperature, and the nature of the receiving fill material and in situ soil affect these processes.

Physical entrapment, increased retention time, and conversion of pollutants in the effluent are important treatment objectives accomplished under unsaturated conditions. Pathogens contained in the effluent are eventually deactivated through filtering, retention, and adsorption by the fill material. In addition, many pollutants are converted to other chemical forms by oxidation processes.

The mound system addresses high water table conditions by elevating the infiltration bed to achieve the needed vertical separation. By using uniform distribution and adequate vertical separation in the selected sand media, vertical unsaturated flow is maintained, thus ensuring the maximum treatment permitted by this technology. On sites with slowly permeable soils, the mound system helps assure a known level of effluent treatment before effluent is discharged to the native soil. These soils are subject to severe damage from smearing and compaction, especially during the construction of conventional systems, which drastically reduces the permeability of the soil by destroying water-moving pores and channels. As a result these sites present a high potential for site and soil interface damage in addition to the need for large soil treatment systems to provide adequate infiltration area. For these sites, mound systems provide the following advantages:

- The mound effluent enters the more permeable natural topsoil over a larger area where it can move laterally until absorbed by the less permeable subsoil.
- The bio-mat that develops at the bottom of the media/sand infiltration area will not clog the filter media as readily as it would the less permeable natural soil.
- The infiltration area within the filter media is much smaller than it would be if placed in the more slowly permeable subsoil, yet the total mound area is probably larger than it would be for a conventional soil treatment system, if one could be used.

Mound systems are used primarily in shallow soils overlying a restrictive layer or elevated groundwater table. The shallower the soil, the more attention must be paid to transporting the treated effluent away from the point of application. Fifteen mound systems in Wisconsin were found to have a total nitrogen reduction of at least 55% from the pretreatment effluent to mound toe effluent (Blasing and Converse, 2004). Sufficient numbers of mounds have been installed in Minnesota and elsewhere to prove that the mound treatment system is a Type I technology. There are more than 50,000 single-family mounds successfully treating sewage in Minnesota.

Dispersal is primarily affected by the depth of the unsaturated receiving soils, their hydraulic conductivity, land slope, and the area available for dispersal. The mound consists of sand material, an absorption bed, and cover material. Effluent is dispersed into the absorption bed, where it flows through the fill material and undergoes biological, chemical, and physical treatment. It then passes into the underlying soil for further treatment and dispersal to the environment. Clean sand (defined by state rule) is required for mounds to effectively treat and disperse effluent.

Cover material consists of material that provides erosion protection, a barrier to excess precipitation infiltration, and allows gas exchange. The native soil serves, in combination with the fill, as treatment media, and it also disperses the treated effluent.

Appendix B

Parcel Data Spreadsheet

Existing Status Report for Jefferson Lake Drive Community

	Property Information	System Information						PPL Unsewered Documentation									Tank Status					Future ISTS (E=Estimated for Non-inspected Properties)							
								Compliance status	Non-compliant			UAND Status	Setback Status: X if in violation																
CAR ID# Number	Permanent Residence (P), Seasonal Residence (S), Business (B), Vacant (V), Community bldg (C) (church, city hall, etc)	Permit on file? If Y - year	Year system installed, if known	Survey Bedrooms	Permit Bedrooms	Current Subsurface soil treatment type: * SSTS: drainfield, mound, holding tank, privy, other, straight pipe or unknown * Cluster * Community collector * Community straight pipe	ESTIMATED FLOW	Compliant (X if Y)	ITPHS (X if Y)	Fail to protect groundwater (X if Y)	Reason: (lack of vertical separation, leaking tank, cesspool, seepage pit, etc.)	System UAND Status(0,1,2,3, or 4) 0=Not visible/not assessed 1=ITPHS 2=Failure to Protect Groundwater 3=Compliant not meeting a setback 4=Compliant 5=Compliant holding tank	Drinking water supply - individual well/cistern or community supply	Buildings (house, garage, out)	Property lines	Surface waters (75')	Survey Total Tank Size (P=Pump Tank)	Tank Field Located (X if Y)	Noncompliant Tank	Compliant Tank before pumping (X if Y)	Compliant Tank after pumping (X if Y)	Type 1 (standard)	Type 2 (holding tank, privy, floodplain)	type 3 (other, <12", problem soils, rip and replace)	Type 4 or 5	Estimated Tank Upgrade Cost	Estimated System Upgrade Costs	Total Estimated Upgrade Cost	Estimated Annual Operation and Maintenance Costs
1	P		2001			Drainfield	300					2					1500/P		E						E	$ -	$ 14,000	$ 14,000	$ 400
2	S	2001	2001	2	2	Holding tank	300	X				5					1500	X			X		X			$ -	$ -	$ -	$ 1,350
3	P	2001	2001	3	4	Drainfield	600			X	VS	2			X		1500 + 500P	X			X			X		$ -	$ 12,000	$ 12,000	$ 100
4	P	1995	1995		4	Drainfield	600			X	VS	2			X		1500 + 500P	X			X			X		$ -	$ 12,000	$ 12,000	$ 100
5	P	1995		2	3	Drainfield	300			X	VS	2			X		1000 + 500P	X			X			X		$ -	$ 12,000	$ 12,000	$ 100
6	P		1999	1		Drainfield	300					2					1000 + 500P		E						E	$ 4,000	$ 14,000	$ 18,000	$ 400
7	S		2001	1		Holding tank	300	X				5					1500	X			X		X			$ -	$ -	$ -	$ 675
8	S			1		Holding tank	300	X				5					1000	X			X		X			$ -	$ -	$ -	$ 675
9	S		2000			Holding tank	300					5									E		E			$ -	$ -	$ -	$ 1,350
10	S					Unknown	300					2							E				E			$ 5,500	$ 500	$ 6,000	$ 1,350
11	S	1999	1999	2	3	Drainfield	450			X	VS	2					1500	X			X		X			$ -	$ 500	$ 500	$ 2,025
12	P	1985	1985	2	2	Drainfield	300			X	VS	2		X			1000	X			X		X			$ -	$ 500	$ 500	$ 5,475
13	S					Holding tank	300					2							E				E			$ 5,500	$ 500	$ 6,000	$ 1,350
14	S			2		Drainfield	300					2					1500/P		E				E			$ 5,500	$ 500	$ 6,000	$ 1,350
15	S					Unknown	300					2							E				E			$ 5,500	$ 500	$ 6,000	$ 1,350
16	P					Type IV Mound	300					4									E				E	$ -	$ -	$ -	$ 400
17	S	2004	2004	2	2	Holding tank	300	X				5						X			X		X			$ -	$ -	$ -	$ 1,350
18	V					Vacant	0					0										E				$ 4,000	$ 8,000	$ 12,000	$ 100
19	P	2000	2000	3	3	Drainfield	450	X				4					1000 + 750P	X			X			X		$ -	$ -	$ -	$ 100
20	P		1999			Drainfield	300					4									E			E		$ -	$ -	$ -	$ 100
21	P		2001			At-Grade	300					4									E			E		$ -	$ -	$ -	$ 100
22	S	2005	2005	2	2	Holding Tank	300	X				5					1000	X			X		X			$ -	$ -	$ -	$ 1,350
23	S	2004	2004	2	1	Type IV Peat Filter	300			X	Op. Permit	2					1000	X			X				X	$ -	$ -	$ -	$ 400
24	S					Holding Tank	300					2							E				E			$ 5,500	$ 500	$ 6,000	$ 1,350
25	P					Unknown	300					2							E			E				$ 4,000	$ 8,000	$ 12,000	$ 100

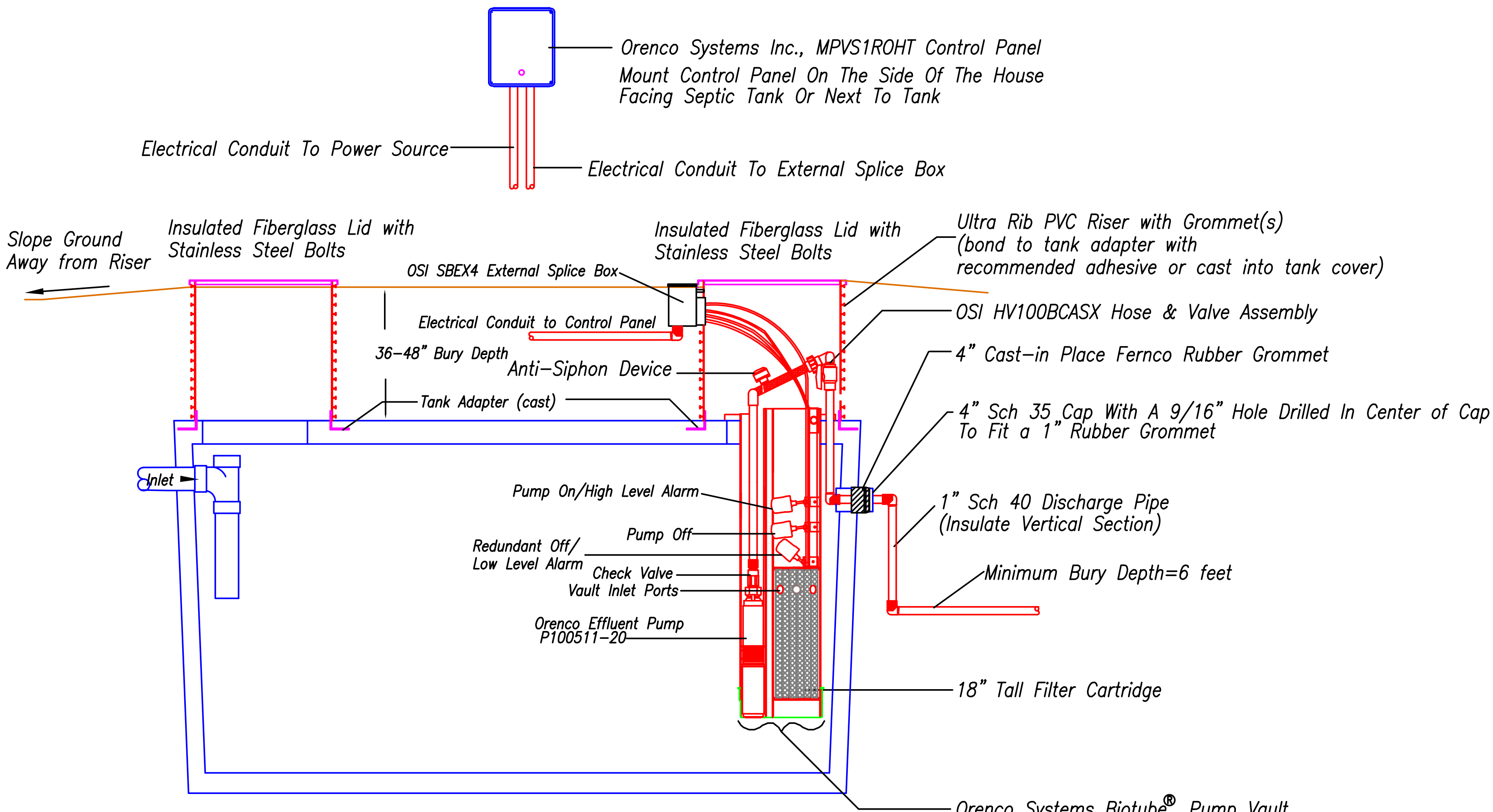
Properties that volunteered for the JGSIP are highlighted in green

Appendix C

Septic Tank Effluent Pump (STEP) Detail

STEP TANK - TYPICAL

Drawing provided by Orenco, Systems, Inc.



SCALE: NONE

Appendix D

Flow Calculations

Minnesota Pollution Control Agency

OSTP Flow Estimation
Alternative 2:
LISTS Cluster

University of Minnesota

v 12.08.06

FS ID#	# of Bedrooms (minimum = 2)	Dwelling Classification (see Table IV)	7080.1860 Design Flow (gpd) (See Table 1)	Reduction Factor - 0.45 (if applicable*)	LISTS Flow per Dwelling (gpd)
2	2	I	300	1.00	300
7	2	I	300	1.00	300
8	2	I	300	1.00	300
9	2	I	300	1.00	300
10	2	I	300	1.00	300
11	3	I	450	1.00	450
12	2	I	300	1.00	300
13	2	I	300	1.00	300
14	2	I	300	1.00	300
15	2	I	300	1.00	300
17	2	I	300	0.45	135
22	2	I	300	0.45	135
24	2	I	300	0.45	135
				Total Dwelling Flow Estimate	3555

* Use 1.0 for the flow from the ten highest flow dwellings and 0.45 for remaining dwellings

Minnesota Pollution Control Agency

OSTP Flow Estimation
Alternative 3:
MSTS Cluster

University of Minnesota

v 12.08.06

FS ID#	# of Bedrooms (minimum = 2)	Dwelling Classification (see Table IV)	7080.1860 Design Flow (gpd) (See Table 1)	Reduction Factor - 0.45 (if applicable*)	LISTS Flow per Dwelling (gpd)
1	2	I	300	1.00	300
2	2	I	300	1.00	300
3	4	I	600	1.00	600
4	4	I	600	1.00	600
5	3	I	450	1.00	450
6	2	I	300	1.00	300
7	2	I	300	1.00	300
8	2	I	300	1.00	300
9	2	I	300	0.45	135
10	2	I	300	0.45	135
11	3	I	450	1.00	450
12	2	I	300	0.45	135
13	2	I	300	0.45	135
14	2	I	300	0.45	135
15	2	I	300	0.45	135
16	2	I	300	0.45	135
17	2	I	300	0.45	135
18	2	I	300	0.45	135
19	3	I	450	1.00	450
20	2	I	300	0.45	135
21	2	I	300	0.45	135
22	2	I	300	0.45	135
23	2	I	300	0.45	135
24	2	I	300	0.45	135
25	2	I	300	0.45	135
Total Dwelling Flow Estimate					6075

* Use 1.0 for the flow from the ten highest flow dwellings and 0.45 for remaining dwellings

Minnesota Pollution Control Agency

OSTP Final Permitting Flow Alternative 2: LISTS Cluster

UNIVERSITY OF MINNESOTA

v 12.08.06

1. Flow from Dwellings	Flow from Dwellings	**3555**	gpd	From either existing and new development worksheet
2. Flow from Other Establishments	Permitting Flow from Other Establishments	**0**	gpd	From either Measured or Estimated-OE worksheet
3. Flow from Collection System	a) Total Length of Collection Pipe:	**2459**	feet	Design flow must include 200 gallons of infiltration and inflow per inch of collection pipe diameter per mile per day with a minimum pipe diameter of two inches. Flow values can be further increased if the system employs treatment devices that will infiltrate precipitation.
	b) Diameter of Pipe (Minimum of 2 in):	**2.00**	inches	
	c) Flow from I& I in Collection System:	**186**	gpd	
4. Final Permitting Flow		**3741**	gpd	Sum of 1, 2 and 3c.

OSTP Final Permitting Flow Alternative 3: MSTS Cluster

Minnesota Pollution Control Agency

University of Minnesota

v 12.08.06

1. Flow from Dwellings	Flow from Dwellings	**6075**	gpd	From either existing and new development worksheet
2. Flow from Other Establishments	Permitting Flow from Other Establishments	**0**	gpd	From either Measured or Estimated-OE worksheet
3. Flow from Collection System	a) Total Length of Collection Pipe:	**3555**	feet	Design flow must include 200 gallons of infiltration and inflow per inch of collection pipe diameter per mile per day with a minimum pipe diameter of two inches. Flow values can be further increased if the system employs treatment devices that will infiltrate precipitation.
	b) Diameter of Pipe (Minimum of 2 in):	**2.00**	inches	
	c) Flow from I& I in Collection System:	**269**	gpd	
4. Final Permitting Flow		**6344**	gpd	Sum of 1, 2 and 3c.

Appendix E

Cost Analysis

Alternative 2 Costs - LISTS Cluster + ISTS

ITEM	# PROPERTIES SERVED	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
Collection					
Individual Septic Tank/Pump Tank (New)	14	21,000	gal	$1.50	$31,500
Individual Pump Tank (New)	7	7,000	gal	$1.50	$10,500
Individual Septic Tank (Upgrade)	4	4	ls	$1,500.00	$6,000
Individual Pump Tank (Upgrade)	4	4	ls	$1,500.00	$6,000
Septic Tank Abandonment	14	14	ea	$500.00	$7,000
STEP Pump Package and Controls	13	13	package	$4,000.00	$52,000
STEP Package Electric Install	13	13	ea	$500.00	$6,500
4" Building Sewer Replacement	21	630	lf	$25.00	$15,750
2" Forcemain Collection	13	1,823	lf	$20.00	$36,460
2" Laterals	13	780	lf	$20.00	$15,600
Air/Vacuum Release Valves	13	2	ea	$3,500.00	$7,000
Isolation valves/cleanouts	13	4	ea	$3,000.00	$12,000
2" Curb stops	13	13	ea	$750.00	$9,750
Lawn Seeding/Restoration	13	1	ea	$7,500.00	$7,500
Roadway Crossing (Class V)	13	13	ea	$800.00	$10,400
Pipe Insulation (4")	13	515	sy	$40.00	$20,600
Mobilization	13	1	ls	$2,500.00	$2,500
Total Collection	13	1	ls	-	$257,060
Treatment					
Common Septic (Stilling) Tank	13	2,500	gal	$1.50	$3,750
Stilling Tank Effluent Screen	13	1	ea	$750.00	$750
Common Pump Tank	13	4,200	gal	$1.50	$6,300
Common Dosing Package (duplex)	13	2	package	$4,000.00	$8,000
Common Control Panel	13	1	unit	$7,500.00	$7,500
Common Drainfield (Mound)	13	1	unit	$49,500.00	$49,500
Mound Cell Supply Piping	13	250	lf	$20.00	$5,000
Insulation (4")	13	110	sy	$40.00	$4,400
Electrical Component Install Costs	13	1	ls	$7,500.00	$7,500
Service Road	13	100	lf	$50.00	$5,000
Electrical Service to Treatment Site	13	200	lf	$30.00	$6,000
Clearing, grubbing, etc.; md trees/brush	13	0.0	ac	$6,000.00	$0
Site Restoration	13	2.0	ac	$4,000.00	$8,000
Erosion Control	13	1.0	ls	$5,000.00	$5,000
Mobilization	13	1	ls	$2,500.00	$2,500
Total Common Treatment	13	1	ls	-	$119,200
Individual ISTS	12	12	ls	$92,000.00	$92,000
Total Treatment	25	1	ls	-	$211,200
TOTAL*	25	1	LS	-	$468,260
AVERAGE/PROPERTY*	25	1	LS	-	$18,730

*Does not include costs for land acquisition, legal, engineering, administration, or contingency.

OPERATION AND MAINTENANCE FOR ALTERNATIVE 2: LISTS + ISTS

ESTIMATED STEP OPERATION AND MAINTENACE COSTS PER HOME

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	NOTES
Tank pumping	500	gal	$0.15	$75.00	1500 gallons 1x/3 years
Electricity (0.5 hp pump)	68	kwh	$0.10	$6.75	gpd/ gallons/min /min/hr * days/year * kwh
Service Visit	0.5	hr	$65.00	$32.50	.25 hrs 2x/year
Pump Replacement	0.1	each	$500.00	$50.00	1x/10 years
Total				**$164.25**	
Contingency (10%)				$16.43	
Final Total				$180.68	
Total for 13 properties				$2,348.81	

ESTIMATED OPERATION AND MAINTENACE COSTS FOR 4000 GPD DRAINFIELD

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	
Tank pumping	1333	gal	$0.15	$200.00	5000 gallons 1x/3 years
Electricity (0.5 hp pump)	900	kwh	$0.10	$90.03	gpd/ gallons/min /min/hr * days/year * kwh
Service Visit	4	hr	$65.00	$260.00	2 hrs 2x/year
Pump Replacement	0.2	each	$500.00	$100.00	1x/5 years
Remote Monitoring/Reporting	5.2	hr	$65.00	$338.00	0.1 hrs/week
Total				**$988.03**	
Contingency (10%)				$98.80	
Final Total				$1,086.84	
Final Total for All				$3,435.65	
Total/property/month				$22.02	

ESTIMATED OPERATION AND MAINTENACE COSTS FOR 12 ISTS PROPERTIES

	QUANTITY			TOTAL PRICE/YEAR	
ISTS OM	12		2400	$2,400.00	Four Type IV systems @ $400/yr and Eight Type I or II @ $100/yr
ISTS/property/month				$16.67	
Final Total for All (Cluster+ISTS)				**$5,835.65**	
All properties/month				**$19.45**	

Alternative 3 Costs - MSTS

ITEM	# PROPERTIES SERVED	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
Collection					
Individual Septic Tank/Pump Tank (New)	14	21,000	gal	$1.50	$31,500
Individual Pump Tank (New)	7	7,000	gal	$1.50	$10,500
Individual Septic Tank (Upgrade)	4	4	ls	$1,500.00	$6,000
Individual Pump Tank (Upgrade)	4	4	ls	$1,500.00	$6,000
Septic Tank Abandonment	14	14	ea	$500.00	$7,000
STEP Pump Package and Controls	25	25	package	$4,000.00	$100,000
STEP Package Electric Install	25	25	ea	$500.00	$12,500
4" Building Sewer Replacement	25	750	lf	$25.00	$18,750
2" Forcemain Collection	25	2,024	lf	$20.00	$40,480
2" Laterals	25	1,500	lf	$20.00	$30,000
Air/Vacuum Release Valves	25	2	ea	$3,500.00	$7,000
Isolation valves/cleanouts	25	4	ea	$3,000.00	$12,000
2" Curb stops	25	25	ea	$750.00	$18,750
Lawn Seeding/Restoration	25	1	ea	$7,500.00	$7,500
Class V Roadway Crossing	25	25	ea	$800.00	$20,000
Insulation (4")	25	225	sy	$40.00	$9,000
Mobilization	25	1	ls	$2,500.00	$2,500
Total Collection	25	1	ls	-	$339,480
Treatment					
Common Septic (Stilling) Tank	25	4,200	gal	$1.50	$6,300
Stilling Tank Effluent Screen	25	1	ea	$750.00	$750
Common Pump Tank	25	4,200	gal	$1.50	$6,300
Common Dosing Package (duplex)	25	2	package	$4,000.00	$8,000
Common Control Panel	25	1	unit	$7,500.00	$7,500
Common Drainfield (Mound)	25	1	unit	$101,437.50	$101,438
Mound Cell Supply Piping	25	250	lf	$20.00	$5,000
Insulation (4")	25	150	sy	$40.00	$6,000
Electrical Component Install Costs	25	1	ls	$7,500.00	$7,500
Service Road	25	100	lf	$50.00	$5,000
Electrical Service to Treatment Site	25	200	lf	$30.00	$6,000
Clearing, grubbing, etc.; md trees/brush	25	0.0	ac	$5,200.00	$0
Site Restoration	25	2.5	ac	$3,000.00	$7,500
Erosion Control	25	1.0	ls	$5,000.00	$5,000
Mobilization	25	1	ls	$2,500.00	$2,500
Total Common Treatment	25	1	ls	-	$174,788
Total Treatment	25	1	ls	-	$174,788
TOTAL*	25	1	LS	-	$514,268
AVERAGE/PROPERTY*	25	1	LS	-	$20,571

*Does not include costs for land acquisition, legal, engineering, administration, or contingency.

OPERATION AND MAINTENANCE FOR ALTERNATIVE 3: MSTS

ESTIMATED STEP OPERATION AND MAINTENACE COSTS FOR PER HOME

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	NOTES
Tank pumping	500	gal	$0.15	$75.00	1500 gallons 1x/3 years
Electricity (0.5 hp pump)	68	kwh	$0.10	$6.75	gpd/ gallons/min /min/hr * days/year * kwh
Service Visit	0.5	hr	$65.00	$32.50	.25 hrs 2x/year
Pump Replacement	0.1	each	$500.00	$50.00	1x/10 years
Total				**$164.25**	
Contingency (10%)				$16.43	
Final Total				$180.68	
Total for 25 properties				$4,516.94	

ESTIMATED OPERATION AND MAINTENACE COSTS FOR 7000 GPD DRAINFIELD

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	
Tank pumping	2333	gal	$0.15	$350.00	7000 gallons 1x/3 years
Electricity (0.5 hp pump)	1576	kwh	$0.10	$157.56	gpd/ gallons/min /min/hr * days/year * kwh
Service Visit	8	hr	$65.00	$520.00	2 hrs 4x/year
Pump Replacement	0.2	each	$500.00	$100.00	1x/5 years
Remote Monitoring/Reporting	26	hr	$65.00	$1,690.00	0.5 hrs/week
Total				**$2,817.56**	
Contingency (10%)				$281.76	
Final Total				$3,099.31	
Final Total for All				$7,616.26	
Total/property/month				**$25.39**	

Alternative 3 Costs - MSTS w/Nitrogen Removal

ITEM	# PROPERTIES	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE
Collection					
Individual Septic Tank/Pump Tank (New)	14	21,000	gal	$1.50	$31,500
Individual Pump Tank (New)	7	7,000	gal	$1.50	$10,500
Individual Septic Tank (Upgrade)	4	4	ls	$1,500.00	$6,000
Individual Pump Tank (Upgrade)	4	4	ls	$1,500.00	$6,000
Septic Tank Abandonment	14	14	ea	$500.00	$7,000
STEP Pump Package and Controls	25	25	package	$4,000.00	$100,000
STEP Package Electric Install	25	25	ea	$500.00	$12,500
4" Building Sewer Replacement	25	750	lf	$25.00	$18,750
2" Forcemain Collection	25	2,024	lf	$20.00	$40,480
2" Laterals	25	1,500	lf	$20.00	$30,000
Air/Vacuum Release Valves	25	2	ea	$3,500.00	$7,000
Isolation valves/cleanouts	25	4	ea	$3,000.00	$12,000
2" Curb stops	25	25	ea	$750.00	$18,750
Lawn Seeding/Restoration	25	1	ea	$7,500.00	$7,500
Class V Roadway Crossing	25	25	ea	$800.00	$20,000
Pipe Insulation (4")	25	225	sy	$40.00	$9,000
Mobilization	25	1	ls	$2,500.00	$2,500
Total Collection	25	1	ls	-	$339,480
Treatment					
Common Septic (Stilling) Tank	25	7,000	gal	$1.50	$10,500
Common Reactor Tank #1	25	3,200	gal	$1.50	$4,800
Common Clearwater Tank #1	25	3,000	gal	$1.50	$4,500
Common Reactor Tank #2	25	500	gal	$1.50	$750
Common Pump Tank	25	4,000	gal	$1.50	$6,000
Stilling Tank Effluent Screen	25	1	ea	$750.00	$750
Common Dosing Package (duplex)	25	1	package	$3,000.00	$3,000
Common Control Panel	25	1	unit	$7,500.00	$7,500
Common Drainfield (Mound)	25	1	unit	$101,437.50	$101,438
Insulation (4")	25	200	sy	$40.00	$8,000
Mound Cell Supply Piping	25	250	lf	$20.00	$5,000
Electrical Component Install Costs	25	1	ls	$7,500.00	$7,500
Service Road	25	100	lf	$50.00	$5,000
Amphidrome Plus Reactor	25	1	ls	$160,000.00	$160,000
Control Building	25	1	ls	$15,000.00	$15,000
Labor and Install of Amphidrome	25	1	ls	$75,000.00	$75,000
Electrical Service to Treatment Site	25	150	lf	$30.00	$4,500
Clearing, grubbing, etc.; md trees/brush	25	2.5	ac	$5,200.00	$13,000
Erosion Control	25	1.0	ls	$5,000.00	$5,000
Site Restoration	25	2.5	ac	$3,000.00	$7,500
Mobilization	25	1	ls	$2,500.00	$2,500
Total Common Treatment	25	1	ls	-	$447,238
Total Treatment	25	1	ls	-	$447,238
TOTAL*	25	1	LS	-	$786,718
AVERAGE/PROPERTY*	25	1	LS	-	$31,469

*Does not include costs for land acquisition, legal, engineering, administration, or contingency.

OPERATION AND MAINTENANCE FOR ALTERNATIVE 3: MSTS WITH NITROGEN REMOVAL

ESTIMATED STEP OPERATION AND MAINTENACE COSTS FOR 2 BDR HOME

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	NOTES
Tank pumping	500	gal	$0.15	$75.00	1500 gallons 1x/3 years
Electricity (0.5 hp pump)	68	kwh	$0.10	$6.75	gpd/ gallons/min /min/hr * days/year * kwh
Service Visit	0.5	hr	$65.00	$32.50	.25 hrs 2x/year
Pump Replacement	0.1	each	$500.00	$50.00	1x/10 years
Total				**$164.25**	
Contingency (10%)				$16.43	
Final Total				$180.68	
Total for 32 properties				$5,781.69	

ESTIMATED OPERATION AND MAINTENACE COSTS FOR 7000 GPD DRAINFIELD

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	
Tank pumping	2333	gal	$0.15	$350.00	7,000 gallons 1x/3 years
Electricity (0.5 hp pump)	1576	kwh	$0.10	$157.56	gpd/ gallons/min /min/hr * days/year * kwh
Service Visit	8	hr	$65.00	$520.00	2 hrs 4x/year
Pump Replacement	0.2	each	$500.00	$100.00	1x/5 years, 2 pumps
Remote Monitoring/Reporting	26	hr	$65.00	$1,690.00	0.5 hrs/week
Total				**$2,817.56**	
Contingency (10%)				$281.76	
Final Total				$3,099.31	

ESTIMATED NO3 REMOVAL OPERATION AND MAINTENACE COSTS

ITEM	QUANTITY	UNIT	UNIT PRICE	TOTAL PRICE/YEAR	
Amphidrome Power	5283	kwh	$0.12	$633.96	Adapted from vendor information
Sludge Disposal	10700	gal	$0.15	$1,605.00	Adapted from vendor information
Methanol	203	gal	$3.00	$609.00	Adapted from vendor information
Alkalinity	1	ls	$200.00	$200.00	Adapted from vendor information
Telephone/Internet	12	$/month	$50.00	$600.00	Estimate
Amphidrome Repair Reserve	0.13	total	$10,000.00	$1,250.00	Pump/Blower Replacement at 1x/8 years, 8 pumps, 2 blowers
Service Visit	104	hr	$65.00	$6,760.00	Estimated 2 hours/week average
Sampling	12	sample	$100.00	$1,200.00	Sample effluent 1x/month for TN, CBOD, and TSS.
Building Heating and Power	12.00	$/month	$50.00	$600.00	Assumed cost of $50/month
Remote Monitoring/Reporting	26	hr	$65.00	$1,690.00	0.5 hrs/week
Total				**$15,147.96**	
Contingency (10%)				$1,514.80	
Final Total				$16,662.76	
Final Total for All				**$25,600.00**	
Total/property/month				**$85.33**	