Community Assessment Report

City of Afton
Washington County,
Minnesota

Wenck File #2656-01

Prepared for:
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1.0 Introduction

BACKGROUND

The Community of Afton is located along the St. Croix River in Washington County, Minnesota (Figure 1). The residents are served water by a combination of individual and community water supply wells. The community is unsewered and wastewater needs are met by individual subsurface treatment systems (ISTS)[1] or cluster subsurface sewage treatment systems (SSTS). Wenck Associates, Inc. (Wenck) was retained to assess the probable compliance status of any existing SSTS, and to provide soil-based SSTS alternatives for viable long term infrastructure to collect and treat wastewater for the Community of Afton.

Based on the 2010 census, there was an average of 2.67 people per household in Afton's zip code. Using this logic, the population of the Community Assessment Report (CAR) area is estimated at 182, based on 68 residences at 2.67 people per residence. The population in the CAR area is year-round (not seasonal) in nature.

This CAR was made possible through a Small Community Program Technical Assistance Grant from the Minnesota Public Facilities Authority. These grants are available to small unsewered communities so they may analyze possible solutions to wastewater problems associated with non-complying septic systems. The Small Community Program Technical Assistance Grants are designed to help communities develop the technical, managerial and financial capacity necessary to build, operate, and maintain new SSTS.

[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.

PREVIOUS INVESTIGATIONS

An Unsewered Area Needs Documentation[2] (UAND) was completed by Wenck prior to grant funding being received for the preparation of a CAR. The UAND was completed using records obtained from Washington County, soil survey data, and a visual survey of the area. Washington County issues ISTS permits for the Community of Afton when individual homeowners construct new systems. Information gathered in the Unsewered Area Needs Documentation was reviewed and incorporated into the findings of this report.

REPORT PURPOSE

This report is a planning document for possible long-term solutions for wastewater collection and treatment within the Community of Afton. Within this report are developed concepts and a framework to provide sanitary sewer service to the existing residences in this area. A cluster system alternative has been developed in this report for long-term wastewater treatment infrastructure.

WORK PERFORMED

To determine the baseline for the analysis, the UAND was completed in August 2010 to assess the existing condition of ISTS. The analysis also evaluated future ISTS 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.

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[2] Unsewered Area Needs Documentation is a form created by the MPCA for unsewered communities to complete when applying for funding. The form provides a preliminary status of existing ISTS condition.

[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/

Building from the information gathered in the UAND, two alternatives are being evaluated for long-term wastewater infrastructure within this report.

Alternative 1:	Existing properties install compliant ISTS
Alternative 2:	Cluster Large Subsurface/Sewage Wastewater Treatment System (LSTS) for CAR service area

All potential wastewater generating properties (84) were selected for inclusion in analysis of a cluster system to allow for a calculation of average costs for the Alternative; parcels may be added or removed from the cluster system as a project develops. In addition, the cost for an individual property to install a compliant SSTS on their property (CAR Alternative 1) is included in Appendix B.

2.0 Existing Conditions

INTRODUCTION

This section summarizes the findings of the existing condition of ISTS in the CAR area. All the properties evaluated were 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 combination of ISTS and/or cluster systems to provide compliant wastewater treatment.

The number of addresses currently or historically generating wastewater identified for investigation by the City of Afton was 86. Two addresses identified for evaluation prior to completion of the UAND could not be located during field reconnaissance. These two addresses were deleted from any further analysis, leaving 84 addresses. One vacant parcel with no ISTS, one vacant parcel (no buildings) with a remaining ISTS, and three properties with multiple ISTS were included as part of the 84 evaluated addresses. Therefore, a total of 83 properties with existing ISTS and 86 total ISTS were evaluated for likely compliance.

METHODS

Wenck was able to complete a visual inspection (from the property boundaries) 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

[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

options. The determination of feasibility of ISTS and/or cluster system installation required an evaluation of the soils. In addition to the soil survey data available, Wenck used existing permit records to evaluate soils throughout the CAR area.

Prior to commencement of field work, Washington County provided available past permitting/design/inspection records for individual parcels as well as the GIS shape file of the parcels. Wenck also relied upon the Washington County staff to answer certain parcel specific questions related to past permitting efforts.

Wenck visited the community in August 2010. During field work wells and SSTS were identified and evaluated via a visual survey from the property boundaries. The visual survey was performed to obtain the information found in Section 2.3.

FINDINGS

The purpose of the visual survey was to obtain:

- 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,
- location of the ISTS (if any) relative to required setbacks from wells, property lines, buildings, and surface water features,
- the likely compliance status of the ISTS, and
- the most likely next ISTS to serve the dwelling.

2.1.1 Drinking Water Source

The source of drinking water for the dwellings in the CAR area is individual and shared wells. The wells identified were either deep (screened at greater than 50 feet below ground surface) or shallow (screened at less than 50 feet below the ground surface or "sand point"). Depth and location of wells must be taken into account when considering ISTS setback requirements. Well

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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."

locations were identified during the visual survey and by the Minnesota Department of Health County Well Index. Table 1 summarizes the makeup of the wells serving the 84 addresses in the CAR Area as discovered during field reconnaissance and as reported by the County Well Index:

Table 1: Existing Well Types

Well Type	Number of Residences Served	Percentage
Shallow (<50')	3	4%
Deep (>50')	24	29%
Unknown	57	67%

A shallow well requires a 100 foot setback and a deep well requires a 50 foot setback to a SSTS treatment/absorption area.

2.1.2 Parcel Type

Table 2 shows the type of wastewater generating structures in the CAR area. The data in the table was collected via visual survey and conversations with individuals knowledgeable about the parcel types. An important factor when considering the type of structure existing on a parcel is the flow and strength of wastewater generated. A business will produce a different strength of waste, as well as a different pattern of wastewater flow than a full-time residential home. One address had a septic system present, but did not have structures on the parcel, and was therefore considered vacant rather than residential.

Table 2: Parcel Type

Usage Pattern	Number	Percentage
Residential Only	63	75%
Vacant	2	2%
Business or multi-use	19	23%

2.1.3 ISTS Types

Table 3 provides a breakdown of the ISTS types in the CAR area for participating properties. The descriptions listed in this table are common names.

Table 3: Existing ISTS Types

ISTS Type	Number	Percentage
Drainfield	54	63%
Mound	9	10%
Holding Tank	4	5%
Unknown	19	22%

2.1.4 ISTS Likely Compliance Status

Upon visual survey of each individual parcel a determination was made regarding the potential that the ISTS for the dwelling(s) would be compliant or non-compliant with Minnesota Rules Chapter 7080 and Washington County ordinance.

The ISTS that are likely non-compliant were identified as such for one of two reasons; 1) ITPHS as identified from site reconnaissance, or 2) failure to protect groundwater (FTPG).

Table 4 summarizes the likely ISTS compliance status data for the properties. Compliance status is based on county permit information, soils data, information provided by county staff and/or property owners, and our visual survey.

Table 4: ISTS Likely Compliance Status

Status	Number	Percentage
Non-Compliant ITPHS	1	1%
Non-Compliant FTPG	24	29%
Compliant not Meeting Setbacks	15	18%
Compliant Meeting Setbacks	44	52%

Appendix B contains a table that shows the likely compliance status of evaluated addresses. Figure 2 visually depicts the parcels' likely compliance status.

2.1.5 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. Tanks were evaluated based on permit records. Some tanks were identified during the visual survey that did not have permit records, and could not therefore be considered water-tight.

Table 5: Likely Tank Compliance Status

Status	Number	Percentage
Properties having tanks with a permit	60	72%
Properties having tanks without a permit	23	28%

CURRENT ENVIRONMENTAL IMPACT

As documented in this section, there was 1 property identified during the visual survey that was an ITPHS with surfacing effluent. An additional 24 ISTS are currently failing to protect groundwater. An additional 15 of the 59 ISTS that are compliant do not meet one or more required setback to buildings, surface water, wells, or property lines, therefore requiring a variance. The Community of Afton as a community currently ranks 157th out of 349 projects on the 2012 Clean Water Revolving Fund's Project Priority List.

SUMMARY

Of the 84 addresses that were evaluated, 30% (25 properties) are estimated to have an ISTS in non-compliance. The properties would be considered non-compliant due to surfacing effluent or a drainfield that fails to protect groundwater.

3.0 Alternatives Analysis

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 (completed by WSB & Associates, Inc).
2. Treatment: Removal of pathogens and nutrients in primary, secondary, and tertiary 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:

1. Existing homes install compliant ISTS (Alternative 1)
2. Cluster LSTS for the entire community (Alternative 2)

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

COLLECTION SYSTEM

WSB & Associates, Inc completed a collection system alternatives analysis. Results of this evaluation provided by WSB, including descriptions of alternatives are found in the following sections.

3.1.1 Collection System

Two options were evaluated for collection of wastewater from services within the proposed service area. The options include a gravity collection system and a low pressure forcemain collection system. A description of each option is presented in the following paragraphs.

3.1.1.1 Gravity Collection System

A gravity collection system would be comprised of 8-inch diameter trunk lines that would run along Saint Croix Trail and 8-inch diameter branch lines that would extend from the trunk sewer down the side streets, within the CAR service area. Individual sewer services would be connected to the trunk sewer and branch lines and extend to the homes and businesses to be served. The trunk lines on Saint Croix Trail would run to a main lift station located along Saint Croix Trail between 34th Street and 35th Street, which would then pump the flow north through a 4-inch forcemain to the treatment and dispersal system. Figure 5 shows the proposed layout of the gravity collection system alternative. The total estimated capital cost for the gravity collection system option is approximately $1,768,000. A detailed breakdown of the cost estimate is included in Appendix E. The annual operation and maintenance cost for the gravity collection system is estimated to be approximately, $14,400 per year.

3.1.1.2 Low Pressure Forcemain Collection System

A low pressure forcemain collection system would be comprised of grinder pump stations that would collect wastewater from the individual homes and businesses served and then pump the wastewater through small 1.5” and 2 “ diameter forcemain lines to a central main lift station located along Saint Croix Trail. The main lift station would then pump the flow north through a 4-inch forcemain to the treatment and dispersal system. This type of system is comprised of many pumps, but has lines buried only to a depth to protect them from freezing. This option is

estimated to be higher in construction cost than the gravity collection system as well as higher in operation and maintenance cost, because of the grinder pumps. Typically, a low pressure forcemain collection system is used when it is very difficult or expensive to obtain gravity flow such as around lakes or in ledge rock. The total estimated capital cost for the low pressure forcemain collection system alternative is approximately $2,125,000. A detailed breakdown of the cost estimate is included in Appendix E. The annual operation and maintenance cost for the low pressure forcemain collection system is estimated to be approximately, $32,600 per year.

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 City would be the financial and operational vehicle to assist property owners with ISTS upgrades. The City 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.

A disadvantage to City ownership is that the flows for each ISTS, within ½ mile radius, would be cumulative for permitting purposes. Therefore, if all ISTS within the Community of Afton are owned and operated by the City, a State Disposal System (SDS) permit would be required. Hand in hand with greater permitting effort is greater cost for both the installation and operation and maintenance of the ISTS when permitted under an SDS permit.

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 City 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 which are being experienced now in Afton.

3.3.3 ISTS Upgrades

As stated in Section 2, 30% of ISTS at participating properties are estimated to be in non-compliance. This accounts for some type of imminent ISTS upgrade at 25 evaluated properties, although all properties will require an upgrade at some point in the future based on the limited life expectancy of ISTS. 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.

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 for all potential ISTS properties in the CAR area using permit records and soil survey data, individual borings were not performed at each parcel.

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. Type 1 systems that do not meet compliance due to FTPG may be upgraded to a Type 4 or 5 systems if they currently have at least one foot of vertical separation. Adding advanced pretreatment (devices that reduce fecal coliform bacteria to less than 10,000 colonies/100 mL) allows wastewater effluent to be discharged with a reduced vertical separation to seasonally saturated soil requirement.

ISTS rules dictate that systems that are not considered Type 1-3 may require an operating permit. Any system with an operating permit may require annual operation and maintenance of the systems by a licensed Service Provider[6].

Table 6 summarizes the most likely ISTS to be installed when the likely non-compliant systems are upgraded, assuming a homeowner would not install a holding tank if another option exists.

Table 6: Next ISTS Replacing Likely Non-Compliant Systems

ISTS Type	Number	Percentage
Type 1 (standard)	8	32%
Type 2 (holding tank, privy, floodplain)	5	20%
Type 3 (other, <12", problem soils, rip and replace)	5	20%
Type 4 or 5	7	28%

Type 1 and 3 systems comprise the small majority, approximately 52% (13 parcels) of the ISTS types needed at upgrade for likely non-compliant properties. These dwellings can achieve compliance with the installation of Type 1 or 3 systems with three feet of vertical separation beneath the effluent dispersal area and the seasonally saturated condition. The Type 1 and 3 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. The difference in the Type 1 and Type 3 systems is that the Type 3 systems will require special design and installation procedures; increasing their overall capital cost. Average annual operating costs for a Type 1 or 3 systems are estimated at less than $100.

[6] Service Provider is a new license category under 2011 MN Rules Chapter 7083.0780 to be adopted by all Minnesota Counties by February 2012. A Service Provider can assess, adjust, and service ISTS for proper operation.

Type 2 (holding tanks) 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 Type 1 or Type 3 ISTS. 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 4 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).

Seven likely non-compliant systems were discovered during the CAR process that would likely upgrade to a Type 4 ISTS. Similar to Type 2 systems, Type 4 systems also 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 that provide alternative treatment other than a Type 1 subsurface drain field or mound.

Table 7 summarizes what the make-up of the ISTS in the community will be after upgrades to all parcels (including currently compliant parcels) if all parcels stay on ISTS rather than choosing a cluster SSTS. 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 reflected in Appendix B.

Table 7: Community Makeup of Future ISTS by Property

ISTS Type	Number	Percentage
Type 1 (standard)	32	37%
Type 2 (holding tank, privy, floodplain)	7	8%
Type 3 (other, <12", problem soils, rip and replace)	31	36%
Type 4 or 5	16	19%

Data presented in Table 7 indicates that 37% of parcels have adequate room and suitable soil conditions on their property to install a Type 1 ISTS for the next system. Nearly 8% (7 properties) have a Type 2 holding tank as their only feasible ISTS option, and will require tank pumping on a regular basis. This is due to seasonally saturated conditions in the underlying soils, lot sizes, and location of houses and/or other permanent structures that prevent homeowners from installing a different system type. Type 3 systems comprise about 36% (31 properties) of the next system total. Most of the Type 3 systems are classified as such because they will require a variance from a required setback (well, property line, surface water, or building) for installation.

Sixteen residences would likely employ a Type 4 ISTS as their system of choice for meeting wastewater treatment and dispersal needs. Type 4 ISTS employ an additional pretreatment unit in addition to the septic tank prior to final dispersal in the soil treatment area. Because of the additional treatment provided, Type 4 systems typically have a smaller landscape footprint and may also have reduced vertical separation requirements. However, Type 4 systems typically have greater operation and maintenance costs in the form of electricity, chemical, and/or maintenance by a service provider. Annual costs for a Type 4 ISTS are estimated at $400.

Appendix B contains a table that documents the likely next ISTS for the evaluated parcels.

3.3.4 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
    - Ownership by the City requires State permit, leading to increased permitting, construction, and operation and maintenance costs
- Private ISTS Program Alternative
  - Advantages
    - Capital and operation and maintenance costs based on need, you pay for your problem and nobody else's
    - Less cost than community owned/managed ISTS program alternative
    - County permit for each system rather than State permit for all systems
  - 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

CLUSTER LSTS (ALTERNATIVE 2)

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 (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 City to qualify for public funding. Private ownership is an option but presents legal challenges as it relates to land ownership/easements and fee collection.

Design flows will 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, the system is classified as a LSTS and permitting is completed through a Minnesota Pollution Control Agency SDS Permit. Greater permitting effort increases the overall cost of design, construction, and operation and maintenance as more research and investigation is required upfront and greater pretreatment of effluent will be required.

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. To decipher housing bedroom characteristics in the City of Afton, information from the 2010 US Census Bureau was utilized. This information was then rendered to a study area that includes 71 housing units for inclusion in the cluster system. Flow values for the dwellings

were calculated using 2011 Minnesota Rules, Part 7080.1860 and 7081.0120. All commercial establishments' design flows were calculated using MN Rules, Part 7081.0130. Finally, collection system inflow/infiltration was estimated and included in the total design flow. A detailed design flow calculation is included in Appendix D. Also, information regarding the number of users and equivalent dwelling units (EDU) is included below. Determining EDUs is essential as over 50% of the wastewater flow is from commercial users including restaurants, office buildings, banks, retail stores, a hotel, church, and a park. EDU calculations are as follows:

(17,310 gpd residential flow) / (71 dwellings) = 245 gpd/dwelling = wastewater flow per EDU

(21,052 gpd commercial flow) / (245 gpd/EDU) = 86 commercial EDUs

Total number of EDUs = 71 residential + 86 commercial = 157 Total EDUs

Because of the total daily wastewater flow discharging to the soil is greater than 10,000 gpd, the MPCA recommends the design follow the "Design Guidance for Large Subsurface Wastewater Treatment Systems". Table 8 lists specific LSTS constituents and limits for soil dispersal. BOD and TSS do not have particular limits per say; however these constituents have direct correlation to applicable soil loading rates. Simply stated, if the pretreatment technology reduces BOD/TSS, then effluent may be applied to the soil at higher loading rates (gpd/ft^2). Similarly, fecal coliform bacteria do not have a specific limit. However, if the pretreatment device reduces bacteria then separation distances from the infiltrative surface to the limiting condition (seasonal water table, bedrock, hardpan, etc) may be reduced. The extent of separation distance reduction is associated to the level of pretreatment and reduction of coliform bacteria prior to soil dispersal.

Table 8: MPCA LSTS Subsurface Discharge Effluent Limits

Constituent	Limit
$CBOD_5$	None, however for system performance this parameter should be low (i.e. less than 25 mg/L)
TSS	None, however for system performance this parameter should be low (i.e. less than 30 mg/L)
Permit option #1: Total Nitrogen	10 mg/L end-of-pipe
Permit option #2: Nitrate Nitrogen	10 mg/L @ property boundary
Fecal Coliform	None

Of greatest importance is the nitrogen permitting options. The nitrogen policy was chosen to ensure the state's groundwater be protected and to provide a consistent technical baseline during permitting. Two nitrogen treatment performance permitting options are available and include (1) total nitrogen less than 10 mg/L at the end-of-pipe prior to soil dispersal and (2) an annual average nitrate-nitrogen limit of 10 mg/L placed at the property boundary.

The first option is the simplest and fastest option in terms of permitting. This option requires the LSTS meet an end-of-pipe (before soil dispersal) limit of 10 mg/L total nitrogen measured as an annual average. A limited hydrogeologic review is required, but nitrogen modeling and monitoring wells are not.

The second option requires a complete hydrogeologic investigation and groundwater monitoring network. An annual average nitrate-nitrogen limit of 10 mg/L would be placed on monitoring wells at the property boundary. Even with choosing option #2, a level of total nitrogen reduction will be required to achieve the nitrate-nitrogen property boundary limit.

The actual total nitrogen limit at the end-of-pipe is determined after the hydrogeologic and groundwater investigation. The results of these studies and characteristics of the treatment area's soil will determine the total nitrogen limit provided by the MPCA. If during operation this limit is exceeded, the permittee must evaluate to identify potential problems and may need to apply additional technology/components to reduce total nitrogen, as necessary. Therefore, there is a level of risk as limits are issued by the agency based on model results and, if flawed, corrective measures may be taken to ensure proper nitrogen treatment is achieved.

3.4.1 Treatment and Dispersal System

3.4.1.1 Soils

Evaluating the receiving environment is critical in determining suitable areas and site capability to safely treat and disperse wastewater. This information is very useful in ruling specific areas favorable or non-favorable and gaining knowledge of potential soil-based treatment system

types. Soil information that aids decision making includes soil texture, soil structure, drainage, permeability, high water table depths, flooding, ponding, and depth to the limiting condition: seasonal groundwater, bedrock, or an impermeable soil layer.

Property access was allowed for a soil investigation on two sites designated as potential treatment areas nearby Afton; (1) property located south of town, MSJR Properties, Jean Langlais, 15923 45th Street South and (2) property located north of town, David Eastwood, 2318 St. Croix Trail South (Figure 3). The field investigations, reviewing soil maps, and general viewing of the property reveal that soil at both locations would be suitable for a soil-based dispersal component; however the northern property is much more favorable (Figure 4).

Soils of the south property are mapped as the Santiago silt loam and consist of silt loam over sandy loam and sandy clay loam. These soils formed in loess or silty lacustrine deposits underlying dense sandy loam till on moraines. Silt loam extending to sandy loam and sandy clay loam soils were observed in four soil borings completed. All borings ceased because of boring refusal due to coarse fragments.

Soils are mapped across the north property as the Burkhardt and Mahtomedi loamy sand. These deep, lacustrine outwash soils are found on outwash plains, terraces, and moraines. Eight soil borings were completed within this area to an average depth of 72-inches below grade. Within the profile, loamy sands and sands extend to coarse sands with no signs of redoximorphic or bedrock observed. Soil loading rates within this area could be up to 1.6 gpd/ft^2 as highly pretreated (< 25 mg/L BOD, < 30 mg/L TSS) effluent will be applied. Figure 4 shows locations of recorded soil borings at the north site. Boring results are located in Appendix C.

3.4.1.2 Soil Dispersal

Pressurized in-ground infiltration trenches and seepage beds are first excavated to designated bottom elevations and suitable aggregate is placed into the excavation until the top of the aggregate is at the elevation of the distribution piping. Piping components, typically 1-1/4 to 3-inch diameter PVC, are utilized. Additional aggregate is placed over the distribution laterals and covered with a geotextile fabric. Finally, backfill is placed on top of the fabric. Effluent is pumped into the distribution piping at specific rates and volumes for infiltration into the soil. Because of the coarse textured soils and depth, the seepage cells will be completely below grade and can be loaded up to 1.6 gpd/ft^2.

Actual infiltrative surface area constructed and in operation is described in Attachment 7 of the LSTS guidance document and requires that the constructed infiltrative area be completed as follows:

(1) Divide the total design wastewater flow by the soil loading rate = infiltrative area required.
(2) Multiply the total infiltrative area by 2.0; this accounts for the reserve area.
(3) Construct and operate 1.5 times the area required; the remaining area (difference of step (2) and (3)) shall be set aside and serve as reserve/replacement area.
(4) Divide the constructed area in to multiple cells/zones.

The design flow used to calculate the required infiltrative area is 42,362 gpd. Table 9 displays soil loading rates and infiltration areas required. There are several categories of areas; required infiltrative area, reserve area, required constructed area, and estimated constructed footprint. The estimated constructed footprint is the final area required including the expansion/reserve area, component spacing, cell/zone spacing, tanks, required setbacks, pretreatment components, and pipe routing-in other words, the total estimated footprint required for the entire wastewater treatment and dispersal system. The trench alternative requires a larger footprint because this method does not utilize land area as efficiently due to trench spacing. Trench separation distances lead to greater required areas.

Table 9: Soil Loading Rates and Infiltrative Area Requirements

Dispersal Method	Design Soil Loading Rate (gpd/ft^2)	Required Infiltrative Area (ft^2)	Required Constructed Area (ft^2)*	Resultant Loading Rate (gpd/ft^2)**	Reserve Area* (ft^2)	Total Estimated Constructed Footprint (acre)
Pressurized seepage cells	1.6	26,477	39,720	1.06	13,240	3.0
Pressurized trenches	1.6	26,477	39,720	1.06	13,240	5.0

* Must construct 1.5 times or 150% the required infiltrative area: 26,477 ft^2 + 13,240 ft^2 = 39,720 ft^2
** Design wastewater flow divided by constructed infiltrative area: (42,362 gpd) / (39,720 ft^2) = 1.06 gpd/ft^2

3.4.1.3 Pretreatment Technology

Utilization of a pretreatment system will provide advanced treatment by lowering the constituents in the wastewater that must be decomposed by biological activity in the soil. Benefits of pretreating include: increased soil loading rates leading to less required infiltrative area, reduced vertical separation to limiting conditions in the soil profile, protection of groundwater resources, and increased system life. Examination of feasible pretreatment alternatives is critical in component selection. Within this CAR study, each alternative was evaluated based on the following criteria:

- Ability to achieve regulatory requirements
- Constructability
- Operation and maintenance requirements
- Opinion of probable costs (20 yr. present worth analysis)

As described earlier, the LSTS will need to address nitrogen treatment by either supplemental components to treat total nitrogen to 10 mg/L end-of-pipe, or treating total nitrogen to greater than 10 mg/L end-of-pipe and monitoring nitrate-nitrogen at the property boundary via groundwater wells. There is risk with this option- if these limits are not met at the property boundary, additional components may be needed. Also, due to the coarse textured soils present across the proposed treatment site, there will not be much nitrogen uptake within the soil. Water movement within the soil will be rapid and dominantly vertical prior to groundwater recharge. By choosing the 10 mg/L total nitrogen end-of-pipe option the upfront detailed hydrogeological assessment will not be required, monitoring wells do not need to be installed or monitored throughout the life of the system, and most importantly nitrogen treatment uncertainty will be

eliminated. Either the case, some level of total nitrogen reduction will be needed within pretreatment devices. Not all common pretreatment technologies will meet the required limit and therefore special design considerations must be applied. Pretreatment devices that are anticipated to reduce total nitrogen are the recirculating gravel filter (RGF) and attached growth aerobic treatment unit (ATU). Pretreatment devices that are anticipated to reduce total nitrogen to 10 mg/L end-of-pipe are the RGF with an anoxic upflow filter and carbon source additive, a submerged attached growth bioreactor (SAGB) with carbon additive, and an ATU with an anoxic upflow filter and carbon additive.

Recirculating Gravel Filter

The fundamental components of the recirculating gravel filter (RGF) system include a septic or settling tank, recirculation tank, the media filter, pumps & controls, and a dose tank for final dispersal. The media filter is a fixed film process in which the wastewater is distributed over the media. Bacteria present in the wastewater attach themselves to the media surface and as more wastewater passes over, aerobic bacteria extract nutrients, organic matter, and pathogens by utilizing the dissolved oxygen within the filtrate. Ambient oxygen is readily available within the filter and promotes various chemical and biological reactions. The wastewater is recirculated through the media for further treatment at 3:1 to 5:1 recirculation ratios. A design consists of select gravel media, coarse rock, pea gravel, underdrain piping, cleanouts, a PVC liner, and a distribution network typically of 1 to 2-inch diameter piping. To meet the LSTS total nitrogen 10 mg/L end-of-pipe limit, supplemental denitrification components will be needed.

Recirculating media filters will require routine operation and maintenance responsibilities. Typical tasks include monitoring & logging flows, rotating cells, inspecting pumps & controls, examining the media filter, field flushing distribution laterals, inspecting effluent quality, and checking treatment tanks for sludge. The tanks must be pumped periodically (as required by MPCA). Advantages: passive & resilient technology; influent strength capacity; excellent treatment performance; flexibility; straightforward operation and maintenance; low operational costs; limited mechanical and control components; and ease of construction. During normal

operation RGFs are very quiet. Disadvantages: media cost and availability; area requirement; and temperature loss during winter months.

Aerobic Treatment Unit – Attached Growth

An attached growth ATU is a proven pretreatment technology. This packaged unit consists of a precast concrete tank, treatment media substrate, and a remote blower. Wastewater flows up through the media via ambient air which is forced from the blower, through the piping and into the media chamber. It exists the piping at the bottom of the chamber and flows upward lifting aerated wastewater, or mixed liquor, towards the top of the chamber. The mixed liquor gravitates through the media where aerobic bacteria utilize dissolved oxygen to physically break down or digest wastewater constituents.

To achieve sufficient total nitrogen reduction, supplemental nitrification and denitrification components will be required. The nitrification components are similar to that of the ATU where air is forced through a media substrate. Nitrogen not converted to nitrate within the first ATU will be in the nitrification unit. A denitrification unit will also be required to achieve regulatory requirements.

ATUs will require routine operation and maintenance responsibilities. Typical tasks include monitoring & logging flows, inspecting blower & controls, examining the media chamber, inspecting effluent quality, and checking treatment tanks for sludge. Dependent upon use, the tanks will have to be pumped periodically. Advantages: low aerial footprint requirement; operational flexibility; excellent treatment performance; low aesthetic impact; and ease of construction. Disadvantages: addition of blowers leading to higher operational costs and noise.

Submerged Attached Growth Bioreactor

The SAGB is similar to a sequencing batch reactor system with an added attached growth media substrate. The system operates on a “fill” and “draw” activated sludge technology where wastewater is cycled through the media. A SAGB is a packaged wastewater system that is delivered complete and prepared for installation within precast concrete tanks. The system

includes an anaerobic anoxic chamber, pump tanks, blowers, carbon feed equipment, and the SAGB basin. Most of the processes of this activated sludge/attached growth system occur automatically via system controls however added monitoring is required due to the many processes. Therefore this system requires a skilled operator to successfully monitor and operate.

These systems require routine operation and maintenance tasks for examination of all process streams. This increases operational costs, as additional operator presence is mandatory to adjust timer settings related to the batching. Also, tanks, controls, valves, and pumps must be inspected regularly. Advantages: consistent treatment performance; low aerial footprint requirement; and operational flexibility. Disadvantages: extensive operation, monitoring, and maintenance requirements.

Anoxic Upflow Denitrification Filter

An anoxic dentrification upflow filter is a device designed specifically for total nitrogen reduction. The filter itself includes a media substrate that promotes the growth of denitrifying bacteria which are affixed to the media's surface area. A circulation pump is included to mix the nitrified wastewater and carbon source additive. As the wastewater passes the media, affixed bacteria uses nitrates within the wastewater (as oxygen is not available) transforming the nitrates to harmless nitrogen gas. As the bacteria die off, they will slough and fall to the tank bottom. Depending upon the amount of total nitrogen in the wastewater stream, the extent of solids within the device varies.

To ensure adequate carbon, a flow proportional pump would be utilized to supply a supplemental carbon additive (the electron donor). Dependent upon flow, temperature, detention time, and nitrate concentration, an established amount of carbon additive will be mixed with the nitrified effluent. Implementing this technology, the operator would be able to "dial in" the system to achieve 10 mg/L total nitrogen or lower. Once the proper amount of carbon is established, this system is relatively passive or self-sufficient. Also, as this is an attached growth, or fixed

system, it is more resilient to flow fluctuations and atypical conditions that would otherwise hinder the pretreatment process.

3.4.2 Cluster System Summary

- Advantages
  - Subsidized interest rate loans and grants for LSTS system construction
  - Lower operation and maintenance expenses for properties to replace ISTS
  - Dispersal of highly treated effluent away from surface waters
  - Allows for more usable land on individual lots
  - Increase in resale values above what an ISTS provides
  - Single location of wastewater treatment and dispersal
  - Single operator ensuring proper treatment, operation and maintenance

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

OTHER ALTERNATIVES

No other alternatives have been investigated for treatment and dispersal of wastewater from the City of Afton. However, it is expected that any mechanical, biological, or stabilization pond system with a new continuous surface discharge of treated wastewater to Lake St Croix would be cost prohibitive based on likely MPCA permitting and discharge limit requirements. In addition, long-range pumping of effluent to a nearby wastewater treatment plant would also likely be cost prohibitive based on the location of the CAR area relative to an existing wastewater treatment plant with capacity for additional wastewater treatment.

4.0 Cost Comparison of Alternatives

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 20 years.

COLLECTION SYSTEM

Table 10 provides the cost estimates for two collection system alternatives including installation of all components.

Table 10: Collection System Capital Costs

	Gravity Collection System	Low Pressure Forcemain Collection System
Capital Costs	$1,339,000	$1,610,000
Contingency (10%)	$134,000	$161,000
Non-construction	$295,000	$354,000
Total Capital Cost	$1,768,000	$2,125,000
Cost per EDU	$11,260	$13,540

INDIVIDUAL SEWAGE TREATMENT SYSTEMS (ALTERNATIVE 1)

The average capital cost estimates to replace/upgrade each residential property with an ISTS owned and operated by the individual homeowner are as follows:

- Type 1 Drainfield: $4-$8K plus tank upgrade costs (if needed run $3,000-$4,000)
- Type 2: $3,000 (new tank)
- Type 3: $5-$10K plus tank upgrade costs (if needed run $3,000-$4,000)
- Type 4: $8K for pretreatment costs plus tank ($3,000-$4,000 if needed) and drainfield upgrade costs ($3,000-$6,000 if needed).

The actual price paid for a new system will vary by property. Homes with more bedrooms will pay more for a new system while homes with fewer bedrooms will pay less. Properties where an existing septic tank is watertight and can be reused in a new system will also save money on tank purchase and installation. Appendix B shows the average cost for each system recommended for each residential property assuming new tanks and soil treatment areas. The costs shown in Appendix B do not take the individual size of the homes into account in the estimate of the system cost, as the number of bedrooms per individual home was not available for this report (i.e. a larger home may pay more than this cost, a smaller home would likely pay less.)

What is important to note about these costs is that they are for residential properties only. Business properties in the City of Afton are largely concentrated on small lots; therefore, most business properties would have difficulty using an ISTS system.

CLUSTER SYSTEM (ALTERNATIVE 2)

Table 11 provides the cost estimates for five cluster treatment systems including installation of all primary, secondary, and tertiary treatment; and soil dispersal components (seepage cells).

Table 11: Capital Cost Estimates of Cluster System Alternatives

Alternative	Total Nitrogen Treatment < 10 mg/L	Capital Cost	Contingency (10%)	Non-construction*	Total Capital Cost	Cost per EDU
ATU w/ anoxic upflow	Yes	$1,128,075	$112,800	$275,700	$1,516,575	$9,660
SAGB	Yes	$1,153,275	$115,330	$281,220	$1,549,820	$9,870
RGF w/ anoxic upflow	Yes	$937,110	$93,710	$233,660	$1,264,490	$8,050
RGF	No	$892,110	$89,210	$268,760	$1,250,090	$7,960
ATU	No	$947,480	$94,750	$280,950	$1,323,170	$8,430

*Includes: Engineering (18%), survey (treatment area), wetland delineation, geotechnical, legal & administrative (2%). Also includes monitoring wells and hydrogeologic assessment for non-10 mg/L total nitrogen end-of-pipe.

Alternative costs were based on average daily flow and organic loading estimates for all users in the CAR area (residential and commercial). Adding users would change the size requirement for the LSTS, the overall cost, and the cost per EDU. The cluster LSTS will require nitrogen removal technology no matter the nitrogen permitting option chosen. Table 10 reflects the

difference in capital cost estimates depending upon the level of nitrogen treatment. Prices included in Table 10 also include non-construction costs including engineering, survey, wetland delineation, geotechnical investigation, legal, administrative; and monitoring wells and hydrogeologic assessment (if nitrogen permitting option #2 is chosen). The cost of the 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 LSTS guidance. Costs assume ownership of the LSTS by the City of Afton.

All alternatives assume a soil dispersal treatment system consisting of 21 foot wide by 120 foot long pressurized seepage beds. The soil infiltration system will be designed into multiple cells to allow for smaller pumping and piping components thus lower equipment cost. More importantly, the operator will have the ability to manage the system by bringing cells in and out of service depending on the volume of wastewater to be treated. For higher flows, all cells can be put into service and during periods of low flow the number of active cells can be reduced, again depending on flow volumes. The rotation of cells in and out of service serves as a resting period for the cells, increasing the longevity of the soil dispersal system. The cell configuration will consist of sixteen seepage cells totaling 40,320 ft^2; another 13,240 ft^2 will be set aside as reserve area.

ANNUAL OPERATION AND MAINTENANCE COSTS

When comparing costs for wastewater infrastructure alternatives, all costs including capital and annual operation, maintenance, and replacement (O, M, & R) must be considered. Table 12 provides the average annual operation, maintenance, and replacement cost estimates for each cluster LSTS alternative. LSTS O, M, & R costs include the costs for the entire wastewater system including pretreatment components and the drainfield system (see Appendix E).

Table 12: Annual Operation, Maintenance, & Replacement Costs

Alternative	Estimated Annual O,M,&R	Yearly cost per EDU	Monthly cost per EDU
Gravity Collection	$14,400	$91.75	$7.75
Low-pressure Collection	$32,600	$207.75	$17.25
ATU w/ anoxic upflow	$56,940	$362.75	$30.25
SAGB	$60,680	$386.50	$32.25
RGF w/ anoxic upflow	$33,850	$215.75	$18.00
RGF	$35,160	$224.00	$18.75
ATU	$49,020	$312.25	$26.00

For comparison with a typical ISTS, yearly operation and maintenance costs for an individual residential system over the complete estimated 20-year life span are as follows:

- Type 1: $100
- Type 2: $\frac{\text{Bedrooms/home * 50 gallons/day/bedroom * 365 days/year * \$150/pump event}}{\text{1000 gallon holding tank capacity}}$
- Type 3: $100
- Type 4: $400

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 holding tank system can run into the thousands of dollars annually with full time occupancy.

PRESENT WORTH ANALYSIS

Alternatives discussed in this report require different capital costs and operation, maintenance, and replacement 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.

4.1.1 Collection System (WSB & Associates, Inc.)

For the purposes of this report, a 20-year present worth analysis was completed to compare the wastewater collection system options from an economic perspective. The 20-year present worth analysis includes the initial capital investment, but also considers the long-term costs, such as operation, maintenance, and replacement (O,M,R), salvage values, and other significant long-term costs for a period of 20 years,. A summary of the opinion of probable capital costs and 20-year present worth values for the wastewater collection system options are summarized in Table 13. Details for calculating the present worth costs and equivalent annual life cycle costs are included in Appendix E.

Based on this present worth analysis, Option No. 1, which is construction of a gravity sewer collection system, would result in the lowest cost for the City of Afton.

Table 13: Present Worth Analysis (20-Year) for Wastewater Collection System Options

	Gravity Collection System	Low Pressure Forcemain Collection System
Capital Costs	$1,339,000	$1,610,000
Contingency (10%)	$134,000	$161,000
Non-construction	$295,000	$354,000
20-year Present Worth O,M,R	$310,442	$645,667
Total Salvage Value of Expenditures	$457,000	$239,000
Estimated Total 20-year Present Worth	$1,621,442	$2,531,667
Estimated Total 20-year Present Worth per EDU	$10,328	$16,125
Estimated Total Equivalent Annual Cost per EDU	$520	$810

1. Present worth costs were determined using a 3% inflation rate on labor, 2% inflation rate on materials and an interest rate of 4% over a 20-year period.
2. Opinions of equivalent annual life cycle costs are based on the present worth of capital and O&M costs over a 20-year period.

4.1.2 Wastewater Treatment Alternatives

Section 4.3 evaluated operation, maintenance, and replacement costs of the cluster LSTS alternatives. Table 14 summarizes a present worth analysis over a 20-year period showing the *average* present worth costs for the entire project based on the different LSTS scenarios proposed in the report.

Table 14: Present Worth Analysis (20-year) by Wastewater Alternative w/ Cost Summary

	ATU w/ anoxic upflow	SAGB	RGF w/ anoxic upflow	RGF	ATU
Total Nitrogen Treatment to ≤ 10 mg/L	Yes	Yes	Yes	No	No
Capital Costs	$1,128,075	$1,153,275	$937,110	$892,110	$947,480
Contingency (10%)	$112,800	$115,330	$93,710	$89,210	$94,750
Non-construction	$275,700	$281,220	$233,660	$268,760	$280,950
20-year Present Worth O,M,&R	$773,830	$824,660	$459,970	$477,770	$666,130
Total Salvage Value on Expenditures	$124,860	$92,600	$129,460	$122,620	$111,000
Estimated Total 20-year Present Worth	$2,165,545	$2,281,890	$1,594,990	$1,605,230	$1,878,310
Estimated Total 20-year Present Worth per EDU	$13,790	$14,530	$10,160	$10,220	$11,960
Estimated Total Equivalent Annual Cost per EDU	$690	$730	$505	$510	$600

The estimated total 20-year present worth amounts are tallied in Table 12 in the middle row. The estimated total equivalent annual cost per EDU represents the annual cost to pay off the total present worth cost over a 20-year period. The estimated equivalent annual cost per EDU is simply the total annual cost divided by the number of EDUs.

The estimated equivalent annual cost per EDU shown in the last row of Table 12 is not the actual cost experienced by the EDU each year. The timing and magnitude of actual costs will vary including upfront capital costs (i.e., assessments, individual system repairs, etc.), loan and grant amounts, percent interest rate on loan dollars, 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. Actual costs cannot be determined until the project is bid, constructed, and in operation.

5.0 Summary and Recommendations

SUMMARY

This report estimates the likely compliance status for existing ISTS, provides the side by side comparison of treatment alternatives for long-term wastewater infrastructure to serve properties in the City of Afton service area, and provides an evaluation of feasible collection system alternatives. A summary of the findings:

- 30% (25) of the field evaluated ISTS are likely non-compliant and either an imminent health threat or fail to protect groundwater
- 32 of the 86 existing properties have the option of installing a Type 1 ISTS to replace their current system in the future
- Estimated capital costs on average for the CAR evaluated alternatives:
  - Collection system
    - $11,260 - $13,540 per EDU
  - ISTS:
    - Type 1 drainfield: $4-$8K plus tank upgrade costs (if needed run $3,000-$4,000)
    - Type 2 holding tank: $3,000 (new tank)
    - Type 3 drainfield: $5-$10K plus tank upgrade costs (if needed run $3,000-$4,000)
    - Type 4 drainfield with pretreatment: $8K for pretreatment costs plus tank ($3,000-$4,000 if needed) and drainfield upgrade costs ($3,000-$6,000 if needed).
  - LSTS cluster wastewater treatment system (total nitrogen treatment $\leq$ 10 mg/L end-of-pipe)
    - $8,050 - $9,660 per EDU

- LSTS cluster wastewater treatment system (total nitrogen treatment > 10 mg/L end-of-pipe)
    - $7,960 - $8,430 per EDU

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 CAR area be treated by parcel, with the following recommendations based on Community values:

- If the City of Afton values the lowest cost alternative, then the following recommendations apply:
    - Currently compliant parcels continue with ISTS and explore private funding options for any future upgrades.
    - Parcels needing future upgrade to holding tank (particularly commercial properties); evaluate potential to obtain additional land in close proximity for placement of a drainfield or a small cluster drainfield. Evaluate potential to attain public financing to fund systems owned and operated by the City. If this is not possible, Community should investigate Alternative 2; the LSTS cluster treatment system option.
    - Currently non-compliant parcels suggested for Type 1, 3 or 4 ISTS; install compliant ISTS if sufficient area exists and explore private funding options.
    - All systems (public and private ISTS and 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 collection system alternatives and Alternative 2; the LSTS cluster treatment system option. Evaluate potential to attain public financing to fund this option.

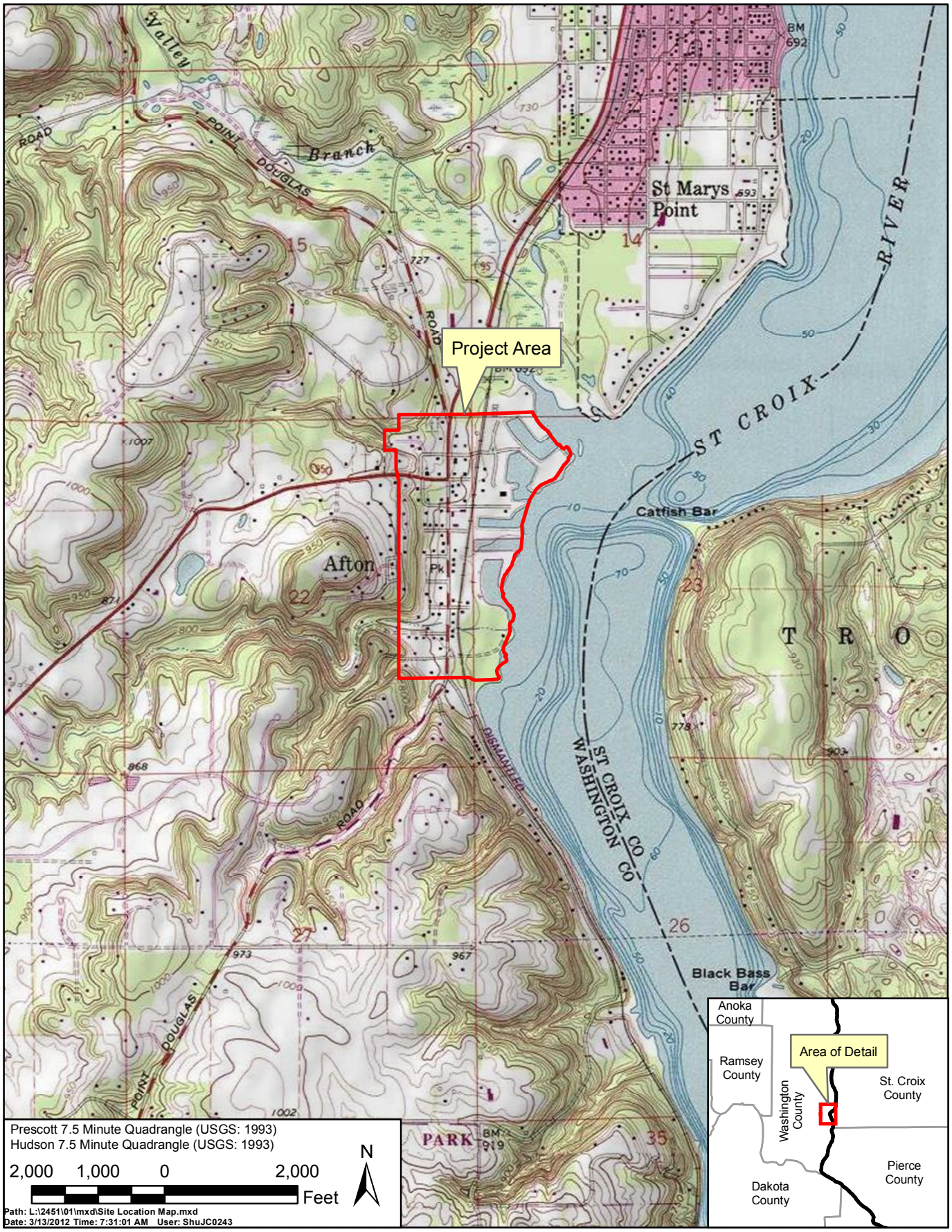
- Investigate acquiring land located north of town, David Eastwood, 2318 St. Croix Trail South (property #2 described above).
- Investigate the level of hydrogeologic assessment to determine the degree of nitrogen removal technology to be implemented.

NEXT STEPS

The following describes future actions that could be taken by the City of Afton based on the CAR 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 soil test pits, and (where applicable) borings to groundwater, and groundwater mounding assessments.
- Washington County will 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.

Figures



CITY OF AFTON

Site Location Map

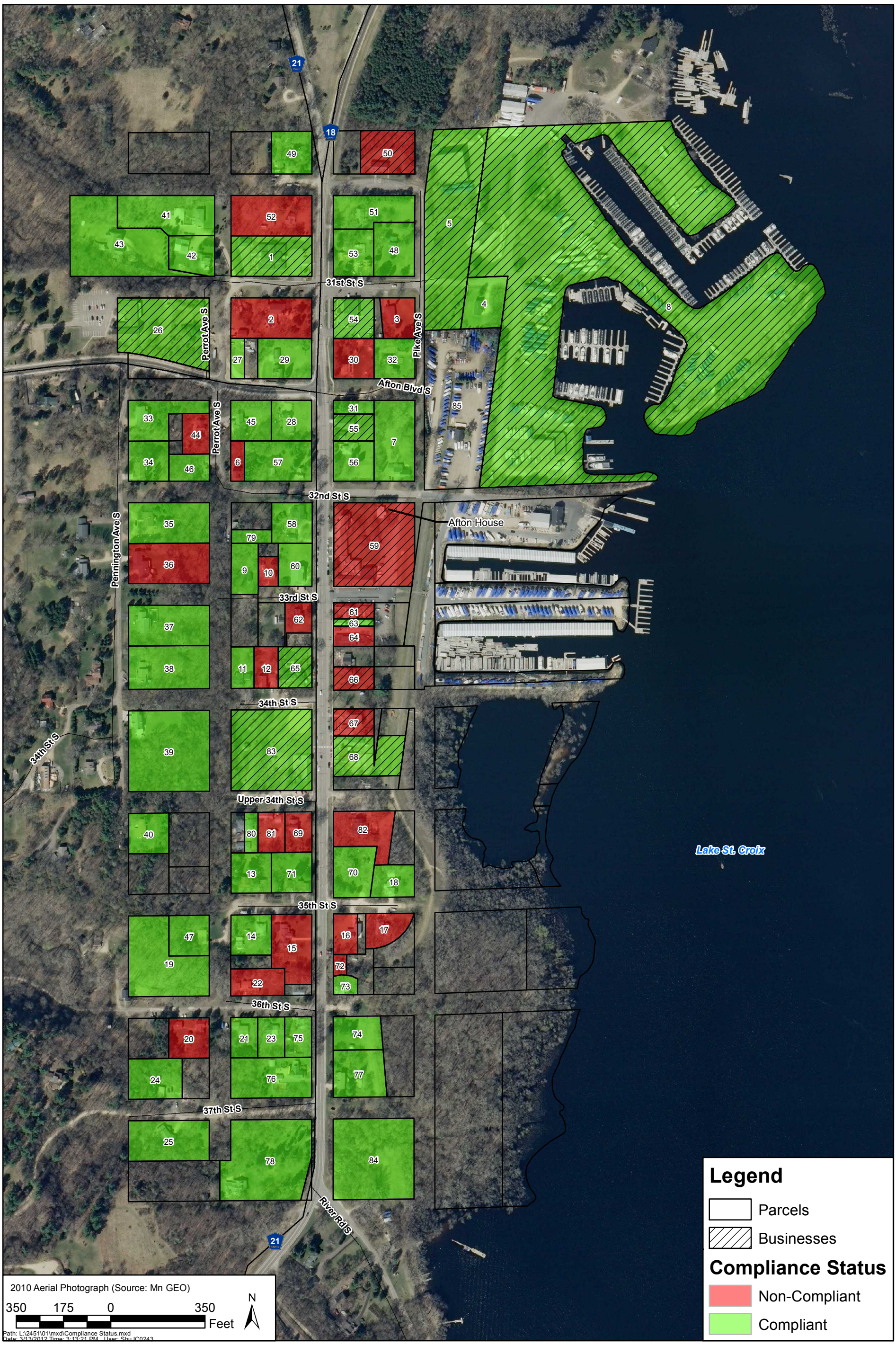
Wenck

Engineers - Scientists
Business Professionals
www.wenck.com

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

MAR 2012

Figure 1



CITY OF AFTON

Compliance Status

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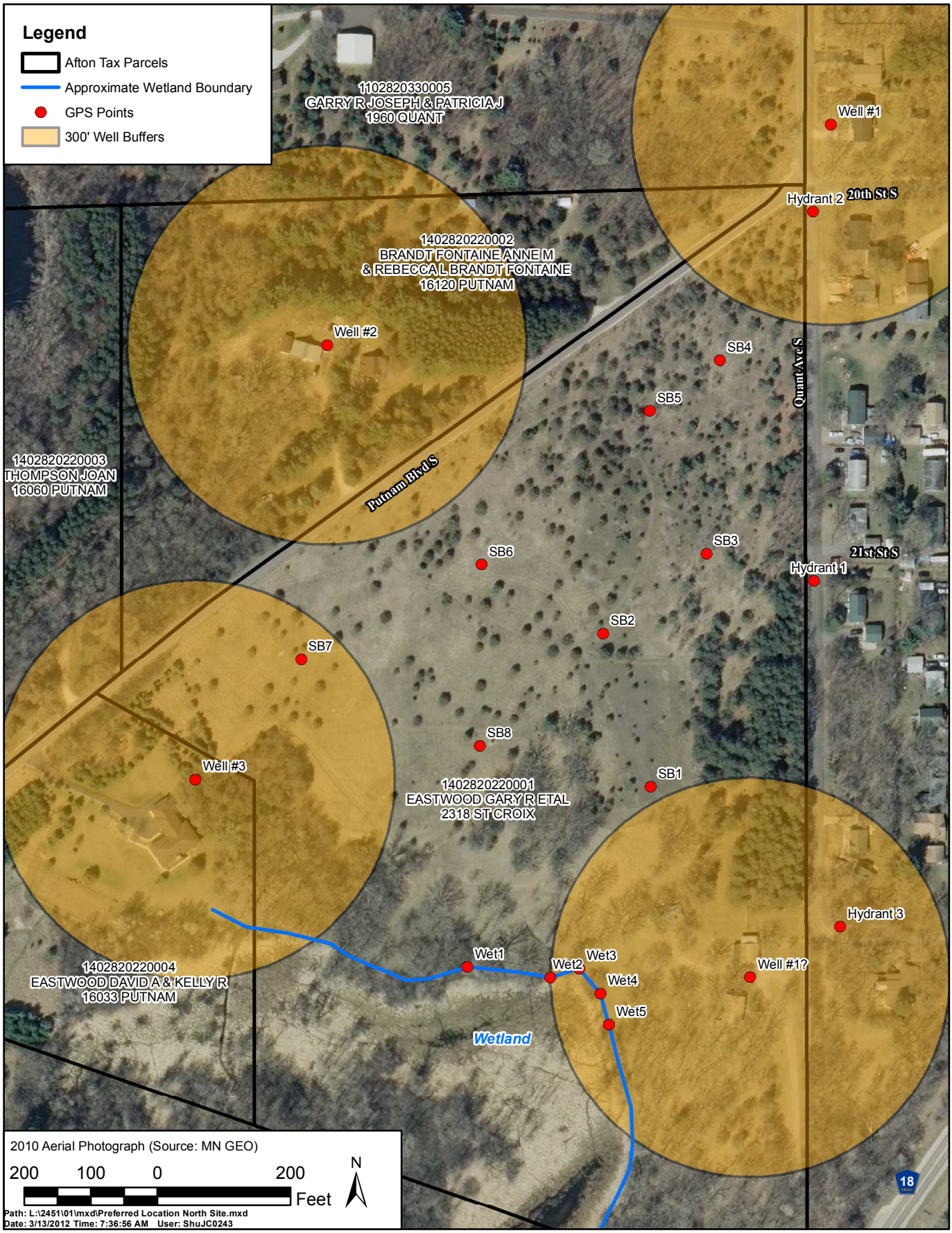
Maple Plain, MN 55359-0429
1-800-472-2232

MAR 2012

Figure 2

CITY OF AFTON	Wenck Engineers - Scientists Business Professionals www.wenck.com 1800 Pioneer Creek Center Maple Plain, MN 55359-0429 1-800-472-2232	MAR 2012
Potential Treatment and Dispersal Locations		Figure 3



CITY OF AFTON

Preferred Treatment and Dispersal Location-North Site

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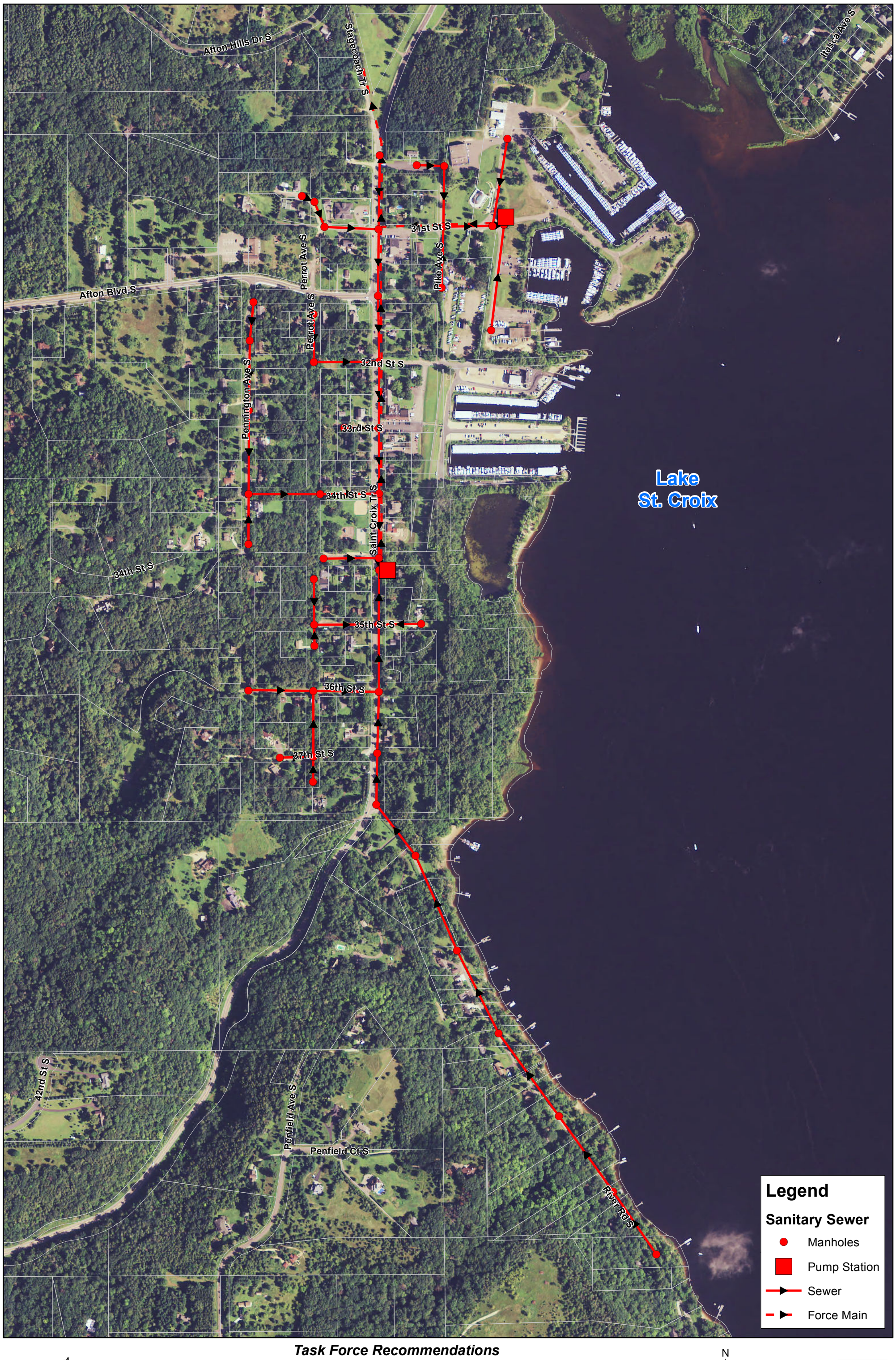
Figure 4



City of Afton

Task Force Recommendations
for Infrastructure Improvements
in the Old Village

Figure 5: Sanitary System Concept

N

0 500 Feet

WSB & Associates, Inc.

Appendix A

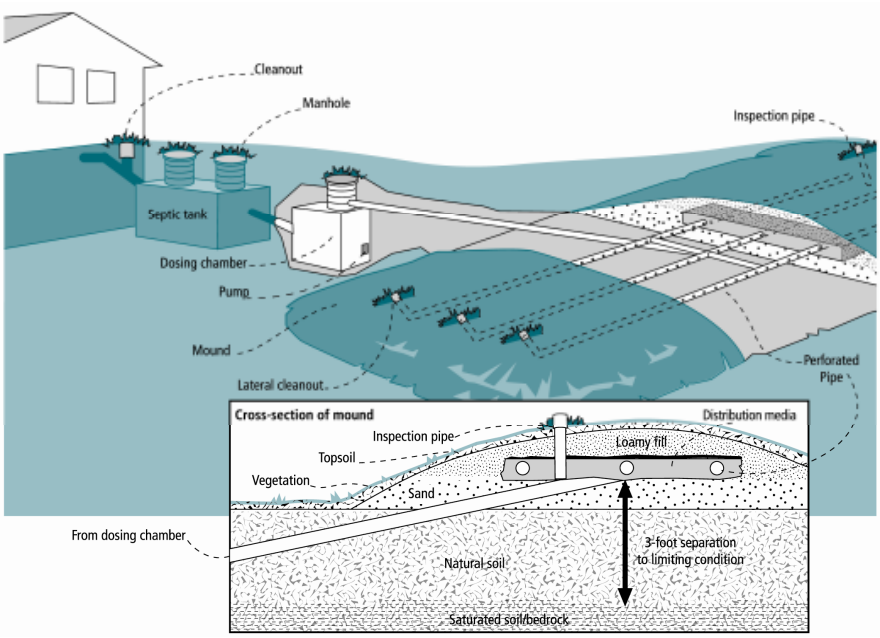
U of M ISTS Information

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.

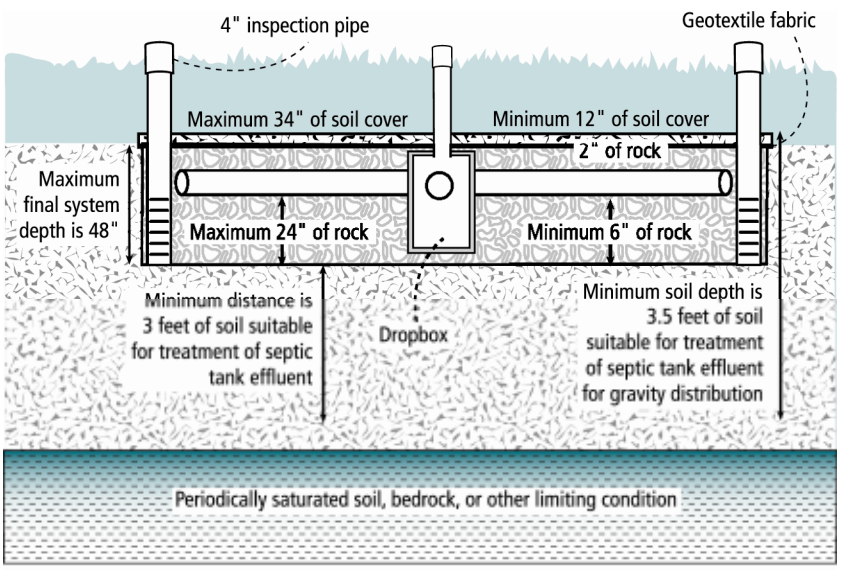
Below-Grade Systems

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



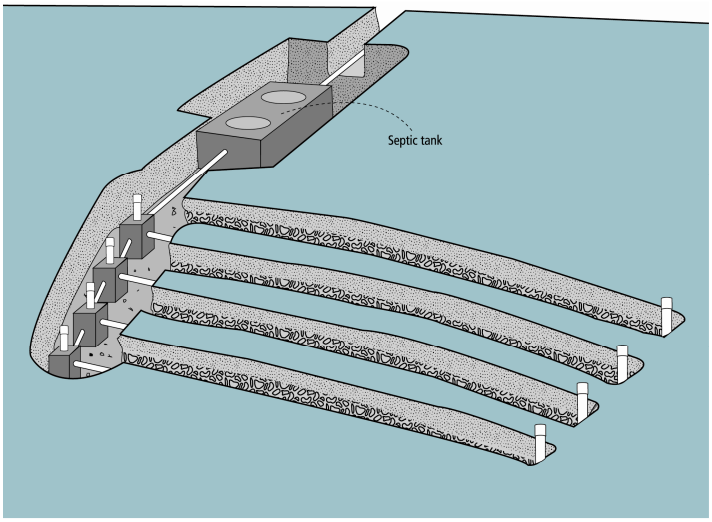
From MN Rules 7080.2260 Subp. 3. If the distribution media in a trench or a bed is in contact with soil texture group 2 through 4 (medium sand, fine sand, coarse and medium loamy sand) pressure distribution must be used.

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.

Appendix B

Parcel Data Spreadsheet

Existing Status Report for *Afton*

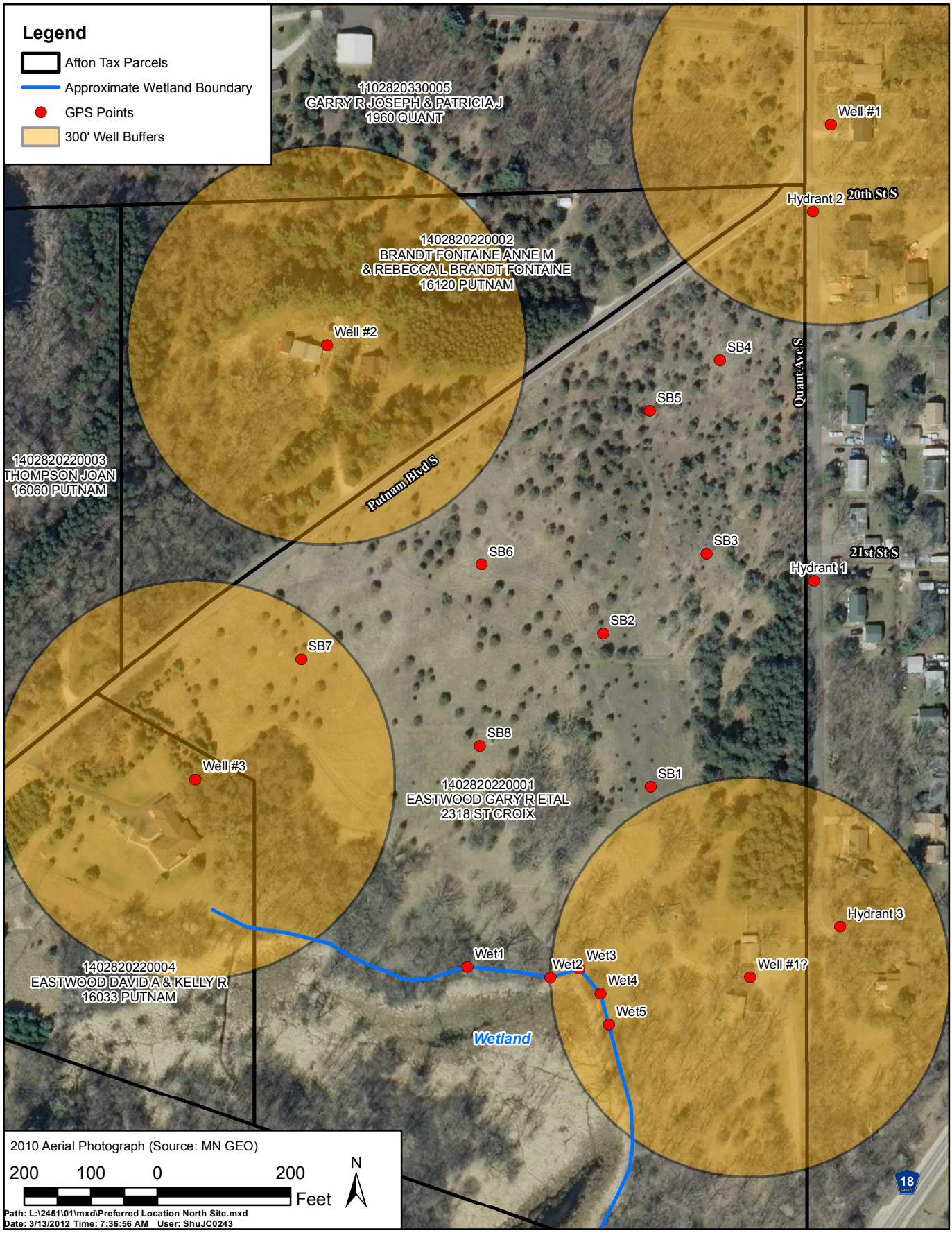
					PPL Unsewered Documentation															
					Compliance evaluation status				Setback Status X if in violation				UAND Existing System Condition Status	Yes/No each; * best option						
						Likely non-compliant														
CAR ID#	Parcel ID	House (H), Vacant (V) Cabin (C'), Business (B)	Well Type: Deep (D), Shallow (S), Unknown (U), Community (C), None (N)	Current SSTS type: drainfield (D), mound (M), holding tank (H), none (N) or unknown (U) *=Cluster	SSTS Likely Compliant (X if True)	ITPHS (X if True)	Likely failing to protect groundwater (X if True)	Reason: (lack of vertical separation (V), cesspool (C), prior (P), surfacing (S), no permit (N))	Drinking water supply -deep well (50' setback) or shallow well (100' setback)	Buildings (house, garage, out)	Property lines	Surface waters	Score: 1=ITPHS, 2=FT PGW, 3=Compliant not meeting setbacks, 4=Compliant meeting setbacks	Type 1 (standard)	Type 2 (holding tank, privy, floodplain)	Type 3 (other, <12", problem soils, rip and replace)	Type 4 or 5	Upgrade Type for Non-compliant	Average upgrade cost to ISTS for residential properties	Comments
1	2202820110021	b	d	d	x								4			x		0	NA	Pulled inspection pipe, ponding water, system questionable
2	2202820110023	h	d	d		x		s					1			x		3	$14,000	surfacing
3	2202820110012	h	u	d			x	n					2	x				1	$12,000	
4	2302820220004	h	s	d	x								4			x		0	$14,000	
5	2302820220001	b	d	d	x								4	x				0	NA	
6	2202820110029	h	u	d			x	n			x		2				x	4	$18,000	small lot
7	2202820110007	h	u	d	x								4	x				0	$12,000	
8	2302820220003	b	d	d+h	x								4		x		x	0	NA	drainfield built on river side of levee
9	2202820140063	v	u	n									4	x				0	NA	shed only
10	2202820140030	h	u	u			x	n					2		x			2	$3,000	small lot
11	2202820140040	h	u	d	x						x		3				x	0	$18,000	looks like system installed in right of way sw of house
12	2202820140038	h	u	u			x	n			x		2				x	4	$18,000	
13	2202820410019	h	u	d	x								4				x	0	$18,000	
14	2202820410020	h	d	d	x								4				x	0	$18,000	
15	2202820410021	h	d	u			x	n					2	x				1	$12,000	
16	2202820410009	h	u	u			x	n					2				x	4	$18,000	
17	2202820410014	h	d	u			x	n					2				x	4	$18,000	
18	2202820410017	h	d	d	x						x		3			x		0	$14,000	system in levee
19	2202820410038	h	d	d	x								4	x				0	$12,000	
20	2202820410035	h	u	u			x	n					2			x		3	$14,000	
21	2202820410028	h	u	d	x								4			x		0	$14,000	
22	2202820410024	h	u	u			x	n					2	x				1	$12,000	
23	2202820410027	h	d	d	x								4			x		0	$14,000	
24	2202820410037	h	d	d	x								4	x				0	$12,000	
25	2202820410032	h	u	d	x								4	x				0	$12,000	
26	2202820110053	b	d	d	x								4	x				0	NA	
27	2202820110025	v	u	d	x								4	x				0	NA	
28	2202820110027	h	d	d	x								4			x		0	$14,000	
29	2202820110022	h	d	d	x								4	x				0	$12,000	
30	2202820110009	h	d	u			x	n					2	x				1	$12,000	
31	2202820110005	h	u	d	x						x		3				x	0	$18,000	
32	2202820110010	h	u	d	x								4			x		0	$14,000	
33	2202820110030	h	u	d	x								4	x				0	$12,000	
34	2202820110031	h	d	m	x						x		3			x		0	$14,000	installed in ROW
35	2202820140054	h	d	d	x								4	x				0	$12,000	
36	2202820140053	h	u	u			x	n					2	x				1	$12,000	
37	2202820140049	h	u	d	x								4	x				0	$12,000	
38	2202820140065	h	u	d	x								4			x		0	$14,000	
39	2202820140048	h	d	d	x						x		3			x		0	$14,000	installed in perot ave easement
40	2202820140046	h	u	m	x								4				x	0	$18,000	
41	2202820110049	h	d	d	x								4			x		0	$14,000	
42	2202820110047	h	u	d	x						x		3			x		0	$14,000	
43	2202820110051	h	u	d	x								4	x				0	$12,000	
44	2202820110036	h	u	d			x	n					2				x	4	$18,000	
45	2202820110026	h	d	d	x						x		3				x	0	$18,000	
46	2202820110032	h	u	d	x						x		3				x	0	$18,000	
47	2202820410040	h	u	d	x						x		3			x		0	$14,000	installed in ROW of perot
48	2202820110013	h	d	d	x								4	x				0	$12,000	
49	2202820110019	b+h	u	h+d	x								4	x	x			0	NA	
50	2202820110017	b	d	u			x	n					2	x				1	NA	
51	2202820110015	h	u	d	x								4	x				0	$12,000	
52	2202820110020	h	u	u			x	n					2	x				1	$12,000	
53	2202820110014	h	d	d	x								4			x		0	$14,000	
54	2202820110008	b	u	d	x						x		3				x	0	NA	
55	2202820110004	b	u	d	x								4			x		0	NA	
56	2202820110006	h	s	d	x								4	x				0	$12,000	redrill well for future type 1
57	2202820110028	b+h	u	d	x								4	x				0	NA	
58	2202820140028	h	u	d	x								4			x		0	$14,000	

Existing Status Report for *Afton*

					PPL Unsewered Documentation															
					Compliance evaluation status				Setback Status X if in violation				UAND Existing System Condition Status	Yes/No each; * best option						
						Likely non-compliant														
CAR ID#	Parcel ID	House (H), Vacant (V) Cabin (C'), Business (B)	Well Type: Deep (D), Shallow (S), Unknown (U), Community (C), None (N)	Current SSTS type: drainfield (D), mound (M), holding tank (H), none (N) or unknown (U) *=Cluster	SSTS Likely Compliant (X if True)	ITPHS (X if True)	Likely failing to protect groundwater (X if True)	Reason: (lack of vertical separation (V), cesspool (C), prior (P), surfacing (S), no permit (N))	Drinking water supply -deep well (50' setback) or shallow well (100' setback)	Buildings (house, garage, out)	Property lines	Surface waters	Score: 1=ITPHS, 2=FT ROW, 3=Compliant not meeting setbacks, 4=Compliant meeting setbacks	Type 1 (standard)	Type 2 (holding tank, privy, floodplain)	Type 3 (other, <12", problem soils, rip and replace)	Type 4 or 5	Upgrade Type for Non-compliant	Average upgrade cost to ISTS for residential properties	Comments
59	2202820140062	b+h	u	d+m			x	f					2			x		3	NA	df installed in floodplain, mound looks compliant
60	2202820140029	b+h	u	d	x								4	x				0	NA	
61	2202820140013	b	u	d			x	n,f					2			x		3	NA	below dike
62	2202820140035	h	u	u			x	n,f					2	x				1	$12,000	
63	2202820140014	b	u	m	x						x		3			x		0	NA	mound on 34th in dike
64	2202820140012	b+h	u	u			x	n					2		x			2	NA	
65	2202820140037	b	u	d	x								4			x		0	NA	
66	2202820140016	b	u	u			x	n					2			x		3	NA	
67	2202820140007	b	u	u			x	n					2		x			2	NA	
68	2202820140006	b	u	m	x						x		3			x		0	NA	mound in dike
69	2202820140045	h	u	u			x	n					2		x			2	$3,000	most of property in flood plain
70	2202820410016	h	d	m	x						x		3			x		0	$14,000	built in easement
71	2202820410018	h	s	d	x								4			x		0	$14,000	
72	2202820410011	h	u	u			x	n			x		2		x			2	$3,000	
73	2202820410012	h	u	d	x						x		3			x		0	$14,000	installed in 36th st ROW
74	2202820410007	h	u	m	x								4			x		0	$14,000	installed in levee on property
75	2202820410029	h	u	d	x								4			x		0	$14,000	
76	2202820410030	h	u	d	x								4	x				0	$12,000	
77	2202820410006	h	u	m	x								4			x		0	$14,000	
78	2202820410031	h	u	d	x								4	x				0	$12,000	
79	2202820140026	h	u	d	x								4	x				0	$12,000	15871 32nd st
80	2202820140043	h	u	h	x						x		3	x				0	$12,000	room for type 1 in easement to the west
81	2202820140044	h	u	u			x	n					2				x	4	$18,000	
82	2202820140004	h	u	u			x	n					2				x	4	$18,000	
83	2202820140041	b	u	h	x								4	x				0	NA	holding tank on privy in park
84	2202820410005	h	u	m*	x								4			x		0	$14,000	2001 cluster mound for river road system

Appendix C

Soil Borings



CITY OF AFTON

Preferred Treatment and Dispersal Location-North Site

Wenck

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

MAR 2012

Figure 4

sb1
sb4
sb2
sb3
2010 Aerial Photograph
0 100 200 400
Feet
N
Path: L:\2656\01\mxd\afton.mxd

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 1 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 10	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	10 – 22	7.5YR 3/4	Sand	----	----	1.2	1.6
3	22 – 36	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
4	36 – 72	7.5YR 4/6	Sand	----	----	1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 2 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 16	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	16 – 56	10YR 3/4	Coarse sand	----	----	1.2	1.6
3	56 – 64	7.5YR 4/4	Sand	----	----	1.2	1.6
4	64 – 78	5YR 4/4	Fine sand	----	----	0.6	1.0

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

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SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 3 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 10	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	10 – 26	7.5YR 4/4	Loamy coarse sand	----	----	1.2	1.6
3	26 – 34	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
4	34 – 48	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
5	48 – 72	5YR 4/4	Sand			1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

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Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 4 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 8	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	8 – 12	7.5YR 4/4	Loamy coarse sand	----	----	1.2	1.6
3	12 – 34	7.5YR 4/4	Coarse sand	----	----	1.2	1.6
4	34 – 56	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
5	56 – 72	5YR 4/4	Sand			1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 5 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 14	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	14 – 30	7.5YR 4/4	Coarse sand	----	----	1.2	1.6
3	30 – 44	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
4	44 – 60	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
5	60 – 72	5YR 4/4	Sand			1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 6 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 8	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	8 – 32	7.5YR 4/4	Loamy sand	----	----	1.2	1.6
3	32 – 42	7.5YR 4/6	Coarse sand	----	----	1.2	1.6
4	42 – 72	5YR 4/4	Sand	----	----	1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 7 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 14	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	14 – 42	7.5YR 4/4	Coarse sand	----	----	1.2	1.6
3	42 – 58	7.5YR 4/6	Sand	----	----	1.2	1.6
4	58 – 72	5YR 4/4	Sand	----	----	1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – North Site

SOIL BORING # 8 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 16	10YR 3/3	Loamy sand	----	----	1.2	1.6
2	16 – 50	7.5YR 4/4	Loamy sand	----	----	1.2	1.6
3	50 – 72	5YR 4/4	Sand	----	----	1.2	1.6

COMMENTS: North site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – South Site

SOIL BORING # 1 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 10	10YR 3/3	Silt loam	----	----	0.5	0.8
2	10 – 24	10YR 4/6	Silt loam	----	----	0.5	0.8
3	24 – 36	7.5YR 4/4	Sandy loam; 5 – 10% coarse fragments	----	----	0.8	1.0
ROCKS CEASED BORING							

COMMENTS: South site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – South Site

SOIL BORING # 2 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 6	10YR 3/3	Silt loam	----	----	0.5	0.8
2	6 – 12	10YR 4/6	Silt loam	----	----	0.5	0.8
3	12 – 26	7.5YR 4/4	Loamy sand; 2% coarse fragments	----	----	1.2	1.6
4	26 – 38	7.5YR 4/6	Sandy clay loam; 5% coarse fragments	----	----	0.45	0.6
5	38 – 44	5YR 4/6	Sandy clay loam; 5% coarse fragments	----	----	0.45	0.6
6	44 – 56	7.5YR 4/6	Sandy loam	----	----	0.8	1.0
7	56 – 64	5YR 4/6	Sandy clay loam; 5 - 10% coarse fragments	----	----	0.45	0.6
ROCKS CEASED BORING							

COMMENTS: South site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – South Site

SOIL BORING # 3 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 10	10YR 3/3	Silt loam	----	----	0.5	0.8
2	10 – 20	10YR 4/6	Silt loam	----	----	0.5	0.8
3	20 – 36	7.5YR 4/4	Sandy clay loam	----	----	0.45	0.6
ROCKS CEASED BORING							

COMMENTS: South site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Wenck
Engineers • Scientists

SOIL PROFILE DESCRIPTION

PROJECT City of Afton **PROJECT NO.** 2656-01 **DATE** 10/28/2011

SCOPE Community Assessment Report **PROJECT LOCATION** Afton, MN – South Site

SOIL BORING # 4 **PIT** ☐ **AUGER** ☒ **ELEVATION** --- **SLOPE & ASPECT** ---

DESCRIPTION BY Peter G. Miller, PSS **CERTIFICATION** Professional License No. 42636

HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 18	10YR 3/3	Silt loam	----	----	0.5	0.8
2	18 – 34	10YR 4/6	Silt loam	----	----	0.5	0.8
3	34 – 40	10YR 5/6	Sandy clay loam; 5% coarse fragments	----	----	0.45	0.6
ROCKS CEASED BORING							

COMMENTS: South site

APT = Advanced Pretreatment
Maximum soil loading rate values per MPCA "Design Guidance for Large Subsurface Wastewater Treatment Systems"

Appendix D

Flow Calculations

Attachment 2 – Design flow considerations

This attachment is to be used to determine the design sizing of the wastewater facilities. It should also be used in Attachment 6 to design the drainfield.

How many dwellings are connected to the LSTS? 71

What is the design Average Wet Weather (AWW) Flow for the LSTS?

Step 1 Number of dwellings 71 dwellings

Step 2a Flow Determination for Existing Dwellings Section 2, Part A 17,310 gpd

Step 2b Flow Determination for New Dwellings, Section 2 Part B 0 gpd

Step 2c Flow per "other" establishments, Section 2 Part C 21,052 gpd

(List all "other establishments" separately and show how the flow was calculated.)

Note: Refer back to Attachment 1 for flow determination examples.

Step 3 Step 2a + Step 2b + Step 2c flows = 38,362 gpd

Step 4 Average diameter of sewer lines 8 inches

Step 5 Total length of sewer lines 2.5 miles

Step 6 Inflow/infiltration (I/I) flow 4,000 gpd

(Use this equation: I/I = Step 4 x Step 5 x 200 gallons/inch/mile)

Step 7 AWW flow = Step 3 + I/I flow (Step 6) 42,362 gpd

City of Afton
Wastewater Community Assessment Report
Estimate Design Wastewater Flow for Residential Units

February 9, 2012

2010 Census Data for Housing Characteristics in Afton

	Number of Bedrooms					
	0	1	2	3	4	5 or more
% of Total Housing Units in Afton	0%	0.00%	12.30%	47.80%	32.90%	6.90%

Total Housing Units in Afton = 1100 (Based on 2010 Census Data)

Housing Units in Study Area = 71

	Number of Bedrooms					
	0	1	2	3	4	5 or more
Number of Housing Units in Study Area	0	0	9	34	23	5

For the Study Area assume 1/2 of the dwellings have a Classification of I and 1/2 of the dwellings have a Classification of II for the size of bedrooms.

1	2	3	4	5	6
# of Bedrooms	**# of Dwellings in Study Area**	**Classification**	**Initial Flow Per Dwelling**	**Reduction Factor (0.45)**	**Design Flow, GPD (columns 2 x 4 x 5)**
2	5	I	300	0.45	675
2	4	II	225	0.45	405
3	17	I	450	0.45	3442.5
3	17	II	300	0.45	2295
4	11	II	375	0.45	1856.25
4	7	I	600	0.45	1890
4	5	I	600	1	3000
5	5	I	750	1	3750
				Total Residential Design Flow, GPD	**17,310**

City of Afton
Wastewater Community Assessment Report
Estimated Wastewater Flow for Non-Residential Units

February 9, 2012

Septic System #	Facility Unit Size	Units	Building Use	WW Flow GPD/Unit	Employees	WW Flow GPD/Employee	Design WW Flow, GPD
29	45	Seats	Restaurant	30	3	18	1404
30	4000	SF	Future Office	0.18	2	15	750
32	2800	SF	Bank	0.18	3	15	549
38	1400	SF	Commercial Bus	0.15	1	15	225
40	4800	SF	Bank	0.18	6	15	954
41	1600	SF	Retail Store	0.13	1	15	223
43	3750	SF	Retail Store	0.13	2	15	517.5
44	1350	SF	Retail Store	0.13	1	15	190.5
47	19400	SF	Hotel	0.28	5	15	5507
55	3630	SF	Retail Store	0.13	2	15	501.9
52	3425	SF	Retail Store	0.13	2	15	475.25
66	1600	SF	Retail Store	0.13	1	15	223
68	100	Seats	Restaurant	30	6	15	3090
70	550	Seats	Church	4	4	15	2260
81	2100	SF	Retail Store	0.13	1	15	288
82	11600	SF	Office/Shop	0.18	6	15	2178
83	8860	SF	Retail Store	0.13	3	15	1196.8
85	50	People	Park	10	0	15	500
86	NA		201 System	0	0	15	0
						Total Non-Residential Design Flow, GPD	**21,030**

Appendix E

Cost Analysis

CITY OF AFTON COMMUNITY ASSESSMENT REPORT
SANITARY SEWER COLLECTION SYSTEM
WSB Project No. 01856-290
GRAVITY COLLECTION SYSTEM ALTERNATIVE

Item No.		Item Description	Units	Quantity	Unit Price	Total Price
SCHEDULE A - SURFACE IMPROVEMENTS						
1	2021.501	MOBILIZATION	LUMP SUM	1	$45,500.00	$45,500.00
2	2104.505	REMOVE BITUMINOUS PAVEMENT	SQ YD	230	$2.00	$460.00
3	2104.513	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	LIN FT	250	$4.00	$1,000.00
4	2211.501	AGGREGATE BASE CLASS 5	TON	450	$20.00	$9,000.00
5	2350.501	TYPE LV 3 WEARING COURSE MIXTURE (B)	TON	90	$45.00	$4,050.00
6	2350.502	TYPE LV 3 NON WEARING COURSE MIXTURE (B)	TON	120	$75.00	$9,000.00
7	2357.502	BITUMINOUS MATERIAL FOR TACK COAT	GALLON	50	$3.50	$175.00
8	2563.601	TRAFFIC CONTROL	LUMP SUM	1	$4,000.00	$4,000.00
9	2573.502	SILT FENCE, TYPE HEAVY DUTY	LIN FT	9,500	$2.50	$23,750.00
10	2575.602	SEEDING, MIX 240 (INCL. TOPSOIL & FERTILIZER)	ACRE	1	$4,000.00	$4,000.00
					TOTAL SCHEDULE A - SURFACE IMPROVEMENTS:	$100,935.00
SCHEDULE B - SANITARY SEWER IMPROVEMENTS						
11	2451.602	GRANULAR FOUNDATION AND/OR BEDDING	TON	935	$9.00	$8,415.00
12	2503.602	CHIMNEY SEALS	EACH	40	$250.00	$10,000.00
13	2503.602	8" x 4" PVC WYE	EACH	90	$150.00	$13,500.00
14	2503.603	4" PVC PIPE SEWER - SDR 26	LIN FT	5,700	$30.00	$171,000.00
15	2503.603	8" PVC PIPE SEWER - SDR 26	LIN FT	12,610	$40.00	$504,400.00
16	2503.603	TELEVISE SANITARY SEWER	LIN FT	12,610	$1.65	$20,806.50
17	2503.541	4" PVC PIPE SEWER DESIGN PRESSURE DR 18	LIN FT	5,500	$31.50	$173,250.00
18	2506.516	CASTING ASSEMBLY	EACH	40	$500.00	$20,000.00
19	2506.602	CONNECT TO EXISTING MANHOLE	EACH	1	$4,000.00	$4,000.00
20	2506.603	CONSTRUCT 48" DIA SEWER MANHOLE	LIN FT	500	$225.00	$112,500.00
					TOTAL SCHEDULE B - SANITARY SEWER IMPROVEMENTS:	$1,037,871.50
SCHEDULE C - LIFT STATION IMPROVEMENTS						
21	2100.601	CONSTRUCT LIFT STATION NO. 1	LUMP SUM	1	$200,000.00	$200,000.00
					TOTAL SCHEDULE C - LIFT STATION IMPROVEMENTS:	$200,000.00
	TOTAL SCHEDULE A - SURFACE IMPROVEMENTS:					$101,000.00
	TOTAL SCHEDULE B - SANITARY SEWER IMPROVEMENTS:					$1,038,000.00
	TOTAL SCHEDULE C - LIFT STATION IMPROVEMENTS:					$200,000.00
	SUBTOTAL					**$1,339,000.00**
	CONTINGENCIES (10%)					$134,000.00
	TOTAL ESTIMATE CONSTRUCTION COST					**$1,473,000.00**
	ENGINEERING AND ADMINISTRATION (20%)					$295,000.00
	TOTAL ESTIMATED PROJECT COST					**$1,768,000.00**

**THIS ESTIMATE ASSUMES THAT ROADWAY WORK WOULD BE COMPLETED AS PART OF THE PROJECT AND FUNDED SEPERATELY
**LIFT STATION NO.2 WOULD BE PRIVATE

CITY OF AFTON COMMUNITY ASSESSMENT REPORT
SANITARY SEWER COLLECTION SYSTEM
WSB Project No. 01856-290
LOW PRESSURE FORCEMAIN COLLECTION SYSTEM ALTERNATIVE

Item No.		Item Description	Units	Quantity	Unit Price	Total Price
SCHEDULE A - SURFACE IMPROVEMENTS						
1	2021.501	MOBILIZATION	LUMP SUM	1	$60,000.00	$60,000.00
2	2104.505	REMOVE BITUMINOUS PAVEMENT	SQ YD	230	$2.00	$460.00
3	2104.513	SAWING BITUMINOUS PAVEMENT (FULL DEPTH)	LIN FT	250	$4.00	$1,000.00
4	2211.501	AGGREGATE BASE CLASS 5	TON	450	$20.00	$9,000.00
5	2350.501	TYPE LV 3 WEARING COURSE MIXTURE (B)	TON	90	$45.00	$4,050.00
6	2350.502	TYPE LV 3 NON WEARING COURSE MIXTURE (B)	TON	120	$75.00	$9,000.00
7	2357.502	BITUMINOUS MATERIAL FOR TACK COAT	GALLON	50	$3.50	$175.00
8	2563.601	TRAFFIC CONTROL	LUMP SUM	1	$4,000.00	$4,000.00
9	2573.502	SILT FENCE, TYPE HEAVY DUTY	LIN FT	9,500	$2.50	$23,750.00
10	2575.602	SEEDING, MIX 240 (INCL. TOPSOIL & FERTILIZER)	ACRE	1	$4,000.00	$4,000.00
					TOTAL SCHEDULE A - SURFACE IMPROVEMENTS:	$115,435.00
SCHEDULE B - SANITARY SEWER IMPROVEMENTS						
11	2503.511	TRACER WIRE ACCESS BOX	EACH	40	$190.00	$7,600.00
12	2503.602	1.5" X 2" WYES	EACH	84	$50.00	$4,200.00
13	2503.602	2" WYES	EACH	6	$55.00	$330.00
14	2503.603	1.5" HDPE FORCEMAIN (DIRECTIONAL DRILL)	LIN FT	5700	$15.00	$85,500.00
15	2503.603	2" HDPE FORCEMAIN (DIRECTIONAL DRILL)	LIN FT	12,610	$16.00	$201,760.00
16	2503.603	4" PVC PIPE SEWER DESIGN PRESSURE DR 18	LIN FT	5,500	$31.50	$173,250.00
17	2504.602	1.5" BALL VALVES	EACH	87	$230.00	$20,010.00
18	2504.602	2" BALL VALVES	EACH	4	$290.00	$1,160.00
19	2504.602	CONSTRUCT AIR RELEASE MANHOLE	EACH	2	$5,000.00	$10,000.00
20	2506.601	SIMPLEX GRINDER STATION	EACH	84	$9,000.00	$756,000.00
21	2506.601	DUPLEX GRINDER STATION	EACH	7	$12,000.00	$84,000.00
					TOTAL SCHEDULE B - SANITARY SEWER IMPROVEMENTS:	$1,343,810.00
SCHEDULE C - LIFT STATION IMPROVEMENTS						
22	2100.601	CONSTRUCT LIFT STATION NO. 1	LUMP SUM	1	$150,000.00	$150,000.00
					TOTAL SCHEDULE C - LIFT STATION IMPROVEMENTS:	$150,000.00
	TOTAL SCHEDULE A - SURFACE IMPROVEMENTS:					$116,000.00
	TOTAL SCHEDULE B - SANITARY SEWER IMPROVEMENTS:					$1,344,000.00
	TOTAL SCHEDULE C - LIFT STATION IMPROVEMENTS:					$150,000.00
	SUBTOTAL					**$1,610,000.00**
	CONTINGENCIES (10%)					$161,000.00
	TOTAL ESTIMATE CONSTRUCTION COST					**$1,771,000.00**
	ENGINEERING AND ADMINISTRATION (20%)					$354,000.00
	TOTAL ESTIMATED PROJECT COST					**$2,125,000.00**

**THIS ESTIMATE ASSUMES THAT ROADWAY WORK WOULD BE COMPLETED AS PART OF THE PROJECT AND FUNDED SEPERATELY
**LIFT STATION NO.2 WOULD BE PRIVATE

CITY OF AFTON COMMUNITY ASSESSMENT
WASTEWATER COLLECTION SYSTEM 20-YEAR PRESENT WORTH ANALYSIS

Summary of Costs 03-23-2012

Option	Capital Cost	2012 O&M	20- Year Present Worth	Equivalent Annual Cost
Option No. 1 - Gravity Collection System	$ 1,768,000	$ 14,400	$ 1,621,442	$ 119,000
Option No. 2 - Low Pressure Forcemain Collection System	$ 2,125,000	$ 32,600	$ 2,531,667	$ 186,000

WASTEWATER COLLECTION SYSTEM

ANALYSIS PARAMETERS

20- YEAR PRESENT WORTH COST SUMMARY

Title	Capital Cost	2012 O&M	Present Worth	Equivalent Annual Cost
Option No. 1 - Gravity Collection System	$1,768,000	$14,400	$1,621,442	$119,000
Option No. 2 - Low Pressure Forcemain Collection System	$2,125,000	$32,600	$2,531,667	$186,000

ECONOMIC PARAMETERS

Item	Value	Source/Comment
Base Year	2012	Common for all alternatives.
Commence Construction	2012	Default--adjusted for some alternatives, where noted.
Begin Operation	2012	Default--adjusted for some alternatives, where noted.
Planning Period End	2032	Common for all alternatives. Revised assumption for this analysis.
Inflation Rate - Materials/Supplies/Energy/Construction/Other	3.0%	
Inflation Rate - Natural Gas, Fuel	3.0%	
Inflation Rate - Labor	3.0%	
Discount Rate	4.0%	
Erosion Control	See Cap. Cost Anal.	Percent of construction costs.
Traffic Control	See Cap. Cost Anal.	Percent of construction costs.
Relocation of Utilities	See Cap. Cost Anal.	Percent of construction costs.
Mobilization	See Cap. Cost Anal.	Percent of construction costs.
Engineering, Administration, and Legal Costs	20%	Project specific
Geographic Adjustment	0%	Project specific
Replacement Cost Factor (factor to apply to cost before adjusting for inflation)	1.25	
Expected Useful Life (new facilities)		
Buildings/Structures	40	
Gravity Sewers	40	
Forcemains (dual pipes; corrosion resistant materials)	40	
Process Piping	40	
Process Equipment	20	
Mechanical and Electrical Systems	20	
Instrumentation and Control	15	
Mobile Equipment	10	

OPERATIONS & MAINTENANCE

Category		Unit	Unit Cost	Alt	Source/Comment
Labor (Operations)		$/HR	$25	all	
Utilities					
	Electricity	KwHr	$0.100	all	
Maintenance					
	Labor	$/HR	$25	all	
	Sewer Inspection	LS	2.00%	all	Percent of Construction Cost
	Materials	LS	2.00%	all	Percent of Equipment Cost

FINANCIAL PARAMETERS

Item	Value	Source / Comment
Inflation Rate (per year)		
Labor	3.00%	
Natural Gas; Fuel	3.00%	
Electricity	2.00%	
Materials, chemicals	2.00%	
Construction (for capital expenditures in future years)	2.00%	
Discount Rate (to bring future costs to present value) For Alternatives Analysis	4.00%	

AFTON COMMUNITY ASSESSMENT REPORT
20-YEAR PRESENT WORTH COST ANALYSIS
Option No. 1 - Gravity Collection System

CAPITAL COSTS

Type	Item	2012 Cost	Year of Expenditure	Year in Operation	Drawdown Year 1	Year 2	Year 3	Year 4	Escalated Cost	Present Worth	2012 Dollars Cost of Equip.	Pre-Tax Cost
Site Work	Mobilization	$49,000	2012	2012	100%	0%	0%	0%	$49,000	$49,000	$0	$49,000
Site Work	Bit Pavement Removal/Replacement/Site Restoration	$61,000	2012	2012	100%	0%	0%	0%	$61,000	$61,000	$0	$61,000
Piping	4" PVC Pipe Sewer - SDR 26	$188,000	2012	2012	100%	0%	0%	0%	$188,000	$188,000	$0	$188,000
Piping	8" PVC Pipe Sewer - SDR 26	$602,000	2012	2012	100%	0%	0%	0%	$602,000	$602,000	$0	$602,000
Piping	4" PVC Pipe Sewer Design Pressure DR 18	$191,000	2012	2012	100%	0%	0%	0%	$191,000	$191,000	$0	$191,000
Structure	Sanitary Manholes	$161,000	2012	2012	100%	0%	0%	0%	$161,000	$161,000	$0	$161,000
Structure	Lift Station Structure	$138,000	2012	2012	100%	0%	0%	0%	$138,000	$138,000	$0	$138,000
Equipment	Controls, Control Panel, and SCADA	$50,000	2012	2012	100%	0%	0%	0%	$50,000	$50,000	$50,000	$50,000
Equipment	Submersible Solids Handling Pumps	$33,000	2012	2012	100%	0%	0%	0%	$33,000	$33,000	$33,000	$33,000
	TOTAL CONSTRUCTION COST	$1,473,000							$1,473,000	$1,473,000	$83,000	
Engineering, Administration, & Legal (20%)		$295,000	2012	2012				n/a	$295,000	$295,000		
Geographic Adjustment, (0%)		$0	2012	2012				n/a	$0	$0		
Land Acquisition Costs		$0										
												Sales Tax
	TOTAL PROJECT COST	**$1,768,000**	2012	2012					$1,768,000	$1,768,000	1.0000	

REPLACEMENT COSTS

Type	Item	Useful Life	Replacement First	Second	Third	Fourth	Fifth	Escalated Cost (First)	Present Worth	First	Second	Third	Fourth	Fifth
Piping	4" PVC Pipe Sewer - SDR 26	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Piping	8" PVC Pipe Sewer - SDR 26	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Piping	4" PVC Pipe Sewer Design Pressure DR 18	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Structure	Sanitary Manholes	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Structure	Lift Station Structure	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Equipment	Controls, Control Panel, and SCADA	15	2027	0	0	0	0	$84,000	$47,000	$47,000	$0	$0	$0	$0
Equipment	Submersible Solids Handling Pumps	20	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
	TOTAL							$84,000	$47,000	$47,000	$0	$0	$0	$0

TERMINAL VALUES

Type	Item	Useful Life (Years)	Useful Life at End of Planning Period	Escalated Terminal Value	Present Worth
Piping	4" PVC Pipe Sewer - SDR 26	40	20	($140,000)	(64,000)
Piping	8" PVC Pipe Sewer - SDR 26	40	20	($447,000)	(204,000)
Piping	4" PVC Pipe Sewer Design Pressure DR 18	40	20	($142,000)	(65,000)
Structure	Sanitary Manholes	40	20	($120,000)	(55,000)
Structure	Lift Station Structure	40	20	($103,000)	(47,000)
Equipment	Controls, Control Panel, and SCADA	15	10	($50,000)	(23,000)
Equipment	Submersible Solids Handling Pumps	20	0	$0	0
	TOTAL			($1,002,000)	(458,000)

O&M COSTS

Units	Item	Present Annual Cost	Escalated Annual Cost		Present Worth
					$264,442
2012 - 2032 Estimated O&M Costs		**2012**	**2012**	**2032**	
200	FTE Labor - Operators	$5,000	$5,000	$9,000	
225	FTE Labor - Maintenance	$6,000	$6,000	$11,000	
0	MBTU of Natural Gas	$0	$0	$0	
17000	KwHrs of Electricity	$1,700	$1,700	$2,500	10 HP Pumps
$ 82,500	maintenance-materials (% of Equipment Cost)	$1,700	$1,700	$2,500	
	TOTAL	$14,400	$14,400	$25,000	

USPW Factor 13.5903 (USPW refers to uniform stream present worth factor, 4 percent over 20 years, from 2012 to 2032)

LIFE CYCLE COSTS

TOTAL PRESENT WORTH **Present Worth** **1,621,442**
TOTAL EQUIVALENT ANNUAL COST **Equivalent Annual Cost** **119,000**

USPW Factor 13.5903

2012 Base Year
2.00% Inflation Rate - Materials/Supplies/Energy/Construction/Other
3.00% Inflation Rate - Labor
4.00% Discount Rate

2032 Planning Period End
1.25 Replacement Cost Factor (factor to apply to cost before adjusting for inflation)
2012 Commence Construction
2012 Begin Operation

2032 End of life cycle

	Annual O & M	Annual O&M Labor Only
2012	14400.00	11000.00
2013	14832.00	11330.00
2014	15276.96	11669.90
2015	15735.27	12020.00
2016	16207.33	12380.60
2017	16693.55	12752.01
2018	17194.35	13134.58
2019	17710.18	13528.61
2020	18241.49	13934.47
2021	18788.73	14352.51
2022	19352.40	14783.08
2023	19932.97	15226.57
2024	20530.96	15683.37
2025	21146.89	16153.87
2026	21781.29	16638.49
2027	22434.73	17137.64
2028	23107.77	17651.77
2029	23801.01	18181.32
2030	24515.04	18726.76
2031	25250.49	19288.57
2032	26008.00	19867.22
TOTAL	412941.39	281441.44
		191876.61
O&M PW - 01	264441.93	191876.61

AFTON COMMUNITY ASSESSMENT REPORT
20-YEAR PRESENT WORTH COST ANALYSIS
Option No. 2 - Low Pressure Forcemain Collection System

CAPITAL COSTS

Type	Item	2012 Cost	Year of Expenditure	Year in Operation	Drawdown Year 1	Year 2	Year 3	Year 4	Escalated Cost	Present Worth	2012 Dollars Cost of Equip.	Pre-Tax Cost
Site Work	Mobilization	$66,000	2012	2012	100%	0%	0%	0%	$66,000	$66,000	$0	$66,000
Site Work	Bituminous Pavement Removal/Replacement	$61,000	2012	2012	100%	0%	0%	0%	$61,000	$61,000	$0	$61,000
Piping	1.5" HDPE Forcemain (Directional Drill)	$124,000	2012	2012	100%	0%	0%	0%	$124,000	$124,000	$0	$124,000
Piping	2" HDPE Forcemain (Directional Drill)	$228,000	2012	2012	100%	0%	0%	0%	$228,000	$228,000	$0	$228,000
Piping	4" PVC Pipe Sewer Design Pressure DR 18	$191,000	2012	2012	100%	0%	0%	0%	$191,000	$191,000	$0	$191,000
Structures	Air Release Manholes	$11,000	2012	2012	100%	0%	0%	0%	$11,000	$11,000	$0	$11,000
Equipment	Simplex Grinder Stations	$832,000	2012	2012	100%	0%	0%	0%	$832,000	$832,000	$832,000	$832,000
Equipment	Duplex Grinder Stations	$92,000	2012	2012	100%	0%	0%	0%	$92,000	$92,000	$92,000	$92,000
Equipment	Controls, Control Panel, and SCADA	$50,000	2012	2012	100%	0%	0%	0%	$50,000	$50,000	$50,000	$50,000
Equipment	Submersible Solids Handling Pumps	$33,000	2012	2012	100%	0%	0%	0%	$33,000	$33,000	$33,000	$33,000
Structures	Lift Station Structure	$83,000	2012	2012	100%	0%	0%	0%	$83,000	$83,000	$0	$83,000
	TOTAL CONSTRUCTION COST	$1,771,000							$1,771,000	$1,771,000	$1,007,000	
	Engineering, Administration, & Legal (20%)	$354,000	2012	2012				n/a	$354,000	$354,000		
	Geographic Adjustment, (0%)	$0	2012	2012				n/a	$0	$0		
	Land Acquisition Costs	$0										
												Sales Tax
	TOTAL PROJECT COST	**$2,125,000**	2012	2012					$2,125,000	$2,125,000	1.0000	

REPLACEMENT COSTS

Type	Item	Useful Life	Replacement First	Second	Third	Fourth	Fifth	Escalated Cost (First)	Present Worth	First	Second	Third	Fourth	Fifth
Piping	1.5" HDPE Forcemain (Directional Drill)	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Piping	2" HDPE Forcemain (Directional Drill)	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Piping	4" PVC Pipe Sewer Design Pressure DR 18	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Structures	Air Release Manholes	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Equipment	Simplex Grinder Stations	20	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Equipment	Duplex Grinder Stations	20	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Equipment	Controls, Control Panel, and SCADA	15	2027	0	0	0	0	$84,000	$47,000	$47,000	$0	$0	$0	$0
Equipment	Submersible Solids Handling Pumps	20	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
Structures	Lift Station Structure	40	0	0	0	0	0	$0	$0	$0	$0	$0	$0	$0
	TOTAL							$84,000	$47,000	$47,000	$0	$0	$0	$0

TERMINAL VALUES

Type	Item	Useful Life (Years)	Useful Life at End of Planning Period	Escalated Terminal Value	Present Worth
Piping	1.5" HDPE Forcemain (Directional Drill)	40	20	($92,000)	(42,000)
Piping	2" HDPE Forcemain (Directional Drill)	40	20	($169,000)	(77,000)
Piping	4" PVC Pipe Sewer Design Pressure DR 18	40	20	($142,000)	(65,000)
Structures	Air Release Manholes	40	20	($8,000)	(4,000)
Equipment	Simplex Grinder Stations	20	0	$0	0
Equipment	Duplex Grinder Stations	20	0	$0	0
Equipment	Controls, Control Panel, and SCADA	15	10	($50,000)	(23,000)
Equipment	Submersible Solids Handling Pumps	20	0	$0	0
Structures	Lift Station Structure	40	20	($62,000)	(28,000)
	TOTAL			($523,000)	(239,000)

O&M COSTS

Units	Item	Present Annual Cost	Escalated Annual Cost

Present Worth
$598,667

2012 - 2032 Estimated O&M Costs		**2012**	**2012**	**2032**
425	FTE Labor - Operators	$11,000	$11,000	$20,000
425	FTE Labor - Maintenance	$11,000	$11,000	$20,000
0	MBTU of Natural Gas	$0	$0	$0
49500	Kwhrs of Electricity	$5,000	$5,000	$7,400
$ 278,500	maintenance-materials (% of Equipment Cost)	$5,600	$5,600	$8,300
	TOTAL	$32,600	$32,600	$55,700

USPW Factor 13.5903 (USPW refers to uniform stream present worth factor, 4 percent over 20 years, from 2012 to 2032)

LIFE CYCLE COSTS

TOTAL PRESENT WORTH **Present Worth** **2,531,667**
TOTAL EQUIVALENT ANNUAL COST **Equivalent Annual Cost** **186,000**

USPW Factor 13.5903

2012 Base Year
2.00% Inflation Rate - Materials/Supplies/Energy/Construction/Other
3.00% Inflation Rate - Labor
4.00% Discount Rate

2032 Planning Period End
1.25 Replacement Cost Factor (factor to apply to cost before adjusting for inflation)
2012 Commence Construction
2012 Begin Operation

2032 End of life cycle

	Annual O & M	Annual O&M Labor Only
2012	32600.00	22000.00
2013	33578.00	22660.00
2014	34585.34	23339.80
2015	35622.90	24039.99
2016	36691.59	24761.19
2017	37792.33	25504.03
2018	38926.10	26269.15
2019	40093.89	27057.23
2020	41296.70	27868.94
2021	42535.61	28705.01
2022	43811.67	29566.16
2023	45126.02	30453.15
2024	46479.80	31366.74
2025	47874.20	32307.74
2026	49310.43	33276.97
2027	50789.74	34275.28
2028	52313.43	35303.54
2029	53882.83	36362.65
2030	55499.32	37453.53
2031	57164.30	38577.13
2032	58879.23	39734.45
TOTAL	934853.43	562882.89
		383753.23
O&M PW - 01	598667.16	383753.23

Opinion of Probable Construction Costs - Present Worth Analysis

City of Afton

Washington County, MN

Attached Growth Aerobic Treatment Unit w/ Anoxic Upflow Filter

Mar-12 LSTS Option #1: TN < 10 mg/L

Interest Rate, i = 0.04

#	Item	Life (years)	Quantity	Unit	Unit Price ($)	Capital ($)	Annual Costs ($)	Salvage Value Present Worth ($)	Total Present Worth ($)
1	Septic tank	50	60,000	GAL	1.25	75,000.00		20,537	54,463
2	Equalization tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
3	ATU precast concrete tank	50	10	EA	12,500.00	125,000.00		34,229	90,771
4	Blower pad	50	9	EA	200.00	1,800.00		493	1,307
5	Dose tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
6	Aluminum hatches	20	4	EA	750.00	3,000.00		0	3,000
7	4-inch "curb-stop" valves	20	4	LS	1,500.00	6,000.00		0	6,000
8	Underground treatment piping	40	250	LF	15.00	3,750.00		856	2,894
9	Control building	50	1	EA	50,000.00	50,000.00		13,692	36,308
10	Control building furnishings	20	1	LS	5,000.00	5,000.00		0	5,000
11	Mobilization	20	1	LS	25,000.00	25,000.00		0	25,000
12	Silt fence	20	2,500	LF	1.50	3,750.00		0	3,750
13	Electrical service upgrade	20	1	LS	10,000.00	10,000.00		0	10,000
14	Land acquisition	20	5	ACRE	6,000.00	30,000.00		0	30,000
15	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
16	Treatment tank protective fencing	20	800	LF	12.50	10,000.00		0	10,000
17	Electrical & control equipment installation	20	1	LS	40,000.00	40,000.00		0	40,000
	Supplier quote (see below)	20	1	LS	355,000.00	355,000.00		0	355,000
	Quote includes: effluent screen, equalization tank pumps, guide rails, discharge piping, optical floats, float bracket; (5) ATU units, (4) Nitrification ATU units, (1) Anoxic upflow filter, blowers, airline piping; (2) chemical feed pumps, chemical basin; control panel w/ telemetry; dose tank pumps, guide rails, discharge piping, optical floats, float bracket; onsite installation support, taxes (7.125%)								
	Pressurized Seepage Cells								
18	Distribution piping within cell	40	14,250	LF	5.00	71,250.00		16,259	54,991
19	Distribution rock media	50	1,500	CY	25.00	37,500.00		10,269	27,231
20	Distribution rock media installation	20	1,500	CY	7.50	11,250.00		0	11,250
21	Geotextile fabric	20	6,000	SY	2.00	12,000.00		0	12,000
22	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
23	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
24	Distribution lateral flush box	20	16	EA	300.00	4,800.00		0	4,800
25	Topsoil (strip & reuse)	20	1,200	CY	3.00	3,600.00		0	3,600
26	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
27	Valve vault	50	2	EA	7,500.00	15,000.00		4,107	10,893
28	Electronically actuated valve	20	16	EA	1,500.00	24,000.00		0	24,000
29	Manual valve	20	16	EA	750.00	12,000.00		0	12,000
30	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
31	Seepage cell protective fencing	20	1,750	LF	12.50	21,875.00		0	21,875
	PROJECT SUBTOTAL					**1,128,075.00**			
32	**CONTINGENCY (10%)**	20	1	LS		112,807.50			112,808
	Non-Construction								
33	Design & construction engineering (18%)	20	1	LS	223,358.85	223,358.85			223,359
34	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
35	Wetland delineation	20	1	LS	5,000.00	5,000.00			5,000
36	Geotechnical investigatior	20	1	LS	7,500.00	7,500.00			7,500
37	Legal & administration (2%)	20	1	LS	24,817.65	24,817.65			24,818
	ANNUAL O, M, & R COSTS								
38	Operator costs	20	1	LS	9,360.00		9,360		127,205
39	Supplies	20	1	LS	3,000.00		3,000		40,771
40	Reporting, analytical, & monitoring	20	1	LS	4,000.00		4,000		54,361
41	Electrical utility	20	1	LS	20,100.00		20,100		273,166
42	Insurance	20	1	LS	500.00		500		6,795
43	MPCA permitting	20	1	LS	750.00		750		10,193
44	Telephone	20	1	LS	480.00		480		6,523
45	Sludge hauling	20	1	LS	3,000.00		3,000		40,771
46	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
47	Emergency repair & service	20	1	LS	900.00		900		12,231
48	Short-term equipment replacement	20	1	LS	600.00		600		8,154
49	Annual preventative maintenance	20	1	LS	600.00		600		8,154
50	Equipment replacement fund	20	1	LS	10,650.00		10,650		144,737
Total						**1,516,559.00**	56,940	124,858	**2,165,534**

Opinion of Probable Construction Costs

City of Afton

Washington County, MN

Submerged Attached Growth Bioreactor

Mar-12 LSTS Option #1: TN < 10 mg/L

Interest Rate, i = 0.04

#	Item	Life (years)	Quantity	Unit	Unit Price ($)	Capital ($)	Annual Costs ($)	Salvage Value Present Worth ($)	Total Present Worth ($)
1	Anoxic/stilling tank	50	50,000	GAL	1.25	62,500.00		17,115	45,385
2	SAGB reactor tank #1	50	24,000	GAL	1.25	30,000.00		8,215	21,785
3	SAGB clearwater tank #1	50	15,000	GAL	1.25	18,750.00		5,134	13,616
4	SAGB reactor tank #2	50	3,200	GAL	1.25	4,000.00		1,095	2,905
5	SAGB clearwater pump tank #2	50	25,000	GAL	1.25	31,250.00		8,557	22,693
6	SAGB Plus reactor	20	1	LS	335,000.00	335,000.00		0	335,000
7	SAGB Plus reactor installation	20	1	LS	167,500.00	167,500.00		0	167,500
8	Aluminum hatches	20	6	EA	750.00	4,500.00		0	4,500
9	Underground treatment piping	40	250	LF	15.00	3,750.00		856	2,894
10	Control building	50	1	EA	50,000.00	50,000.00		13,692	36,308
11	Control building furnishings	20	1	LS	5,000.00	5,000.00		0	5,000
12	Mobilization	20	1	LS	25,000.00	25,000.00		0	25,000
13	Silt fence	20	2,500	LF	1.50	3,750.00			3,750
14	Electrical service upgrade	20	1	LS	10,000.00	10,000.00		0	10,000
15	Land acquisition	20	5	ACRE	6,000.00	30,000.00		0	30,000
16	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
17	Treatment tank protective fencing	20	800	LF	12.50	10,000.00		0	10,000
18	Electrical & control equipment installation	20	1	LS	40,000.00	40,000.00		0	40,000
	Pressurized Seepage Cells								
19	Distribution piping within cell	40	14,250	LF	5.00	71,250.00		16,259	54,991
20	Distribution rock media	50	1,500	CY	25.00	37,500.00		10,269	27,231
21	Distribution rock media installation	20	1,500	CY	7.50	11,250.00		0	11,250
22	Geotextile fabric	20	6,000	SY	2.00	12,000.00		0	12,000
23	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
24	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
25	Distribution lateral flush box	20	16	EA	300.00	4,800.00		0	4,800
26	Topsoil (strip & reuse)	20	1,200	CY	3.00	3,600.00		0	3,600
27	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
28	Valve vault	50	2	EA	7,500.00	15,000.00		4,107	10,893
29	Electronically actuated valve	20	16	EA	1,500.00	24,000.00		0	24,000
30	Manual valve	20	16	EA	750.00	12,000.00		0	12,000
31	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
32	Seepage cell protective fencing	20	1,750	LF	12.50	21,875.00		0	21,875
	PROJECT SUBTOTAL					**1,153,275.00**			
33	**CONTINGENCY (10%)**	20	1	LS		115,327.50			115,328
	Non-Construction								
34	Design & construction engineering (18%)	20	1	LS	228,348.45	228,348.45			228,348
35	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
36	Wetland delineation	20	1	LS	5,000.00	5,000.00			5,000
37	Geotechnical investigation	20	1	LS	7,500.00	7,500.00			7,500
38	Legal & administration (2%)	20	1	LS	25,372.05	25,372.05			25,372
	ANNUAL O, M, & R COSTS								
39	Operator costs	20	1	LS	15,600.00		15,600		212,009
40	Supplies	20	1	LS	4,100.00		4,100		55,720
41	Reporting, analytical, & monitoring	20	1	LS	4,000.00		4,000		54,361
42	Electrical utility	20	1	LS	8,500.00		8,500		115,518
43	Insurance	20	1	LS	500.00		500		6,795
44	MPCA permitting	20	1	LS	750.00		750		10,193
45	Telephone	20	1	LS	480.00		480		6,523
46	Sludge hauling	20	1	LS	11,600.00		11,600		157,648
47	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
48	Emergency repair & service	20	1	LS	900.00		900		12,231
49	Short-term equipment replacement	20	1	LS	600.00		600		8,154
50	Annual preventative maintenance	20	1	LS	600.00		600		8,154
51	Equipment replacement fund	20	1	LS	10,050.00		10,050		136,583
Total						**1,549,823.00**	60,680	92,601	**2,281,883**

Opinion of Probable Construction Costs

City of Afton

Washington County, MN

Recirculating Gravel Filter w/ Anoxic Upflow Filter

Mar-12 LSTS Option #1: TN < 10 mg/L

Interest Rate, i = 0.04

#	Item	Life (years)	Quantity	Unit	Unit Price ($)	Capital ($)	Annual Costs ($)	Salvage Value Present ($)	Total Present Worth ($)
1	Septic tank	50	85,000	GAL	1.25	106,250.00		29,095	77,155
2	Septic tank effluent screen	50	1	EA	1,000.00	1,000.00		274	726
3	Anoxic upflow tank	50	20,000	GAL	1.25	25,000.00		6,846	18,154
4	Anoxic upflow components	20	1	LS	15,000.00	15,000.00		0	15,000
5	Recirculation tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
6	Recirculation tank pumps	20	2	EA	2,500.00	5,000.00		0	5,000
7	Recirc tank pumps guiderails & discharge piping	20	2	EA	1,500.00	3,000.00		0	3,000
8	Recirc tank floats	20	4	EA	100.00	400.00		0	400
9	Dose tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
10	Dose tank pumps	20	2	EA	2,500.00	5,000.00		0	5,000
11	Dose tank pumps guiderails & discharge piping	20	2	EA	1,500.00	3,000.00		0	3,000
12	Dose tank floats	20	4	EA	100.00	400.00		0	400
13	Aluminum hatches	20	5	EA	750.00	3,750.00		0	3,750
14	Geomembrane	20	14,200	SF	0.75	10,650.00		0	10,650
15	Geotextile	20	1,580	SY	2.00	3,160.00		0	3,160
16	Filter media	50	1,200	CY	25.00	30,000.00		8,215	21,785
17	Coarse stone	50	240	CY	20.00	4,800.00		1,314	3,486
18	PVC distribution laterals	40	5,000	LF	5.00	25,000.00		5,705	19,295
19	RGF force main	40	1,500	LF	15.00	22,500.00		5,134	17,366
20	4" perforated underdrain	40	800	LF	10.00	8,000.00		1,826	6,174
21	4" perforated underdrain cleanout	40	15	EA	125.00	1,875.00		428	1,447
22	3-way splitter valve valve vault	50	1	EA	3,750.00	3,750.00		1,027	2,723
23	3-way splitter valve	20	1	LS	7,500.00	7,500.00		0	7,500
24	Shut-off valve	20	1	LS	1,000.00	1,000.00		0	1,000
25	Chemical feed equipment	20	1	LS	5,000.00	5,000.00		0	5,000
26	RGF electronic valves w/actuators	20	10	EA	1,500.00	15,000.00		0	15,000
27	RGF zone manual valves	20	10	EA	500.00	5,000.00		0	5,000
28	RGF lateral zone flushing apparatus	20	10	EA	500.00	5,000.00		0	5,000
29	Control panel	20	1	LS	20,000.00	20,000.00		0	20,000
30	RGF earthwork	20	2,000	CY	7.50	15,000.00		0	15,000
31	RGF - berm earthwork	20	400	CY	7.50	3,000.00		0	3,000
32	RGF - aggregate installation	20	1,440	CY	7.50	10,800.00		0	10,800
33	RGF water balance test	20	1	EA	5,000.00	5,000.00		0	5,000
34	Underground treatment piping	40	250	LF	15.00	3,750.00		856	2,894
35	Control building	50	1	EA	50,000.00	50,000.00		13,692	36,308
36	Control building furnishings	20	1	LS	5,000.00	5,000.00		0	5,000
37	Mobilization	20	1	LS	25,000.00	25,000.00		0	25,000
38	Silt Fence	20	2,500	LF	1.50	3,750.00		0	3,750
39	Electrical service upgrade	20	1	LS	7,500.00	7,500.00		0	7,500
40	Land acquisition	20	5	ACRE	6,000.00	30,000.00		0	30,000
41	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
42	Treatment area protective fencing	20	1,000	LF	12.50	12,500.00		0	12,500
43	Electrical & control equipment installation	20	1	LS	45,000.00	45,000.00		0	45,000
	Pressurized Seepage Cells								
44	Distribution piping within cell	40	14,250	LF	5.00	71,250.00		16,259	54,991
45	Distribution rock media	50	1,500	CY	25.00	37,500.00		10,269	27,231
46	Distribution rock media installation	20	1,500	CY	7.50	11,250.00		0	11,250
47	Geotextile fabric	20	6,000	SY	2.00	12,000.00		0	12,000
48	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
49	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
50	Distribution lateral flush box	20	16	EA	300.00	4,800.00		0	4,800
51	Topsoil (strip & reuse)	20	1,200	CY	3.00	3,600.00		0	3,600
52	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
53	Valve vault	50	2	EA	7,500.00	15,000.00		4,107	10,893
54	Electronically actuated valve	20	16	EA	1,500.00	24,000.00		0	24,000
55	Manual valve	20	16	EA	750.00	12,000.00		0	12,000
56	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
57	Seepage cell protective fencing	20	1,750	LF	12.50	21,875.00		0	21,875

	PROJECT SUBTOTAL					**937,110.00**			
58	**CONTINGENCY (10%)**	20	1	LS		93,711.00			93,711
	Non-Construction								
59	Design & construction engineering (18%)	20	1	LS	185,547.78	185,547.78			185,548
60	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
61	Wetland delineation	20	1	LS	5,000.00	5,000.00			5,000
62	Geotechnical investigation	20	1	LS	7,500.00	7,500.00			7,500
63	Legal & administration (2%)	20	1	LS	20,616.42	20,616.42			20,616
	ANNUAL O, M, & R COSTS								
64	Operator costs	20	1	LS	9,360.00		9,360		127,205
65	Supplies	20	1	LS	3,000.00		3,000		40,771
66	Reporting, analytical, & monitoring	20	1	LS	4,000.00		4,000		54,361
67	Electrical utility	20	1	LS	4,800.00		4,800		65,234
68	Insurance	20	1	LS	500.00		500		6,795
69	MPCA permitting	20	1	LS	750.00		750		10,193
70	Telephone	20	1	LS	480.00		480		6,523
71	Sludge hauling	20	1	LS	2,900.00		2,900		39,412
72	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
73	Emergency repair & service	20	1	LS	900.00		900		12,231
74	Short-term equipment replacement	20	1	LS	600.00		600		8,154
75	Annual preventative maintenance	20	1	LS	600.00		600		8,154
76	Equipment replacement fund	20	1	LS	2,955.00		2,955		40,159
Total						**1,264,485.20**	33,845	129,462	**1,594,988**

Opinion of Probable Construction Costs

City of Afton

Washington County, MN

Recirculating Gravel Filter

Mar-12 LSTS Option #2: TN > 10 mg/L

Interest Rate, i = 0.04

#	Item	Life (years)	Quantity	Unit	Unit Price ($)	Capital ($)	Annual Costs ($)	Salvage Value Present ($)	Total Present Worth ($)
1	Septic tank	50	85,000	GAL	1.25	106,250.00		29,095	77,155
2	Septic tank effluent screen	50	1	EA	1,000.00	1,000.00		274	726
3	Recirculation tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
4	Recirculation tank pumps	20	2	EA	2,500.00	5,000.00		0	5,000
5	Recirc tank pumps guiderails & discharge piping	20	2	EA	1,500.00	3,000.00		0	3,000
6	Recirc tank floats	20	4	EA	100.00	400.00		0	400
7	Dose tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
8	Dose tank pumps	20	2	EA	2,500.00	5,000.00		0	5,000
9	Dose tank pumps guiderails & discharge piping	20	2	EA	1,500.00	3,000.00		0	3,000
10	Dose tank floats	20	4	EA	100.00	400.00		0	400
11	Aluminum hatches	20	5	EA	750.00	3,750.00		0	3,750
12	Geomembrane	20	14,200	SF	0.75	10,650.00		0	10,650
13	Geotextile	20	1,580	SY	2.00	3,160.00		0	3,160
14	Filter media	50	1,200	CY	25.00	30,000.00		8,215	21,785
15	Coarse stone	50	240	CY	20.00	4,800.00		1,314	3,486
16	PVC distribution laterals	40	5,000	LF	5.00	25,000.00		5,705	19,295
17	RGF force main	40	1,500	LF	15.00	22,500.00		5,134	17,366
18	4" perforated underdrain	40	800	LF	10.00	8,000.00		1,826	6,174
19	4" perforated underdrain cleanout	40	15	EA	125.00	1,875.00		428	1,447
20	3-way splitter valve valve vault	50	1	EA	3,750.00	3,750.00		1,027	2,723
21	3-way splitter valve	20	1	LS	7,500.00	7,500.00		0	7,500
22	Shut-off valve	20	1	LS	1,000.00	1,000.00		0	1,000
23	RGF electronic valves w/actuators	20	10	EA	1,500.00	15,000.00		0	15,000
24	RGF zone manual valves	20	10	EA	500.00	5,000.00		0	5,000
25	RGF lateral zone flushing apparatus	20	10	EA	500.00	5,000.00		0	5,000
26	Control panel	20	1	LS	20,000.00	20,000.00		0	20,000
27	RGF earthwork	20	2,000	CY	7.50	15,000.00		0	15,000
28	RGF - berm earthwork	20	400	CY	7.50	3,000.00		0	3,000
29	RGF - aggregate installation	20	1,440	CY	7.50	10,800.00		0	10,800
30	RGF water balance test	20	1	EA	5,000.00	5,000.00		0	5,000
31	Underground treatment piping	40	250	LF	15.00	3,750.00		856	2,894
32	Control building	50	1	EA	50,000.00	50,000.00		13,692	36,308
33	Control building furnishings	20	1	LS	5,000.00	5,000.00		0	5,000
34	Mobilization	20	1	LS	25,000.00	25,000.00		0	25,000
35	Silt Fence	20	2,500	LF	1.50	3,750.00		0	3,750
36	Electrical service upgrade	20	1	LS	7,500.00	7,500.00		0	7,500
37	Land acquisition	20	5	ACRE	6,000.00	30,000.00		0	30,000
38	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
39	Treatment area protective fencing	20	1,000	LF	12.50	12,500.00		0	12,500
40	Electrical & control equipment installation	20	1	LS	45,000.00	45,000.00		0	45,000
	Pressurized Seepage Cells								
41	Distribution piping within cell	40	14,250	LF	5.00	71,250.00		16,259	54,991
42	Distribution rock media	50	1,500	CY	25.00	37,500.00		10,269	27,231
43	Distribution rock media installation	20	1,500	CY	7.50	11,250.00		0	11,250
44	Geotextile fabric	20	6,000	SY	2.00	12,000.00		0	12,000
45	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
46	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
47	Distribution lateral flush box	20	16	EA	300.00	4,800.00		0	4,800
48	Topsoil (strip & reuse)	20	1,200	CY	3.00	3,600.00		0	3,600
49	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
50	Valve vault	50	2	EA	7,500.00	15,000.00		4,107	10,893
51	Electronically actuated valve	20	16	EA	1,500.00	24,000.00		0	24,000
52	Manual valve	20	16	EA	750.00	12,000.00		0	12,000
53	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
54	Seepage cell protective fencing	20	1,750	LF	12.50	21,875.00		0	21,875

	PROJECT SUBTOTAL					**892,110.00**			
55	**CONTINGENCY (10%)**	20	1	LS		89,211.00			89,211
	Non-Construction								
56	Design & construction engineering (18%)	20	1	LS	176,637.78	176,637.78			176,638
57	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
58	Wetland delineation	20	1	LS	5,000.00	5,000.00			5,000
59	Hydrogeologic study	20	1	LS	27,500.00	27,500.00			27,500
60	Monitoring wells	20	5	EA	3,500.00	17,500.00			17,500
61	Geotechnical investigation	20	1	LS	7,500.00	7,500.00			7,500
62	Legal & administration (2%)	20	1	LS	19,626.42	19,626.42			19,626
	ANNUAL O, M, & R COSTS								
63	Operator costs	20	1	LS	10,320.00		10,320		140,252
64	Supplies	20	1	LS	2,000.00		2,000		27,181
65	Reporting, analytical, & monitoring	20	1	LS	6,000.00		6,000		81,542
66	Electrical utility	20	1	LS	4,800.00		4,800		65,234
67	Insurance	20	1	LS	500.00		500		6,795
68	MPCA permitting	20	1	LS	750.00		750		10,193
69	Telephone	20	1	LS	480.00		480		6,523
70	Sludge hauling	20	1	LS	2,400.00		2,400		32,617
71	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
72	Emergency repair & service	20	1	LS	900.00		900		12,231
73	Short-term equipment replacement	20	1	LS	600.00		600		8,154
74	Annual preventative maintenance	20	1	LS	600.00		600		8,154
75	Equipment replacement fund	20	1	LS	2,805.00		2,805		38,121
Total						**1,250,085.20**	35,155	122,616	**1,605,237**

Opinion of Probable Construction Costs - Present Worth Analysis

City of Afton

Washington County, MN

Attached Growth Aerobic Treatment Unit

Mar-12 LSTS Option #2: TN > 10 mg/L

Interest Rate, i = 0.04

#	Item	Life (years)	Quantity	Unit	Unit Price ($)	Capital ($)	Annual Costs ($)	Salvage Value Present Worth ($)	Total Present Worth ($)
1	Septic tank	50	60,000	GAL	1.25	75,000.00		20,537	54,463
2	Equalization tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
3	ATU precast concrete tank	50	6	EA	12,500.00	75,000.00		20,537	54,463
4	Blower pad	50	6	EA	200.00	1,200.00		329	871
5	Dose tank	50	25,000	GAL	1.25	31,250.00		8,557	22,693
6	Aluminum hatches	20	4	EA	750.00	3,000.00		0	3,000
7	4-inch "curb-stop" valves	20	4	LS	1,500.00	6,000.00		0	6,000
8	Underground treatment piping	40	250	LF	15.00	3,750.00		856	2,894
9	Control building	50	1	EA	50,000.00	50,000.00		13,692	36,308
10	Control building furnishings	20	1	LS	5,000.00	5,000.00		0	5,000
11	Mobilization	20	1	LS	25,000.00	25,000.00		0	25,000
12	Silt fence	20	2,500	LF	1.50	3,750.00		0	3,750
13	Electrical service upgrade	20	1	LS	10,000.00	10,000.00		0	10,000
14	Land acquisition	20	5	ACRE	6,000.00	30,000.00		0	30,000
15	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
16	Treatment tank protective fencing	20	800	LF	12.50	10,000.00		0	10,000
17	Electrical & control equipment installation	20	1	LS	40,000.00	40,000.00		0	40,000
	Supplier quote (see below)	20	1	LS	225,000.00	225,000.00		0	225,000
	Quote includes: effluent screen, equalization tank pumps, guide rails, discharge piping, optical floats, float bracket; (4) ATU units, (2) Nitrification ATU units, blowers, airline piping; control panel w/ telemetry; dose tank pumps, guide rails, discharge piping, optical floats, float bracket; onsite installation support, taxes (7.125%)								
	Pressurized Seepage Cells								
18	Distribution piping within cell	40	14,250	LF	5.00	71,250.00		16,259	54,991
19	Distribution rock media	50	1,500	CY	25.00	37,500.00		10,269	27,231
20	Distribution rock media installation	20	1,500	CY	7.50	11,250.00		0	11,250
21	Geotextile fabric	20	6,000	SY	2.00	12,000.00		0	12,000
22	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
23	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
24	Distribution lateral flush box	20	16	EA	300.00	4,800.00		0	4,800
25	Topsoil (strip & reuse)	20	1,200	CY	3.00	3,600.00		0	3,600
26	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
27	Valve vault	50	2	EA	7,500.00	15,000.00		4,107	10,893
28	Electronically actuated valve	20	16	EA	1,500.00	24,000.00		0	24,000
29	Manual valve	20	16	EA	750.00	12,000.00		0	12,000
30	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
31	Seepage cell protective fencing	20	1,750	LF	12.50	21,875.00		0	21,875
	PROJECT SUBTOTAL					**947,475.00**			
32	**CONTINGENCY (10%)**	20	1	LS		94,747.50			94,748
	Non-Construction								
33	Design & construction engineering (18%)	20	1	LS	187,600.05	187,600.05			187,600
34	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
35	Wetland delineation	20	1	LS	5,000.00	5,000.00			5,000
36	Hydrogeologic study	20	1	LS	27,500.00	27,500.00			27,500
37	Monitoring wells	20	5	EA	3,500.00	17,500.00			17,500
38	Geotechnical investigation	20	1	LS	7,500.00	7,500.00			7,500
39	Legal & administration (2%)	20	1	LS	20,844.45	20,844.45			20,844
	ANNUAL O, M, & R COSTS								
40	Operator costs	20	1	LS	10,320.00		10,320		140,252
41	Supplies	20	1	LS	2,000.00		2,000		27,181
42	Reporting, analytical, & monitoring	20	1	LS	6,000.00		6,000		81,542
43	Electrical utility	20	1	LS	13,615.00		13,615		185,032
44	Insurance	20	1	LS	500.00		500		6,795
45	MPCA permitting	20	1	LS	750.00		750		10,193
46	Telephone	20	1	LS	480.00		480		6,523
47	Sludge hauling	20	1	LS	3,500.00		3,500		47,566
48	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
49	Emergency repair & service	20	1	LS	900.00		900		12,231
50	Short-term equipment replacement	20	1	LS	600.00		600		8,154
51	Annual preventative maintenance	20	1	LS	600.00		600		8,154
52	Equipment replacement fund	20	1	LS	6,750.00		6,750		91,735
Total						**1,323,167.00**	49,015	111,002	**1,878,294**