Wenck File #2656-02
March 1, 2013

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WASTEWATER COLLECTION & TREATMENT SYSTEM FACILITY PLAN

City of Afton
Washington County, Minnesota

Prepared for:

CITY OF AFTON

Prepared by:

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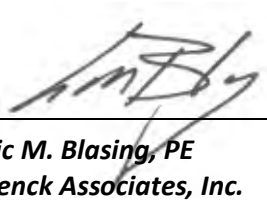
Professional Engineer Certification

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



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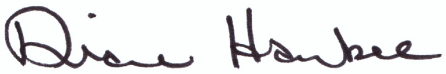
I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



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1.0 Introduction

1.1 BACKGROUND

The City of Afton is located along the St. Croix River in Washington County, Minnesota (Figure 1). 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).

A select wastewater service area within the City has been determined and investigated. Wenck Associates, Inc. (Wenck) and WSB & Associates, Inc. (WSB) have been retained to investigate wastewater collection and treatment alternatives to replace existing ISTS. WSB has assessed wastewater collection alternatives and conducted an evaluation of regionalizing to a nearby sewer interceptor. Wenck was retained to assess the probable compliance status of the existing ISTS/SSTS, complete a preliminary soil investigation on designated lands, and to analyze wastewater treatment alternatives for viable long term infrastructure to treat wastewater for the service area.

Based on the 2010 census, there was an average of 2.67 people per household in Afton. The population of the service area is estimated at 182, based on 68 year-round residences at 2.67 people per residence.

[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.

1.2 PREVIOUS INVESTIGATIONS

An Unsewered Area Needs Documentation[2] (UAND) and Community Assessment Report (CAR)[3] were completed by Wenck in September 2012. The UAND was completed using records obtained from Washington County, soil survey data, and a visual survey of the area. Information gathered in the UAND was reviewed and incorporated into the findings of the September 2012 CAR.

1.3 REPORT PURPOSE

This facility plan is a planning document for possible long-term solutions for wastewater collection and treatment within the Afton service area. Within this report are developed concepts and a framework to provide sanitary sewer service to existing and future connections in this area. It has been prepared in accordance with MN Administrative Code 7077.0272 for approval by MPCA for use in obtaining funding and an Agency permit for system design and construction of the recommended alternative.

This Facility Plan was prepared in accordance with the requirements of the Minnesota Administrative Rules 7077.0272 and is intended to provide a plan to for the City of Afton. The goals of this plan are as follows:

- Define the existing condition of ISTS/SSTS.
- Estimate future wastewater infrastructure design requirements.
- Identify and investigate wastewater collection and treatment system rehabilitation alternatives that would help mitigate problems associated with existing infrastructure.
- Evaluate the technical, non-monetary, and environmental factors for each of the selected alternatives.
- Estimate the opinion of probable construction costs of each feasible alternative and conduct a 20-year present worth analysis on these alternatives.

[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] A Community Assessment Report is a study conducted to evaluate the condition of existing ISTS and evaluate replacement collection and treatment alternatives.

- Determine the impact the proposed improvements will have on user charge rates.
- Present a recommended alternative for approval by the Minnesota Pollution Control Agency (MPCA) to be implemented within the service area.

1.4 PROJECT PLANNING AREA

The Community of Afton is located along the St. Croix River south of Lake St. Croix Beach and east of Woodbury in Washington County, Minnesota. The County Seat, Stillwater, is also located along the St. Croix River approximately 11 miles north of Afton. Washington County is bordered on the east by the St. Croix River, on the west by Anoka, Ramsey, and Dakota counties, north by Chisago County, and on the south by Dakota County. The county has a total area of 423 square miles, of which 392 square miles is land and the rest is water. The service area within the City is outlined within Figure 1. Included within the service area are 77 residential dwellings (66 existing and 11 vacant parcels) and 25 commercial establishments (22 existing and 3 vacant parcels).

2.0 Existing Conditions

2.1 INTRODUCTION

This section summarizes the findings of the existing condition of ISTS/SSTS in the service area. The number of properties currently or historically generating wastewater identified for investigation by the City of Afton was 86. All properties within the service area are served by ISTS/SSTS including some on holding tanks. Existing collection components include only those on private property (building sewer from dwelling to the septic tank). The CAR included a determination of likely ISTS compliance status 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.

2.2 METHODS

During the UAND and CAR field investigations; Wenck was able to complete a visual inspection (from the property boundaries) of 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 alternatives. The determination of ISTS feasibility required an evaluation of the soils. In addition to the soil survey data available, Wenck used existing permit records to evaluate soils throughout the service area.

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

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

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 ISTS/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.

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.

2.3.1 Drinking Water Source

The source of drinking water for the dwellings in the service 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 setback requirements. Well 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 service 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%

2.3.2 Parcel Type

Table 2 summarizes the type of wastewater generating structures in the service area. Data 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 Types

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

2.3.3 ISTS Types

Table 3 provides a breakdown of the ISTS types in the service area for participating properties.

Table 3: Existing ISTS Types

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

2.3.4 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: Likely ISTS 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 A contains a table that shows the likely compliance status of evaluated addresses. Figure 2 visually depicts the parcels' likely compliance status.

2.3.5 Existing Septic Tank Compliance

Even though a property's ISTS soil treatment area may be non-compliant, a septic tank may exist at a property that meets current compliance requirements and could be used in a future ISTS or community cluster system. 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%

2.4 CURRENT ENVIRONMENTAL IMPACT

As documented in this section, there was one 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.

2.5 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. An additional 15 were compliant however did not meet appropriate setback requirements.

3.0 Flows & Loadings

3.1 FLOWS & LOADINGS

Appendix D includes anticipated design flow and loadings for the City of Afton service area. Flow estimates were estimated by WSB and Wenck using the MPCA Design Guidance for Large Subsurface Wastewater Treatment Systems, April 2010. Both residential and commercial flows were estimated and are included in Appendix D. Table 6 below summarizes estimated hydraulic and organic loadings.

Table 6: Estimated Hydraulic and Organic Loadings

Parameter	Units	Value	Comments
Hydraulic Loading			
Residential Flow (77 households)	gpd	18,544	Includes vacant parcels (11) in service area
Commercial Flow (22 establishments)	gpd	28,349	Includes vacant parcels (3) in service area
Inflow/Infiltration Allowance	gpd	4,000	200 gpd/in. diameter piping/mile
Total Peak Wastewater Flow	gpd	50,893	Peak Wet Weather Flow
Organic Loading			
Biochemical Oxygen Demand (CBOD)	lb/day	152.4	Residential & Commercial
Total Suspended Solids (TSS)	lb/day	126.6	Residential & Commercial
Ammonia Nitrogen (NH_3-N)	lb/day	10.3	Residential & Commercial
Phosphorus (P)	lb/day	5.5	Residential & Commercial

Using the MPCA Design Guidance and 2011 Minnesota Rules, Part 7081.0120, an average daily flow for each system or wastewater generator is estimated using a formula. This formula calculates a flow based on the number of bedrooms in each of the residences, the treatment system type, 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 77 housing units, including 11 vacant parcels. 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. Three vacant parcels are included in the design flow. Flow from these parcels was assumed at 500 gpd each. Finally, collection system inflow/infiltration was estimated and included in the total design flow. A detailed design flow calculation is included in Appendix D.

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, bars, office buildings, banks, retail stores, a hotel, church, and a park. EDU calculations are as follows:

(18,544 gpd residential flow) / (77 dwellings) = 245 gpd/dwelling = wastewater flow per EDU

(28,349 gpd commercial flow) / (245 gpd/EDU) = 116 commercial EDUs

Total number of EDUs = 77 residential + 116 commercial = 193 Total EDUs

4.0 Need for Wastewater Project

4.1 Health, Sanitation, Economy, and Security

Afton, MN is a popular destination venue with its historical Old Village district and proximity to the St. Croix River. This location within the City is protected by a levee susceptible to annual flooding of various magnitudes. The levee is not FEMA accredited and deficiencies have been identified by the U.S. Army Corps of Engineers inspection efforts. Substantial flooding has occurred within the City in 1965, 1969, 1993, 1997, and 2001 with smaller flooding events occurring in other years. These flooding events have caused considerable damage. Associated expenses and impacts have caused a significant financial burden to not only the City and its Old Village, but its residents and other businesses.

Many non-compliant ISTS/SSTS serving residential dwellings and commercial establishments within the Old Village are inadequately treating wastewater. During these flooding events, discharge of inadequately treated wastewater occurs and has the potential to expose the public to infectious diseases caused by pathogenic organisms. The proposed project will replace non-compliant ISTS/SSTS and remove systems from levee associated flooding events. In addition, the improvement of these ISTS/SSTS will allow the necessary levee improvements to occur. These essential ISTS/SSTS and levee improvements will greatly reduce damage, financial, health and sanitation impacts to the City, residents, businesses, and general public.

4.2 System Operation and Maintenance (O&M)

Currently each homeowner and business is responsible for maintenance and upkeep of their own ISTS/SSTS. These systems are operated and maintained in variable conditions.

4.3 Growth

A modest growth is anticipated for the City of Afton service area over the next 20 years. Included in the design flow and loading estimates are 77 residential dwellings (66 existing and 11 vacant parcels), or a population of 206 people, and 25 commercial (22 existing and 3 vacant parcels) establishments. The estimated existing population within the service area is 176 people. Therefore, the design includes an estimated population growth of 30 people (17%) over the next 20 years.

5.0 Alternatives Analysis

5.1 INTRODUCTION

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

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

The following alternatives are available for long-term wastewater infrastructure and have been evaluated to serve the City of Afton service area:

Collection Alternative 1:	Gravity Collection System
Collection Alternative 2:	Low Pressure Forcemain Collection System
Treatment Alternative 1:	No Action
Treatment Alternative 2:	Existing homes install compliant ISTS
Treatment Alternative 3:	Cluster LSTS for the entire community
Treatment Alternative 4:	Regionalization to Metropolitan Council Environmental Services (MCES) sewer interceptor

5.2 COLLECTION SYSTEM

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

5.2.1 Collection System Alternatives

Two alternatives were evaluated for collection of wastewater from properties within the proposed service area. The alternatives include: 1) gravity collection system; and 2) low pressure forcemain collection. A description of each alternative is presented below.

5.2.1.1 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. Individual sewer services would connect 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 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 alternative 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.

5.2.1.2 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 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 alternative 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 pump maintenance and replacement needs. 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 bedrock. 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.

5.3 TREATMENT ALTERNATIVE 1 – NO ACTION

ISTS/SSTS serving residents and businesses within the City of Afton service area are posing threat to the general public and surrounding environment. These systems are not properly treating wastewater. Not remediating these issues and continuing to operate in an insufficient manner is not favorable. ISTS/SSTS would continue to discharge inadequately treated wastewater to groundwater, the St. Croix River, and the surrounding watershed. In time, the amount of failures will rise and the associated public health risks will increase. Also, associated pollutant loadings to potable drinking water wells and the watershed will rise. Therefore, the "No Action" alternative is an untenable alternative to protect the water resources in this area.

5.4 TREATMENT ALTERNATIVE 2 – ISTS REPLACEMENT

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 in the future. Appendix A shows each property's most likely future ISTS alternative. The type of future ISTS varies based on the lot size, soils at the site, and current land use. Soil suitability was evaluated for all potential ISTS properties in the service 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.
- **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 pretreatment through a mechanical treatment unit or media filter prior to discharge to a drainfield 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.

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.

Table 7 summarizes the make-up of the ISTS in the community after upgrades to all parcels (including currently compliant parcels) if all parcels stay on ISTS. 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 A.

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)	31	36%
Type 4 or 5	16	19%

Data presented in Table 7 indicates that only 37% of parcels have adequate room and suitable soil conditions on their property to install a Type 1 replacement ISTS. Nearly 8% (7 properties) have a Type 2 holding tank as their only feasible ISTS alternative that will require tank pumping on a regular basis. Type 3 systems comprise about 36% (31 properties) of parcels. 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.

Due to the fact the majority (63%) of the existing structures evaluated do not have a suitable site to install a replacement Type 1 ISTS, it has determined to remove the ISTS replacement alternative from consideration.

5.5 TREATMENT ALTERNATIVE 3 - CLUSTER LSTS

When a series of homes, are connected to a decentralized wastewater treatment system, it is commonly referred to as a cluster 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.

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 Large Subsurface Wastewater Treatment System (LSTS) and permitting is completed through a Minnesota Pollution Control Agency State Disposal System (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 would be required.

Because the total daily wastewater flow discharging to the soil is greater than 10,000 gpd, the MPCA recommends the design follow the April 2010 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).

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

Of greatest importance is the nitrogen permitting alternatives. The MPCA nitrogen policy was chosen to ensure the state's groundwater is protected and to provide a consistent technical baseline during permitting. The policy is based on safe drinking water standards set by federal and state laws (40 CFR part 141.62 and Minn. Rules 4717.7500, supb. 68). Two nitrogen treatment performance permitting alternatives 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 alternative is the simplest and fastest in terms of permitting. This alternative 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 the installation of monitoring wells are not.

The second alternative 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 alternative #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.

5.5.1 Treatment and Dispersal System

5.5.1.1 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.

During the preparation of the CAR, 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 CAR concluded that the northern property is much more favorable (Figure 4).

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 features or bedrock observed. Soil loading rates within this area could be up to 1.6 gpd/ft^2 as highly pretreated effluent would be applied. Figure 4 shows locations of recorded soil borings at the north site. Boring results are located in Appendix B.

5.5.1.2 Soil Dispersal

Soils of the selected north site are favorable for the use of in-ground soil dispersal technologies. Seepage beds have been chosen as they would best suit the site in terms of construction and long-term operation.

Pressurized in-ground infiltration 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 2-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 loamy sands and sands and no signs of seasonal groundwater, the seepage cells would 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 51,000 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.

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	31,875	47,815	1.06	15,940	3.0

* Must construct 1.5 times or 150% the required infiltrative area: 31,875 ft^2 + 15,940 ft^2 = 47,815 ft^2

** Design wastewater flow divided by constructed infiltrative area: (51,000 gpd) / (47,815 ft^2) = 1.06 gpd/ft^2

5.5.1.2.1 Environmental Impacts

Air quality: The soil dispersal methods should not have odor problems as highly pretreated effluent would be dispersed below grade.

Water quality: Water quality within the service area would improve. The failing and non-conforming ISTS would be replaced with a functional wastewater treatment component. Highly pretreated effluent would be evenly dispersed to the soil where it recharges the local groundwater.

Floodplains: Afton MN is approximately 60,000 feet above the confluence with the Mississippi River. The approximate 500 year, 100 year, 50 year, and 10 year floodplain elevations are roughly 695 ft, 691.5 ft, 690 ft, and 686.5 ft (Appendix C). The proposed treatment site located

north of town is well above these floodplain elevations and should not be influenced (Figure 4).

Alterations to landforms, streams and natural drainage patterns: The soil dispersal cells would be positioned along the contour. Landforms, streams and drainage patterns within the vicinity of the soil dispersal cells would be unchanged.

Wildlife: Wildlife would be minimally affected by the construction of the facility. The surrounding land use is densely populated residential areas and wildlife corridors in the vicinity have been greatly minimized due to past development.

5.5.1.3 Pretreatment Technology

Utilization of a pretreatment system would 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, protection of groundwater resources, and increased system life. Examination of feasible pretreatment alternatives is critical in component selection. Within this study, each alternative was evaluated based on the following criteria:

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

As described earlier, the LSTS would 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 alternative. If these limits are not met at the property boundary, additional components may be needed. Also, due to the sandy textured soils present across the proposed treatment site, there would be minimal nitrogen uptake within the soil. Water movement within the soil would be rapid and dominantly vertical prior to groundwater recharge. By choosing the 10 mg/L total nitrogen end-of-pipe alternative,

the upfront detailed hydrogeological assessment would 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 would be eliminated. Therefore, each alternative will be evaluated on achieving less than 10 mg/L total nitrogen at the end-of-pipe.

Not all common pretreatment technologies would meet the required limit and therefore special design considerations must be applied. Pretreatment devices that are anticipated to reduce total nitrogen to less than 10 mg/L total nitrogen end-of-pipe limit are:

1. Recirculating Gravel Filter (RGF) with an anoxic denitrification filter and carbon source additive.
2. Submerged Attached Growth Bioreactor (SAGB) with carbon additive.
3. Attached growth Aerobic Treatment Unit (ATU) with an anoxic filter and carbon additive.

5.5.1.3.1 Recirculating Gravel Filter

The fundamental components of the RGF system include a septic tank, recirculation tank, the media filter, pumps and 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 would be needed as described below.

Recirculating media filters require routine operation and maintenance responsibilities. Typical tasks include monitoring and logging flows, rotating cells, inspecting pumps and controls,

examining the media filter, field flushing distribution laterals, inspecting filtrate quality, and checking treatment tanks for sludge. The tanks must be pumped periodically (as required by MPCA). Advantages: passive and 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.

5.5.1.3.2 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 exits the piping at the bottom of the chamber and flows upward lifting aerated wastewater, or mixed liquor, toward 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 would 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 would be in the nitrification unit. A denitrification unit would also be required to achieve regulatory requirements.

ATUs would require routine operation and maintenance responsibilities. Typical tasks include monitoring and logging flows, inspecting blower and 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.

5.5.1.3.3 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.

5.5.1.3.4 Anoxic Denitrification Filter

An anoxic dentrification 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 there is an adequate carbon source, a flow proportional pump would be utilized to supply a supplemental carbon additive (the electron donor). Dependent upon incoming flow, temperature, detention time, and nitrate concentration, an established amount of carbon additive would 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.

5.5.1.3.5 Environmental Impacts

Air quality: The advanced pretreatment technologies described above should not have odor problems. Sewer gases may exit tanks via air vents but odors associated are anticipated to disperse before encountering the general public as the treatment site is relatively remote. The actual pretreatment devices would have minimal odor as highly pretreated aerobic effluent would be discharged to/from components.

Water quality: Water quality within the service area is anticipated to improve. The failing and non-conforming ISTS/SSTS would be replaced with a functional wastewater treatment system. Highly pretreated effluent from the pretreatment device would be evenly dispersed to the soil where it would recharge the groundwater.

Floodplains: Afton MN is approximately 60,000 feet above the confluence with the Mississippi River. The approximate 500 year, 100 year, 50 year, and 10 year floodplain elevations are roughly 695 ft, 691.5 ft, 690 ft, and 686.5 ft (Appendix C). The proposed treatment site located north of town is well above these floodplain elevations and should not be influenced (Figure 4).

Alterations to landforms, streams and natural drainage patterns: Landforms, streams and drainage patterns within the vicinity of the pretreatment system would be unchanged. Subtle drainage patterns that may be altered by installation would be directed around the system. Proper design considerations would be taken into account not to disrupt any natural drainage patterns.

Wildlife: Wildlife would be minimally affected by the construction of the facility. The surrounding land use is densely populated residential areas and wildlife corridors in the vicinity have been greatly minimized due to past development.

5.6 TREATMENT ALTERNATIVE 4 - REGIONALIZATION

WSB has analyzed the regionalization alternative which would consist of connecting to a MCES sewer interceptor. MCES was contacted during the analysis and they determined that the south Washington County interceptor would be viable. This interceptor conveys sewage to the Eagle's Point Wastewater Treatment Facility. MCES concluded this treatment facility has adequate capacity to accommodate wastewater generated within the service area.
The collection system would collect and convey raw wastewater to a lift station. Approximately 33,000 feet of 6-inch diameter forcemain would be routed along Afton Boulevard, 40th Street, Bailey Road (CR18), and County Road 19. It is estimated three lift stations would be required to convey the wastewater to the interceptor connection point.

MCES would be compensated based off Sewer Availability Charges (SAC) and treatment user costs based on wastewater generated. SAC charges are defined as a user generating 274 gpd and currently are $2,435/user. MCES currently charges $2.03 per 1,000 gallons of wastewater treated by the treatment facility. Both of these charges have been included in the cost estimate analysis.

5.6.1 Environmental Impacts

Air quality: The regionalization alternative should not have odor problems. Sewer gases will exit lift stations and air release valves but odors associated are anticipated to disperse before encountering the general public.

Water quality: Water quality within the service area is anticipated to improve. The failing and non-conforming ISTS/SSTS would be replaced with a functional wastewater collection system that would convey raw wastewater to the Eagle's Point Wastewater Treatment Facility.

Alterations to landforms, streams and natural drainage patterns: Landforms, streams and drainage patterns would be unchanged. Proper design considerations would be taken into account not to disrupt any natural drainage patterns.

Wildlife: Wildlife would be minimally affected by the construction of regionalization alternative as the majority of components will be located within road right-of-way.

6.0 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.

6.1 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

6.2 WASTEWATER TREATMENT

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

Table 11: Wastewater Treatment Alternatives Capital Costs

Alternative	Capital Cost	Contingency (10%)	Non-construction*	Land	Total Capital Cost
ATU w/ anoxic filter	$1,543,140	$154,320	$369,500	$560,000	$2,626,960
SAGB	$1,467,000	$146,700	$352,750	$560,000	$2,526,450
RGF w/ anoxic filter	$1,242,000	$124,500	$303,500	$560,000	$2,230,000
Regionalization	$2,551,000	$255,000	$1,041,480	$0	$3,847,480

*****Includes: Engineering (18%), survey (treatment area), wetland delineation, hydrogeologic/mounding investigation, legal & administrative (2%), MCES SAC charges, and easement acquisition.

Advanced pretreatment alternative costs were based on daily flow and organic loading estimates for all users in the service area (residential and commercial) as detailed in Section 3. Adding users would change the size requirement for the LSTS and therefore the overall cost. Table 11 reflects the difference in capital cost estimates, non-construction costs including engineering, survey, wetland delineation, hydrogeologic/mounding investigation, legal, administrative, and includes a 10% contingency. Costs also take into account constructing 1.5 times the amount of drainfield required to disperse the daily permitting flow, as required by MPCA.

All alternatives assume a soil dispersal treatment system consisting of pressurized seepage beds. The soil infiltration system would be designed into multiple cells to allow for smaller pumping and piping components thus lower equipment cost. More importantly, the operator would 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 would consist of seepage cells totaling 47,815 ft^2; another 15,940 ft^2 would be set aside as reserve area.

6.3 ANNUAL OPERATION AND MAINTENANCE COSTS

When comparing costs for wastewater infrastructure alternatives, all costs including capital and annual operation, maintenance, and replacement (OM & R) must be considered. Table 12 provides the average annual operation, maintenance, and replacement cost estimates for each cluster LSTS pretreatment alternative. LSTS OM & 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, and Replacement Costs

Alternative	Estimated Annual OM & R
Gravity Collection	$14,400
Low-pressure Collection	$32,600
ATU w/ anoxic filter	$68,575
SAGB	$72,100
RGF w/ anoxic filter	$41,550
Regionalization	$82,040

6.4 PRESENT WORTH ANALYSIS

Alternatives discussed in this report require different capital, operation, maintenance, and replacement costs. Certain alternatives can require more infrastructure (capital) costs at the start of the project; while other alternatives experience higher or lower 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.

6.4.1 Collection System

For the purposes of this report, a 20-year present worth analysis was completed to compare the wastewater collection system alternatives 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 (OM & 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 alternatives 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, construction of a gravity sewer collection system, would result in the lowest cost for the City of Afton.

Table 13: Wastewater Collection System Present Worth Analysis

	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

6.4.2 Wastewater Treatment Alternatives

Table 14 summarizes a present worth analysis over a 20-year period showing the calculated present worth costs for wastewater treatment alternatives. These alternatives include ATU w/ anoxic denitrification filter, SAGB, RGF w/ anoxic denitrification filter, and regionalization to the MCES south Washington County Interceptor. Of the four alternatives, the RGF with an anoxic denitrification filter is the least expensive when comparing both capital and 20-year present worth dollars; the regionalization alternative is the most expensive.

Table 14: Wastewater Treatment System Present Worth Analysis

	ATU w/ anoxic filter	SAGB	RGF w/ anoxic filter	Regionalization
Capital Costs	$1,543,140	$1,467,000	$1,242,000	$2,551,000
Contingency (10%)	$154,320	$146,700	$124,500	$255,000
Non-construction	$369,500	$352,750	$303,500	$1,041,480
Land	$560,000	$560,000	$560,000	$0
20-year Present Worth O,M,&R	$931,950	$979,900	$564,600	$1,506,600
Total Salvage Value on Expenditures	$163,800	$122,130	$188,630	$91,000
Estimated Total 20-year Present Worth	$3,395,110	$3,384,220	$2,605,970	$5,263,080

7.0 Selected Project

7.1 DESIGN and SYSTEM PARAMETERS

Section 3 and Appendix D includes wastewater flows and loading estimates which were utilized within this plan. These loadings include both residential and commercial users and were used to size collection system piping, pretreatment components, tertiary treatment components, and required soil dispersal area. Hydraulic flow and organic loading values that will be utilized in design include the design wastewater flow, BOD loadings, and NH_4 organic loadings; 51,000 gpd, 152 lbs per day, and 10.3 lbs per day, respectively. There are no anticipated industrial users within the City of Afton and therefore pretreatment of such wastes would not be needed.

Septage and/or sludge would accumulate within the pretreatment components particularly within the precast concrete tanks. Regular monitoring and periodic removal of the solids would be required. All septage activities including removal and disposal would follow MPCA Chapter 7080 (maintenance) and Chapter 7083 (maintenance license responsibilities). Septage disposal would occur at a MPCA permitted treatment plant and/or land application following MPCA Septage Management Guidelines and Federal Land Application of Septage Regulations – 40 CFP part 503. Specific monitoring and management requirements would be outlined in the LSTS MN state permit.

Residential dwellings and businesses within the City of Afton service area are currently served by ISTS. These ISTS vary in condition and the level of wastewater treatment. During construction of the proposed collection and treatment systems, these ISTS would continue to provide wastewater treatment until the new system is operational. It is anticipated the wastewater treatment system would be constructed initially and/or concurrently the main collection system. It is certain residential and commercial hookups would not occur until the system is operational.

7.2 RECOMMENDED COLLECTION SYSTEM

The proposed collection system to serve the City of Afton service area is the conventional gravity sewer system. The 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 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 forcemain to the treatment and dispersal system. Figure 5 shows the proposed layout of the gravity collection system alternative.

7.3 RECOMMENDED TREATMENT SYSTEM

The proposed treatment system to serve the City of Afton service area is the RGF with anoxic denitrification filter in conjunction with a soil-based drainfield. Non-compliant ISTS serving residential dwellings and commercial establishments would be replaced with this treatment alternative which would provide necessary improvements to protect the waters of the State. The system consists of communal septic tanks, an anoxic denitrification component, recirculation tank, recirculating gravel filter, and a dose tank sized to store and meter flows throughout the day to a seepage cell soil dispersal drainfield. A control building would be included to house various valves and controls. It would also serve as a location to store miscellaneous items pertinent to system operation and maintenance.

The proposed treatment system would be located north of town on the David Eastwood, 2318 St. Croix Trail South property (Figure 4). The exact system location is not known however the system elevation would likely be within 720 to 730. Afton MN is approximately 60,000 feet above the confluence with the Mississippi River. The approximate 500 year, 100 year, 50 year, and 10 year floodplain elevations are roughly 695 ft, 691.5 ft, 690 ft, and 686.5 ft (Appendix C). Therefore, the proposed treatment site is well above these floodplain elevations and would be operable during the 25-year flood and protected during a 100-year flood event.

The system would include necessary tertiary equipment and be designed to meet LSTS end-of-pipe effluent constituent limitations of 10 mg/L total nitrogen. Because of sufficient separation distances to the seasonal groundwater, a below-grade seepage cell drainfield would provide final dispersal and assimilation to the local aquifer. The recirculating gravel filter would be designed to accommodate anticipated wastewater flows and loadings (BOD, TSS, and NH_3). The filter would be lined with a synthetic liner and contain select gravel media to serve as the substrate. Wastewater would flow via gravity from the septic tanks and denitrification unit to the recirculation tank. Duplex pumps within the recirculation tank would dose a specified volume of filtrate to one gravel filter cell. The gravel filter would be divided into twelve cells each 10 ft. x 100 ft. RGF zone dosing would be sequenced and would depend on which zones are active. Wastewater that is pumped to the filter flows downward through the gravel media where it undergoes various physical, chemical, and biological treatment processes. There would be no need for blowers to provide oxygen as the filter utilizes ambient oxygen from the atmosphere.

An anoxic dentrification filter would be included and designed specifically for total nitrogen reduction to $\leq$ 10 mg/L total nitrogen. A precast concrete tank would contain a plastic media substrate. The substrate would provide surface area to promote the growth of denitrifying bacteria. 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. To ensure adequate carbon, a flow proportional pump would be utilized to supply a supplemental carbon additive (acetic acid). Dependent upon flow, temperature, detention time, and nitrate concentration, an established amount of carbon additive would be mixed with the nitrified effluent.

The soil dispersal system would consist of twenty 21 ft. x 115 ft. pressurized seepage beds totaling 48,300 ft^2; another 16,000 ft^2 would be set aside as reserve area. Duplex pumps within the dose tank would dose a specified volume of pretreated effluent to one seepage bed. Each

seepage bed would be pressurized containing a network of distribution piping. Independent electronically actuated valves controlled by the main panel would direct the effluent to the appropriate active bed. Dosing would occur on a timed basis throughout the day.

7.4 TOTAL ESTIMATED PROJECT COST

The entire project is estimated to cost $3,970,000. Operation, maintenance, and equipment replacement costs are estimated at $55,950 annually. These costs include operator wages, insurance, supplies, sampling and associated analytical fees, repairs, maintenance, utilities, permitting fees, sludge hauling, treatment site lawn and snow maintenance, and equipment replacement costs.

7.5 ESTIMATED ANNUAL SEWER SERVICE CHARGES

The annual sewer service charges have been estimated based off the following costs: (1) projected wastewater collection, treatment and land purchase capital costs, (2) operation, maintenance, & replacement costs, (3) projected debt recovery scenarios as described below:

Income: This project proposes setting up a system of user fees based on EDUs. User fees will go toward debt retirement and operation, maintenance, and replacement costs. The user fees are calculated based on an estimated total project cost of $3,970,000. Total project costs will be recovered through grants, loans, and assessments. Grants are estimated at $2.6 million. The remaining portion will be recovered through a low-interest loan and assessments. Also, land purchase costs will be recovered through a low-interest loan. The exact interest rate is not known and will be determined based off the median household income for the City of Afton ($89,000). Two categories are included in the estimated annual sewer service charges; 10-year 2.0% and 20-year 2.0% loans. See the following table below for the user fee information.

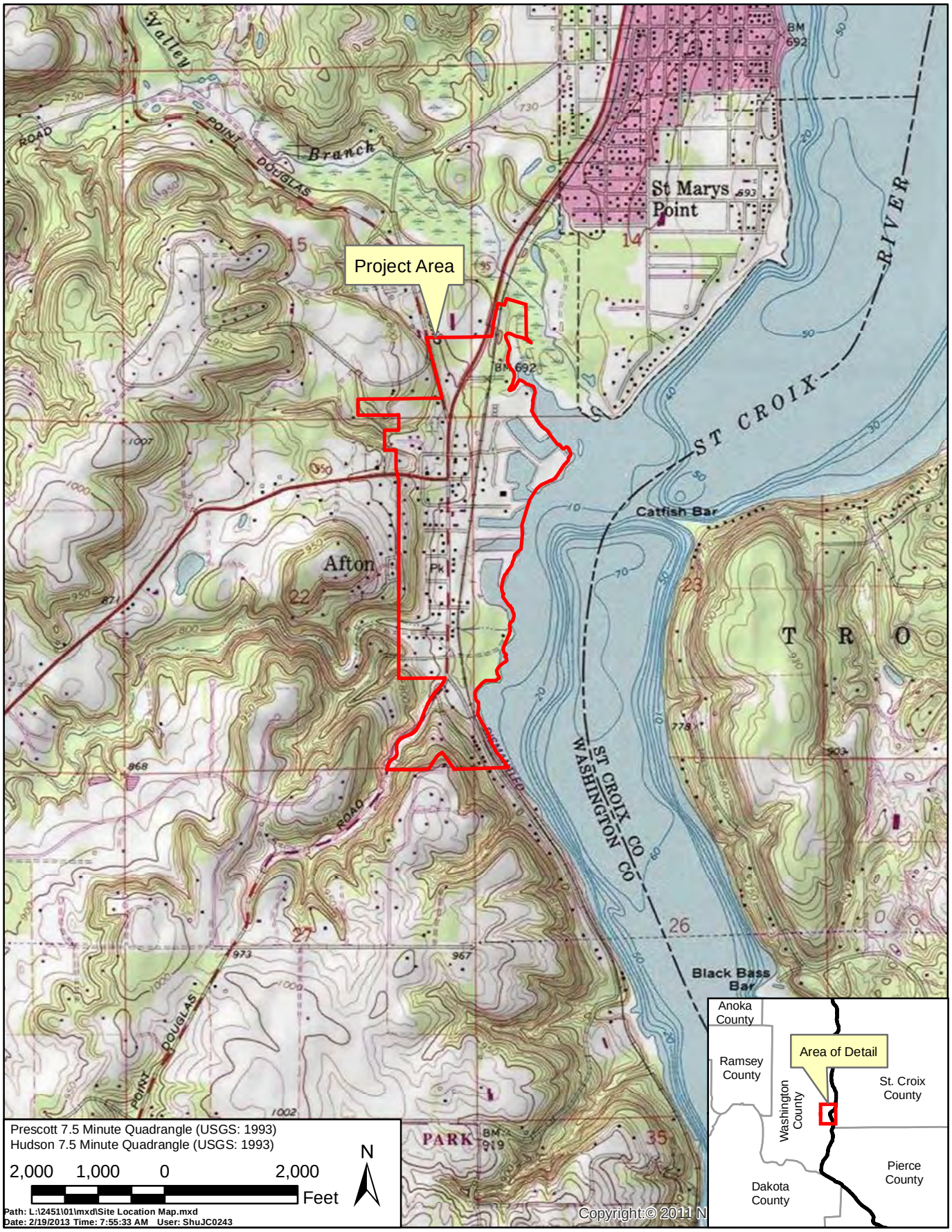
Operations, Maintenance and Equipment Replacement Costs: are estimated at $55,950 including operator wages, insurance, supplies, sampling and associated analytical fees, repairs, maintenance, utilities, permitting fees, sludge hauling, treatment site lawn and snow maintenance, and equipment replacement costs.

Debt Repayment: The following table gives a breakdown of the estimated sewer service charges based on income sources described above.

Table 15: Estimated Sewer Service Charges

Category	10-yr Loan	20-yr Loan
Total EDUs:	193	193
Total Estimated Construction Costs:	$3,970,000	$3,970,000
Yearly OM&R Cost Estimate:	$55,950	$55,950
Grant Amount:	$2,603,000	$2,603,000
Loan Amount:	$1,367,000	$1,367,000
Interest Rate:	2.0%	2.0%
Loan Length (years):	10	20
Yearly Loan Payment:	$152,200	$83,600
Yearly Loan & OM&R Payment:	$208,150	$139,550
Annual Total User Charge Estimate per EDU:	$1,080	$725
Monthly Total User Charge Estimate per EDU:	$90.00	$60.50

Figures



CITY OF AFTON

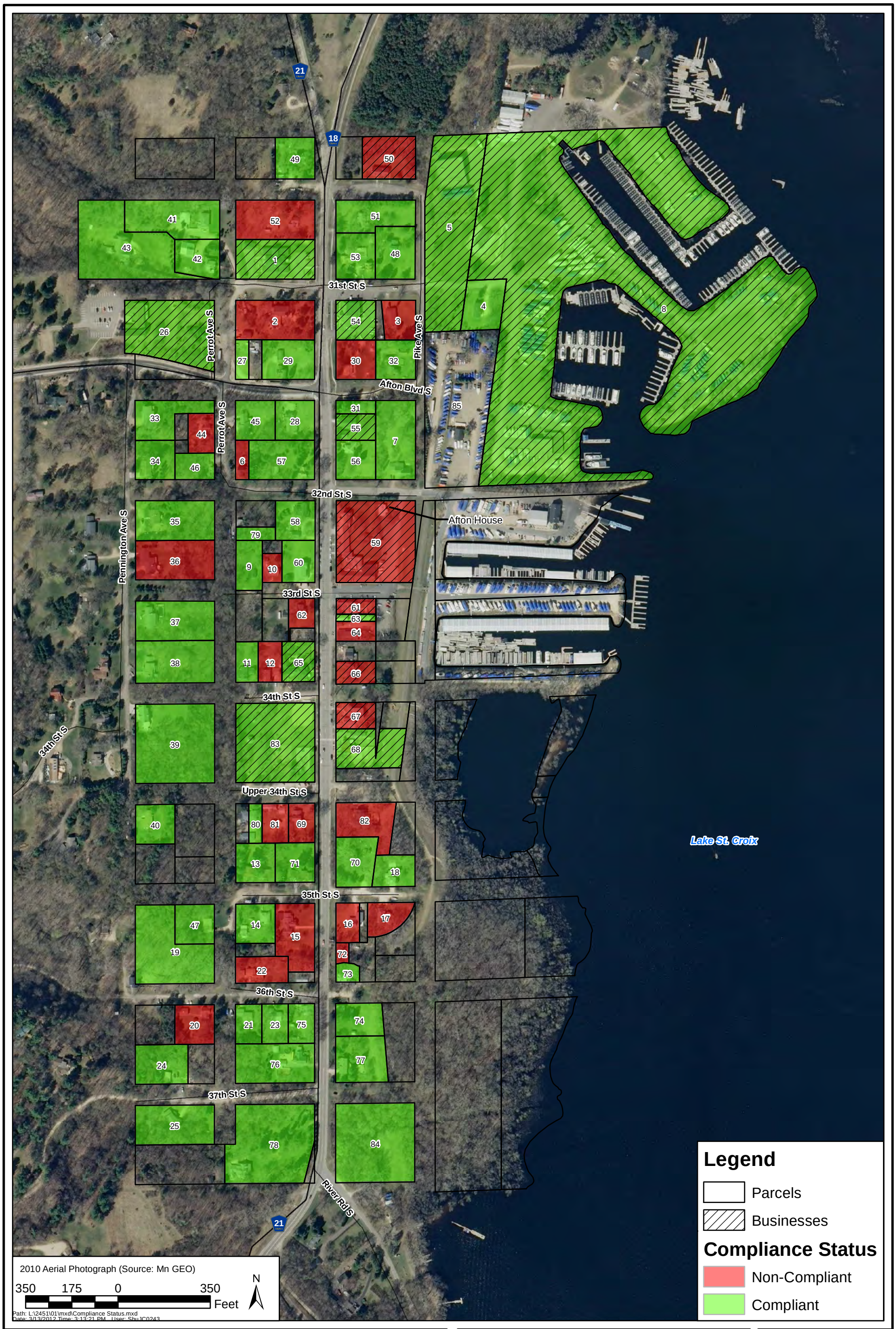
Site Location Map

Engineers - Scientists
Business Professionals
www.wenck.com

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

MAR 2012

Figure 1



CITY OF AFTON

Compliance Status

Wenck

Engineers - Scientists
Business Professionals
www.wenck.com

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

MAR 2012

Figure 2

CITY OF AFTON

Potential Treatment and Dispersal Locations

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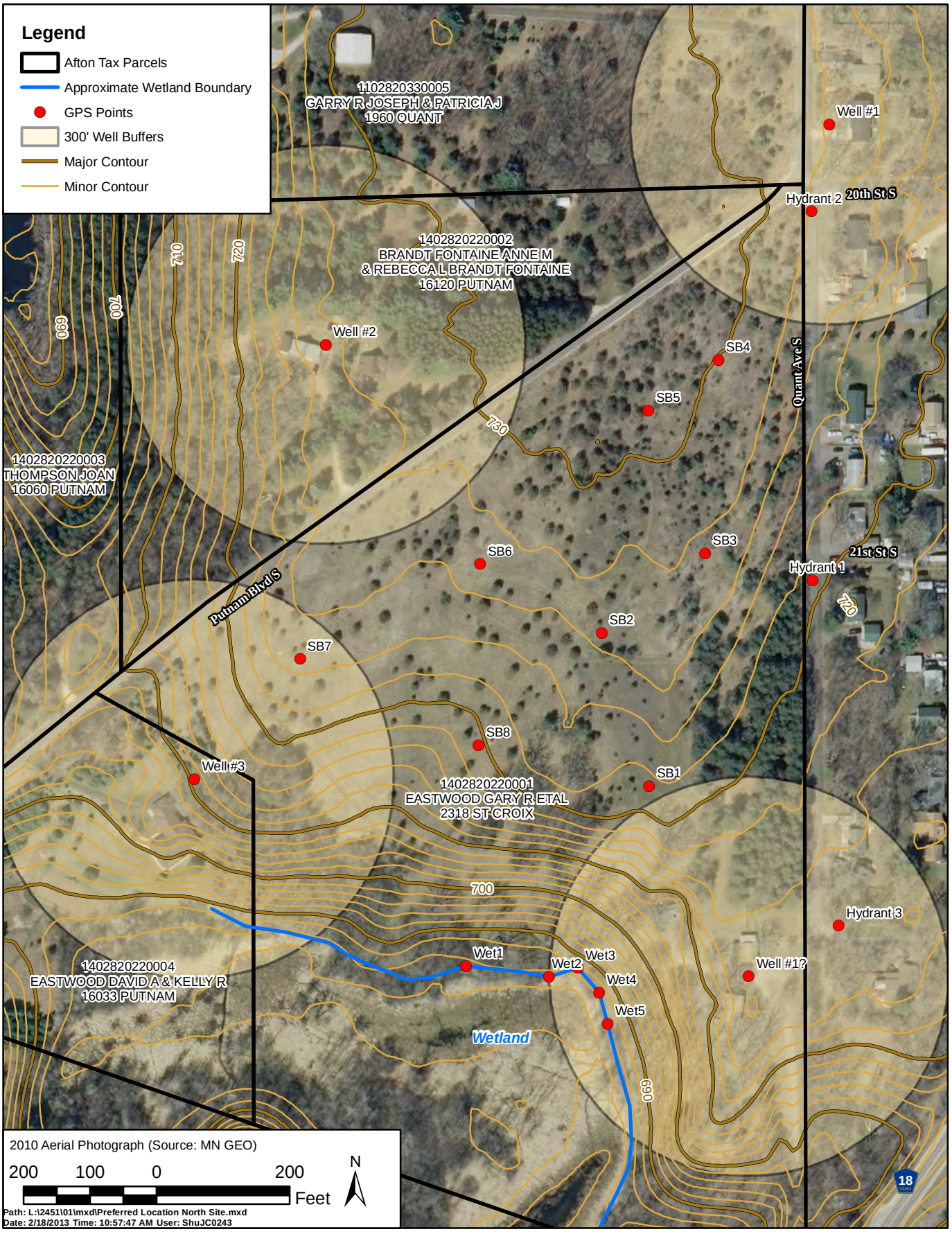
1800 Pioneer Creek Center
Maple Plain, MN 55359-0429
1-800-472-2232

MAR 2012

Figure 3



CITY OF AFTON

Preferred Treatment and Dispersal Location-North Site

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1-800-472-2232

MAR 2012

Figure 4

Task Force Recommendations
for Infrastructure Improvements
in the Old Village

City of Afton

Figure 5: Sanitary System Concept

N

0 500 Feet

WSB

Appendix A

ISTS 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), privy (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=FTRGW, 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	Likely non-compliant			Setback Status X if in violation				UAND Existing System Condition Status	Yes/No each; * best option							
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), privy (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=FTRGW, 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 B

Soil Information

LOCATION SANTIAGO WI+MN

Established Series
Rev. DJH-DEJ-HFG
02/2006

SANTIAGO SERIES

The Santiago series consists of well drained soils which are deep to a densic contact. They formed in loess or silty lacustrine deposits and in the underlying dense sandy loam till on ground moraines, disintegration moraines, and end moraines. Permeability is moderate in the silty mantle, slow or moderately slow in the lower part of the solum, and very slow in the substratum. Slope ranges from 1 to 45 percent. Mean annual precipitation is about 30 inches. Mean annual air temperature is about 42 degrees F.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, frigid Haplic Glossudalfs

TYPICAL PEDON: Santiago silt loam, on a convex, northeast-facing slope of 8 percent, in a cultivated field, at an elevation of about 1,180 feet. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 10 inches; dark brown (10YR 3/3) silt loam, light brownish gray (10YR 6/2) dry; moderate medium granular structure; friable; many fine and few medium roots; 4 percent gravel; slightly acid; abrupt smooth boundary. (6 to 12 inches thick)

E/B--10 to 15 inches; about 60 percent brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure parting to moderate very fine subangular blocky; friable; extends as tongues into or surrounds remnants of dark yellowish brown (10YR 4/4) silt loam (Bt); moderate very fine subangular blocky structure; friable; common faint dark yellowish brown (10YR 3/4) clay films on faces of peds; common fine and medium roots; 1 percent gravel; moderately acid; clear smooth boundary.

B/E--15 to 23 inches; about 70 percent dark yellowish brown (10YR 4/4) silt loam (Bt); moderate very fine subangular blocky structure; friable; common faint dark yellowish brown (10YR 3/4) clay films on faces of peds; penetrated by tongues of brown (10YR 5/3) silt loam (E), very pale brown (10YR 7/3) dry; weak medium platy structure parting moderate very fine subangular blocky; friable; common fine and few medium roots; 1 percent gravel; very strongly acid; abrupt wavy boundary. (Glossic horizon ranges from 5 to 20 inches thick.)

2Bt1--23 to 36 inches; dark brown (7.5YR 3/4) gravelly sandy loam; moderate fine prismatic structure tending to part along horizontal cleavage planes to weak medium plates inherited from the parent material; firm; common fine roots; common faint dark brown (7.5YR 3/3) and few distinct reddish brown (5YR 4/4) clay films on all faces of peds; few prominent brown (10YR 5/3) silt coats on vertical faces of peds; 14 percent gravel and about 1 percent cobbles; slightly brittle; strongly acid; abrupt wavy boundary.

2Bt2--36 to 49 inches; dark brown (7.5YR 3/4) fine sandy loam; moderate fine prismatic structure tending to part along horizontal cleavage planes to weak medium plates inherited from the parent material; firm; few fine roots; many faint dark brown (7.5YR 3/3) clay films on all faces of peds; very few prominent brown (10YR 5/3) silt coats on vertical faces of peds; 11 percent gravel and about 1

percent cobbles; slightly brittle; strongly acid; gradual wavy boundary. (Combined thickness of the 2Bt horizon ranges from 8 to 30 inches.)

2BCd1--49 to 69 inches; dark reddish brown (5YR 3/4) sandy loam; weak very coarse prismatic structure tending to part along horizontal cleavage planes to weak medium plates inherited from the parent material; firm; few fine roots; few faint dark reddish brown (5YR 3/3) clay films on top faces of peds; 9 percent gravel and about 1 percent cobbles; moderately acid; gradual wavy boundary.

2BCd2--69 to 87 inches; dark reddish brown (5YR 3/4) sandy loam; weak extremely coarse prismatic structure tending to part along horizontal cleavage planes to weak medium plates inherited from the parent material; firm; few fine roots; few distinct dark reddish brown (5YR 3/3) clay films on top faces of peds; 7 percent gravel and about 1 percent cobbles; few sandstone channers; moderately acid; gradual wavy boundary. (Combined thickness of the 2BCd horizon ranges from 0 to 70 inches.)

2Cd--87 to 102 inches; reddish brown (5YR 4/4) sandy loam; tending to part along horizontal cleavage planes to weak medium plates; firm; dense and compact; 9 percent gravel and about 1 percent cobbles; slightly acid.

TYPE LOCATION: Barron County, Wisconsin; about 2 miles east and 1.5 miles south of Reeve; located about 1,840 feet south and 2,040 feet east of the northwest corner of section 34, T. 32 N., R. 14 W.; USGS Connorsville topographic quadrangle; lat. 45 degrees 13 minutes 09 seconds N. and long. 92 degrees 05 minutes 12 seconds W., NAD 83.

RANGE IN CHARACTERISTICS: Thickness of the silty mantle ranges from 12 to 36 inches. Depth to the base of the argillic horizon and to densic contact ranges from 40 to 60 inches. Content of clay averages from 7 to 17 percent in the particle-size control section and the content of fine sand or coarser averages 15 to 70 percent. The base saturation (by sum of cations) is less than 60 percent in some part of the argillic horizon. Volume of gravel ranges from 0 to 10 percent in the silty mantle and from 5 to 35 percent in the till. Volume of cobbles ranges from 0 to 3 percent in the silty mantle and from 0 to 5 percent in the till. Volume of stones ranges from 0 to 1 percent in the silty mantle and from 0 to 3 percent in the till. Surface stones have coverage ranging from 0 to 3 percent. Reaction ranges from extremely acid to slightly acid in the solum, except it ranges to neutral in the Ap horizon where the soil is limed. Reaction ranges from strongly acid to neutral in the substratum.

The Ap horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 1 to 3. Dry value is greater than 5.5. Uncultivated pedons have an A horizon, 1 to 4 inches thick, with hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 or 2. Texture is silt loam.

Some pedons have an E horizon with hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Colors of 4/3 or 5/3 have value dry of 7 or more. The E horizon is silt loam or silt.

Some pedons have a Bw horizon with hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 4. It is silt loam. Bw horizons with spodic color have less than 0.6 percent organic carbon.

Santiago soils have a glossic horizon. Horizonation has a wide range depending on the thickness of the silty mantle and the degree to which eluviation has occurred. Therefore, there can be E/B, B/E, 2E/B, or 2B/E horizons singly or in combination.

The E part of the E/B or B/E horizon has color and texture like the E horizon described above. The Bt part has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 4 to 6.

Some pedons have a Bt horizon with color and texture like the Bt part described above.

The 2E part of the 2E/B or 2B/E horizon has hue of 5YR, 7.5YR, or 10YR, value of 4 to 6 and chroma of 2 or 3. Colors of 4/3 or 5/3 have value dry of 7 or more. The 2E part is typically sandy loam, fine sandy loam, loam, or their gravelly analogs, but in some pedons it is loamy sand or gravelly loamy sand. The 2Bt part has color and texture like the 2Bt horizon described below.

The 2Bt horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 3 to 5 and chroma of 4 to 6. It is typically sandy loam, fine sandy loam, loam, or their gravelly analogs. The bulk density ranges from 1.65 to 1.90 gm/cc. Some pedons have pockets or strata of loamy sand or gravelly loamy sand.

The 2BCd horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 3 to 5 and chroma of 4 to 6. It is typically sandy loam, fine sandy loam, or their gravelly analogs. Bulk density ranges from 1.8 to 2.0 gm/cc. Some pedons have pockets or strata of loamy sand or gravelly loamy sand.

The 2Cd horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 3 to 5 and chroma of 4 to 6. It is typically sandy loam, fine sandy loam, or their gravelly analogs. Bulk density ranges from 1.8 to 2.0 gm/cc. Some pedons have pockets or strata of loamy sand or gravelly loamy sand.

COMPETING SERIES: These are the Amery, Arland, Automba, Goodland, Itasca, Kennan, Langlade, Marathon, Pemene, Rosholt, Scoba, and Steamboat series.
Amery and Automba soils do not have a 12 to 36 inch thick mantle that is more than 50 percent silt. In addition, Automba soils have base saturation of more than 60 percent in all parts of the argillic horizon.
Arland soils have a paralithic contact of sandstone at a depth of 20 to 40 inches.
Goodland, Itasca, Kennan, Langlade, Marathon, Pemene, Rosholt, Scoba, and Steamboat soils do not have a densic contact within the series control section.

GEOGRAPHIC SETTING:
Parent material--loess or silty lacustrine and in the underlying dense sandy loam till of Late Wisconsinan Age
Landform--ground moraines, disintegration moraines, and end moraines
Slope--1 to 45 percent
Elevation--800 to 1950 feet
Mean annual air temperature--39 to 45 degrees F
Mean annual precipitation--28 to 33 inches
Frost-free period--120 to 135 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Amery, Freeon, Haugen, Magnor, Newood, Newot, Otterholt, and Spencer soils.
The moderately well drained Freeon and somewhat poorly drained Magnor soils are in a drainage sequence with Santiago soils. They are on slightly lower or less sloping landscape positions.
The well drained Amery and Newot soils are on similar landscape positions and the moderately well drained Haugen and Newood soils are on less sloping landscape positions to those of Santiago soils where the silty mantle is less than 12 inches thick, or is absent.
The well drained Otterholt soils and moderately well drained Spencer soils are on landscape positions similar to those of Santiago soils where the silty mantle is more than 36 inches thick.

DRAINAGE AND PERMEABILITY: Well drained. Surface runoff is medium to very high. Permeability is moderate in the silty mantle, slow or moderately slow in the lower solum, and very slow in the substratum.

USE AND VEGETATION: Many areas of this soil are used for cropland. Corn, small grains, and hay are common crops. Some areas remain in woodland. Native vegetation is mixed hardwood forest with a few conifers. Common trees are sugar maple, American basswood, northern red oak, white ash, American elm, and quaking aspen with some white pine and red pine.

DISTRIBUTION AND EXTENT: Northwestern Wisconsin and east-central Minnesota. LRR K, MLRA 90A and MLRA 90B. This soil is extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Mille Lacs County, Minnesota, 1927. Type location moved to Barron County, Wisconsin with the correlation of the soil survey in 1992.

REMARKS:
Particle size control section - the zone from 15 to 35 inches

Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - the zone from 0 to 15 inches (Ap, E/B);
Albic horizon - the zone from 10 to 15 inches (E part of the E/B);
Glossic horizon - the zone from 10 to 23 inches (E/B, B/E);
Argillic horizon - the zone from 15 to 49 inches (B/E, 2Bt1, 2Bt2);
Densic contact - the contact with dense till (2BCd1, 2BCd2, 2Cd) at 49 inches;
Lithologic discontinuity - at the upper boundary of the 2Bt1 horizon at 23 inches.

The bulk density and platyness of the argillic horizon is considered to be relict of the till, but studies are needed to determine whether or not these horizons meet criteria for fragipans or fragic soil properties.

The 2BCd1 and 2BCd2 horizons were originally described as 2Bt horizons, but were redesignated because they are transitional to the substratum and exhibit densic characteristics.

ADDITIONAL DATA: Former Soil Interpretation Records - WI0137 and WI0346. Refer to soil survey sample number S90WI-005-008 for NSSL data on the typical pedon.

National Cooperative Soil Survey
U.S.A.

LOCATION BURKHARDT WI+IA IL MN

Established Series
Rev. PHC-HFG-TWN
10/2008

BURKHARDT SERIES

The Burkhardt series consists of very deep, somewhat excessively drained soils formed in 25 to 50 centimeters of loamy alluvium and in the underlying sandy outwash. These soils are on outwash plains, outwash terraces, valley trains and on treads and risers on stream terraces in river valleys. Slope ranges from 0 to 30 percent. Mean annual air temperature is about 8 degrees C. Mean annual precipitation is about 840 millimeters.

TAXONOMIC CLASS: Sandy, mixed, mesic Typic Hapludolls

TYPICAL PEDON: Burkhardt sandy loam, on a 1 percent slope, in a cultivated field, at an elevation of about 242 meters above sea level. (Colors are for moist soil unless otherwise stated.)

Ap--0 to 25 centimeters; very dark brown (10YR 2/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; many fine fibrous roots; slightly acid; abrupt smooth boundary. (17 to 26 centimeters thick)

Bt--25 to 43 centimeters; dark brown (7.5YR 3/2) sandy loam; moderate fine subangular blocky structure; friable; few faint clay films on faces of peds and clay bridges between sand grains; few fine fibrous roots; moderately acid; clear smooth boundary. (9 to 35 centimeters thick)

2BC--43 to 48 centimeters; brown (7.5YR 4/4) loamy sand; weak medium subangular blocky structure; very friable; dark-colored stains from organic matter on the faces of some peds; about 12 percent gravel; moderately acid; clear smooth boundary. (0 to 25 centimeters thick)

2C1--48 to 74 centimeters; strong brown (7.5YR 5/6) and brown (7.5YR 4/4) stratified sand and gravelly coarse sand; single grain; loose; about 20 percent gravel; moderately acid; gradual smooth boundary.

2C2--74 to 152 centimeters; strong brown (7.5YR 5/6) stratified sand and gravelly coarse sand; single grain; loose; about 25 percent gravel; moderately acid.

TYPE LOCATION: Major Land Resource Area (MLRA) 104-Eastern Iowa and Minnesota Till Prairies, Pepin County, Wisconsin subset; about 1/2 mile south of Arkansas; located about 300 feet east and 100 feet north of the southwest corner of section 24, T. 25 N., R. 14 W.; USGS Arkansaw topographic quadrangle; lat. 44 degrees 37 minutes 34 seconds N. and long. 92 degrees 01 minute 58 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Thickness of the mollic epipedon--17 to 49 centimeters
Depth to sandy outwash--25 to 50 centimeters
Depth to carbonates--more than 100 centimeters

Clay content in the particle-size control section (weighted average)--5 to 15 percent
Sand content in the particle-size control section (weighted average)--75 to 95 percent

A or Ap horizon:
Hue--7.5YR or 10YR
Value--2 or 3
Chroma--1 to 3
Texture--sandy loam, loam, gravelly sandy loam, or gravelly loam
Clay content--5 to 22 percent
Sand content--45 to 70 percent
Rock fragment content--0 to 35 percent, gravel and 0 to 5 percent, cobbles
Reaction--strongly acid to neutral

AB horizon (when present):
Hue--7.5YR or 10YR
Value--3 or 4
Chroma--2 or 3
Texture--sandy loam, loam, gravelly sandy loam, or gravelly loam
Clay content--5 to 22 percent
Sand content--45 to 70 percent
Rock fragment content--0 to 35 percent, gravel and 0 to 5 percent, cobbles
Reaction--strongly acid to neutral

Bt or Bw horizon:
Hue--7.5YR or 10YR
Value--3 or 4
Chroma--2 to 4
Texture--sandy loam, loam, gravelly sandy loam, or gravelly loam
Clay content--5 to 18 percent
Sand content--35 to 95 percent
Rock fragment content--0 to 35 percent, gravel and 0 to 5 percent, cobbles
Reaction--strongly acid to neutral

The Bt horizon does not meet the requirements for an argillic horizon

2Bt and 2BC horizon (when present):
Hue--7.5YR or 10YR
Value--3 or 4
Chroma--4 to 6
Texture--sand, coarse sand, loamy sand, loamy coarse sand, the gravelly or very gravelly analogs of these textures, or is stratified with these textures
Clay content--2 to 15 percent
Sand content--75 to 95 percent
Rock fragment content--5 to 35 percent, gravel and 0 to 5 percent, cobbles, some individual strata have 1 to 60 percent gravel
Reaction--strongly acid to neutral

2C horizon:
Hue--7.5YR or 10YR
Value--4 to 6
Chroma--4 to 6

Texture--stratified sand, coarse sand, gravelly sand, gravelly coarse sand, very gravelly sand, or very gravelly coarse sand
Clay content--0 to 10 percent
Sand content--75 to 100 percent
Rock fragment content--5 to 35 percent, gravel and 0 to 5 percent, cobbles, some individual strata have 1 to 60 percent gravel
Reaction--moderately acid to slightly acid

In MLRA 104 and the western part of MLRA 105, the reaction is slightly acid to slightly alkaline with small amounts of calcium carbonate in the sandy outwash

COMPETING SERIES: These are the Buckney, Dickman, Estherville, Mishawaka, Pilot Grove, and Round lake series.
Buckney--do not have rock fragments in the series control section
Dickman--have a rock fragment content of less than 15 percent in the series control section
Estherville--have carbonates within a depth of 100 centimeters
Mishawaka--have a rock fragment content of less than 15 percent in the lower third of the series control section
Pilot Grove--have a sand content of less than 75 percent in the lower third of the series control section
Round lake--have a sand content of less than 75 percent in the lower third of the series control section and have a frequently saturated zone within a depth of 1.8 meters during the wettest periods of normal years

GEOGRAPHIC SETTING:
Parent material--25 to 50 centimeters of loamy alluvium and in the underlying sandy outwash
Landform--outwash plains, outwash terraces, valley trains and on treads and risers on stream terraces in river valleys
Slope--0 to 30 percent
Elevation--130 to 595 meters above mean sea level
Mean annual air temperature--3 to 13 degrees C
Mean annual precipitation--660 to 1,015 millimeters
Frost-free period--110 to 215 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dakota, Finchford, Plainfield, and Rasset soils.
Dakota--are on landscape positions similar to those of Burkhardt soils and have a clay content that averages more than 18 percent in the upper half of the particle-size control section
Finchford--are on landscape positions similar to those of Burkhardt soils and do not have a cambic horizon
Plainfield--are on similar landscape positions or are on terrace risers and do not have a mollic epipedon
Rasset--are on landscape positions similar to those of Burkhardt soils and have an argillic horizon

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage class--somewhat excessively drained--a frequently saturated zone does not occur within a depth of 1.8 meters during the wettest periods of years when precipitation is within one standard deviation of the 30 year mean of annual precipitation
Saturated hydraulic conductivity--1.00 to 100.00 micrometers per second in the loamy alluvium and 10.00 to 705.00 micrometers per second in the sandy outwash
Flooding--rarely or very rarely flooded for very brief or brief duration on stream terrace positions with slopes of less than 9 percent

USE AND VEGETATION:
Most areas are cultivated. The principal crops are corn, soybeans, small grain, and hay. Some areas are irrigated. The native vegetation is big bluestem, little bluestem, switchgrass, other grasses of the tall grass prairie or a combination of prairie grasses and bur oaks.

DISTRIBUTION AND EXTENT:
Physiographic Division--Interior Plains
Physiographic Province--Central Lowland
Physiographic sections--Western lake section, Dissected till plains, Wisconsin driftless section, and Till plains
MLRAs--Wisconsin and Minnesota Thin Loess and Till (90),
Eastern Iowa and Minnesota Till Prairies (104),
Northern Mississippi Valley Loess Hills (105),
Illinois and Iowa Deep Loess and Drift (108), and
Central Mississippi Valley Wooded Slopes, Northern Part (115C)
LRR M; West-central Wisconsin, central and eastern Minnesota, northwestern Illinois, and northeastern Iowa
Extent--moderate

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Washington County, Minnesota, 1941.

REMARKS:
Particle-size control section--the zone from a depth of 25 to 100 centimeters;
series control section--the zone from the surface to a depth of 150 centimeters.

Diagnostic horizons and features recognized in this pedon include:
mollic epipedon--the zone from the surface of the soil to a depth of 25 centimeters (Ap horizon);
cambic horizon--the zone from a depth of 25 to 43 centimeters (Bt horizon);
udic moisture regime.

Lab data indicates that Burkhardt soils have base saturation of 50 percent or more (by NH4OAc) in all horizons between the mineral soil surface and a depth of 180 cm. However, it is suspected that the very low CEC in the sandy outwash results in drastic changes in base saturation with the addition of a few bases from fertilization. These soils may be Inceptisols in their natural state.

Taxonomy version--Keys to Soil Taxonomy, tenth edition, 2006.

ADDITIONAL DATA:
Laboratory data--National Soil Survey Laboratory, Lincoln, Nebraska - 5 pedons
(http://ssldata.nrcs.usda.gov/).

National Cooperative Soil Survey
U.S.A.

LOCATION MAHTOMEDI MN+MI WI

Established Series
KRV-ELB-ROP
12/2010

MAHTOMEDI SERIES

The Mahtomedi series consists of very deep, excessively drained, rapidly permeable soils formed in sandy outwash of Late Wisconsinan Age on glacial moraines and outwash plains. These upland soils have slopes ranging from 0 to 45 percent. Mean annual temperature is about 41 degrees F. Mean annual precipitation is about 28 inches.

TAXONOMIC CLASS: Mixed, frigid Typic Udipsamments

TYPICAL PEDON: Mahtomedi loamy sand with a 13 percent convex southwest-facing slope on a glacial outwash plain under oak forest. (Colors are for moist soil unless otherwise stated.)

A--0 to 5 inches; very dark gray (10YR 3/1) loamy sand, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; very friable; about 5 percent gravel; moderately acid; abrupt smooth boundary. (0 to 7 inches thick)

E--5 to 8 inches; brown (7.5YR 5/2) sand; single grain; loose; about 10 percent gravel; strongly acid; clear smooth boundary. (0 to 13 inches thick)

Bw1--8 to 15 inches; brown (7.5YR 4/4) gravelly coarse sand; single grained; loose; about 25 percent gravel and 10 percent cobbles; strongly acid; clear smooth boundary.

Bw2--15 to 30 inches; reddish brown (5YR 4/4) gravelly sand; single grain; loose; about 18 percent gravel and 2 percent cobbles; strongly acid; gradual smooth boundary. (Combined thickness of the Bw horizons is 4 to 30 inches.)

C1--30 to 44 inches; reddish brown (5YR 5/4) gravelly sand; single grain; loose; about 25 percent gravel and 1 percent cobbles; strongly acid; gradual smooth boundary.

C2--44 to 60 inches; light reddish brown (5YR 6/3) gravelly sand; single grain; loose; about 15 percent gravel and 1 percent cobbles; moderately acid.

TYPE LOCATION: Washington County, Minnesota; about 1 1/2 miles northwest of Mahtomedi; 2240 feet south and 100 feet east of the northwest corner, sec. 16, T. 30 N., R. 21 W.

RANGE IN CHARACTERISTICS: Free carbonates typically are absent to depths of 10 feet or more, but a small amount are in the C horizon of some pedons. Content of rock fragments in the control section averages between 10 and 35 percent by volume but subhorizons in some pedons have less than 10 percent or more than 35 percent. They are mostly of igneous origin and commonly 0.2 to 5 cm in diameter but ranges to 2 percent cobbles in the A horizon and 10 percent in the B and C horizons. The texture of the fine-earth fraction in the control section is sand or coarse sand. Mottles are below a depth of 30 inches in some pedons.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 1 to 3. The A and E horizons are coarse sand, sand, loamy coarse sand, loamy sand, fine sand, loamy fine sand, coarse sandy loam, sandy loam or fine sandy loam, or their gravelly analogues. It is strongly acid to slightly acid. Cultivated pedons have an Ap horizon with hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 1 to 3. Some pedons have a thin O horizon.

The Bw horizon has hue of 10YR to 5YR, value of 3 to 5, and chroma of 3 to 6. It is coarse sand, sand, or their gravelly analogues, but has finer textured subhorizons in some pedons. It is strongly acid to slightly acid. Some pedons have a thin BE or BC horizon.

The C horizon commonly has hue of 7.5YR to 5YR (rarely 10YR), value of 4 to 6 and chroma of 3 to 6. It is coarse sand, sand, or their gravelly, very gravelly, or cobbly analogues, but has finer or coarser textured subhorizons in some pedons. It is strongly acid to slightly alkaline.

COMPETING SERIES: These are Champlain, Claire, Corliss, Friendship, Grayling, Menahga, Nymore, Omega, Pelkie, Plainbo, Sartell, Serden, Shawano, and Sunday series. Champlain, Claire, Friendship, Grayling, Menahga, Nymore, Omega, Pelkie, Plainbo, Sartell, Serden, Shawano, and Sunday soils have 10 percent or less rock fragments in the series control section. Corliss soils have a free calcium carbonate within 40 inches.

GEOGRAPHIC SETTING: These soils have plane or convex slopes on glacial moraines and outwash plains. Slope gradients range from 0 to 45 percent. These soils formed in sandy glacial outwash of Late Wisconsinan Age. Mean annual temperature ranges from 36 to 45 degrees F. Mean annual precipitation ranges from about 22 to 33 inches. Frost-free days range from 88 to 142. Elevation above sea level ranges from 670 to 1600 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: Mahtomedi soils are in association with well drained Antigo, Chetek, Onamia, and Rosholt soils. All of those soils formed in a mantle of loamy or silty sediments and underlying sandy or sandy-skeletal glacial outwash. Also, they are associated with Emmert soils which contain more than 35 percent rock fragments in the control section. They are associated in some places with Kingsley and Milaca soils which formed in glacial till.

DRAINAGE AND PERMEABILITY: Excessively drained. Surface runoff is slow or medium. Permeability is rapid. The apparent water table is at 2.5 to 6 feet for the moderately well drained phase (now Lenroot).

USE AND VEGETATION: Mostly in forest and some is pastured. Native vegetation was mixed hardwood-coniferous forest.

DISTRIBUTION AND EXTENT: Central and northern Minnesota and possibly northern Wisconsin. This series is inextensive.

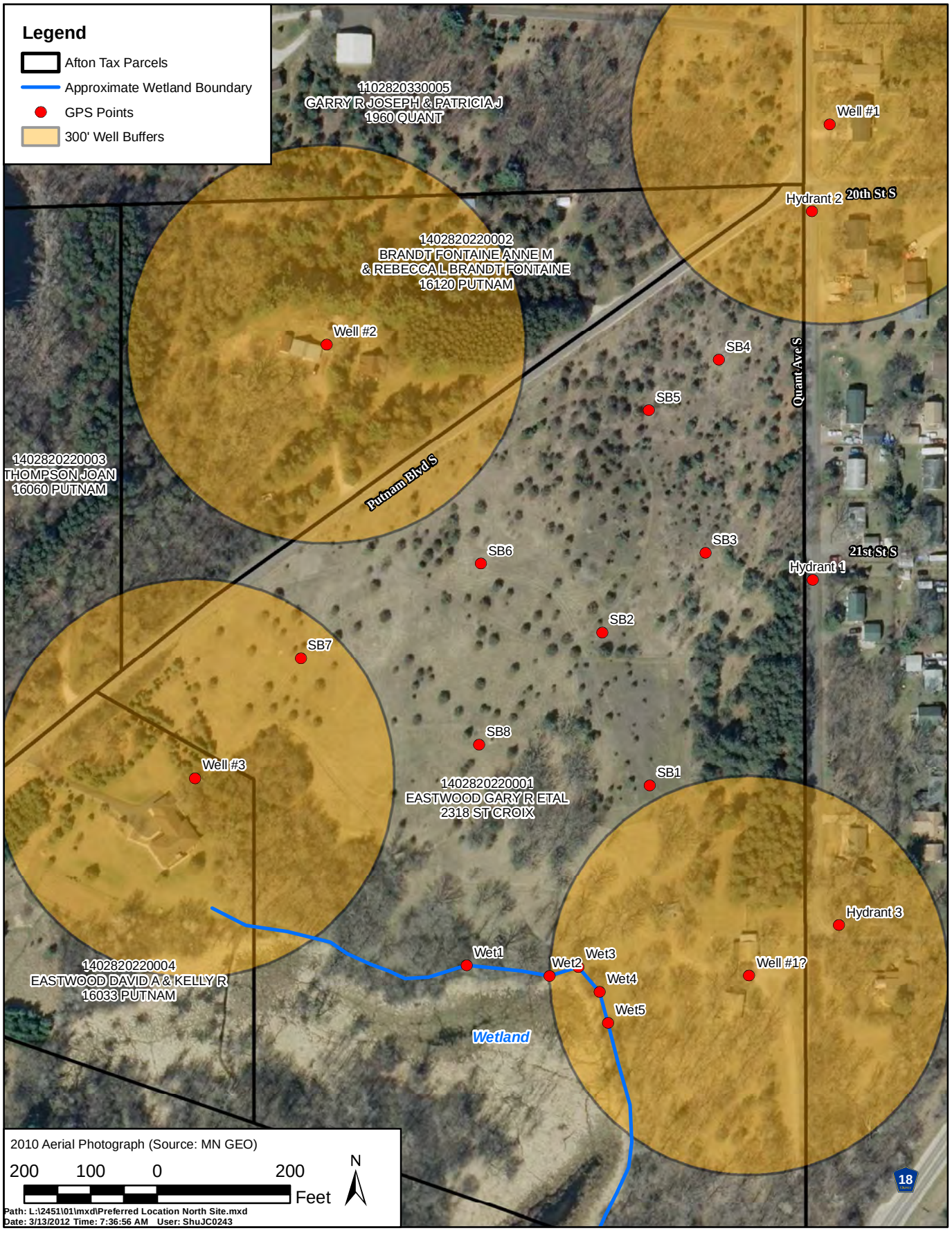
MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: St. Paul, Minnesota

SERIES ESTABLISHED: Washington and Ramsey Counties, Minnesota, 1978.

REMARKS: Diagnostic horizon and feature identified in this soil is: ochric epipedon - the zone from the surface to 8 inches (A and E horizons); udic moisture regime. The moderately well drained Mohtomedi is now the Lenroot series.

ADDITIONAL DATA: Refer to MN Agr. Exp. Sta. Central File Code No.'s 2006, the typical pedon and 2008, an additional pedon, for results of some laboratory analyses.

National Cooperative Soil Survey
U.S.A.



CITY OF AFTON

Preferred Treatment and Dispersal Location-North Site

Engineers - Scientists
Business Professionals
www.wenck.com

Wenck
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

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"

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"

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"

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"

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"

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"

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"

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"

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"

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"

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"

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

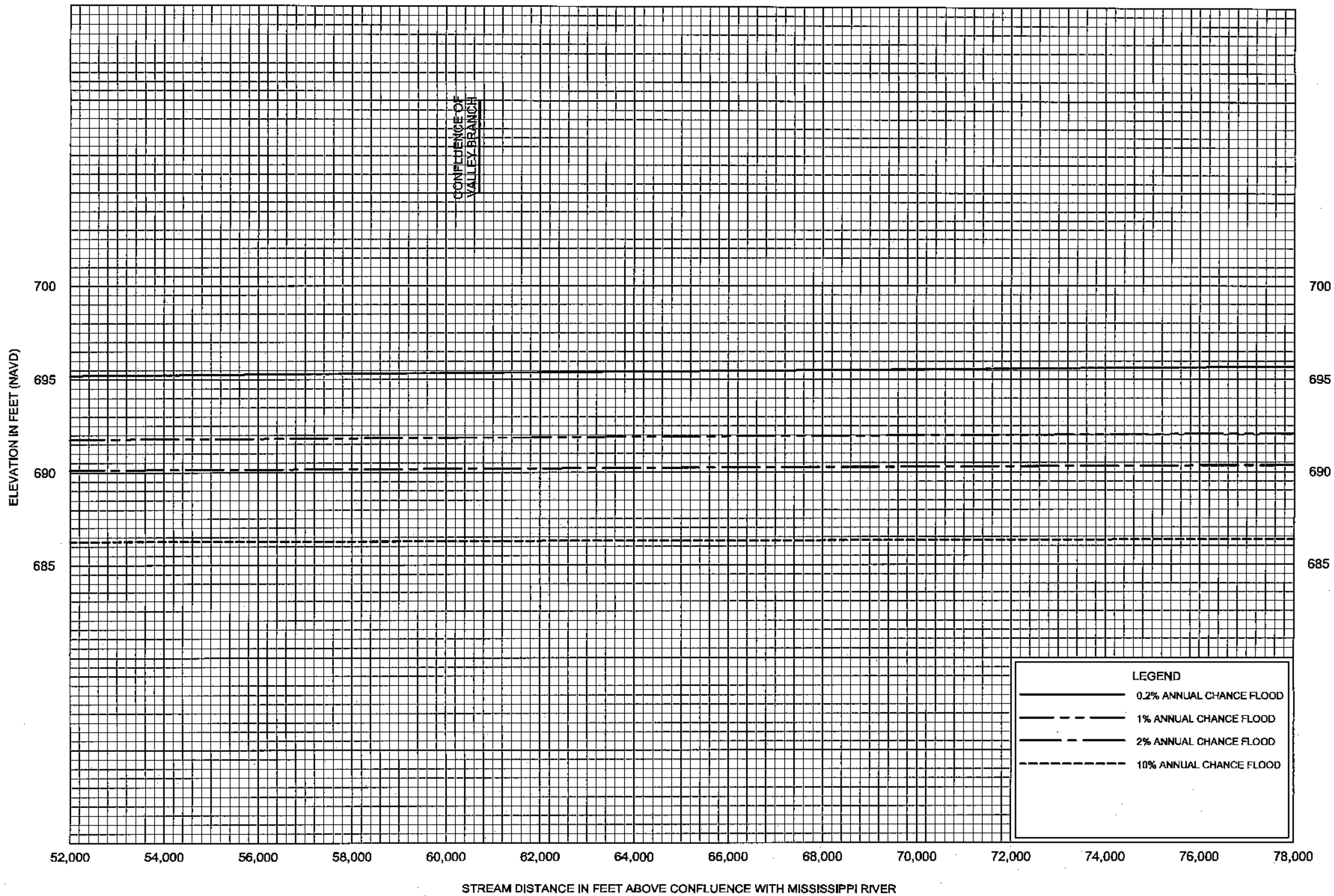
HOR #	DEPTH (in)	MATRIX COLOR	TEXTURE	STRUCTURE	REDOXIMORPHIC FEATURES	MAXIMUM LOADING RATES (gpd/ft^2)	
						W/O APT	W/APT
1	0 – 18	10YR 3/3	Silt loam	----	----	0.5	0.8
2	18 – 34	10YR 4/6	Silt loam	----	----	0.5	0.8
3	34 – 40	10YR 5/6	Sandy clay loam; 5% coarse fragments	----	----	0.45	0.6
ROCKS CEASED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

COMMENTS: South site

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

Appendix C

Floodplain Elevation Data



FLOOD PROFILES

ST. CROIX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, MN

AND INCORPORATED AREAS

25P

Appendix D

Wastewater Flow and Loadings Estimates

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? 77 (including vacant parcels)

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

Step 1 Number of dwellings 77 dwellings

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

Step 2b Flow Determination for New Dwellings, Section 2 Part B 18,544 gpd (existing & vacant parcels)

Step 2c Flow per "other" establishments, Section 2 Part C 28,349 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 = 46,893 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) 50,893 gpd

Design Wastewater Flow with Vacant Parcels

Afton, MN

2/25/2013

		US Census Data (2010 Housing Characteristics in Afton)			
# Bedrooms:		2	3	4	5
		12.30%	47.80%	32.90%	6.90%
Housing units in Afton:	1,100				
Housing units in Study Area WITH VACANT:	77	10	37	24	6
Class I Dwellings:		5	19	12	6
Class II Dwellings:		5	18	12	

MPCA Code Flow - Residential

# Bedrooms	Classification	# Dwellings	Flow	Reduction Factor	Design Flow
5	I	6	750	1	4,500
4	I	4	600	1	2,400
4	I	8	600	0.45	2,160
4	II	12	375	0.45	2,025
3	I	19	450	0.45	3,848
3	II	18	300	0.45	2,430
2	I	5	300	0.45	675
2	II	5	225	0.45	506
	Total:	77			
				Total Residential Flow (gpd):	18,544

MPCA Code Flow - Commercial

Connection	Structure Unit	Units	Building Use	WW flow Unit	Employees	WW flow/emp	Total Flow
43	45	Seats	Restaurant	30	6	18	1,458
40	2,800	SF	Bank	0.18	6	18	612
94	1,400	SF	Commercial	0.15	1	15	964
46	4,800	SF	Bank	0.18	6	18	972
51	1,600	SF	Retail	0.13	1	15	223
44	3,750	SF	Retail	0.13	2	15	518
56	1,350	SF	Retail	0.13	1	15	191
50	50	Guests	Hotel	55	10	18	2,930
50	50	Seats	Restaurant	30	6	18	1,608
50	120	Seats	Restaurant	30	6	18	3,708
50	40	Seats	Bar	36	6	18	1,548
63	3,630	SF	Retail	0.13	2	15	502
27	3,425	SF	Retail	0.13	2	15	475
12	1,600	SF	Retail	0.13	1	15	223
20	100	Seats	Restaurant	30	6	18	3,108
53	550	Seats	Church	4	4	15	2,260
18	2,100	SF	Retail	0.13	1	15	288
2, 2	11,600	SF	Office/Shop	0.18	6	15	2,178
2	8,860	SF	Retail	0.13	3	15	1,197
65	4	Rooms	Day Spa	285	3	18	1,194
54	1,400, 3 BRs	SF, Res	Retail, Res	0.13	4	15	692
58	Vacant		Zoned Commercial			Assumption:	500
61	Vacant		Zoned Commercial			Assumption:	500
62	Vacant		Zoned Commercial			Assumption:	500
					Total Commercial Flow (gpd):		28,349

Est. Commercial Loadings with Vacant Parcels - RAW Wastewater — Afton, MN — 2/8/2013 — EMB

Restaurant/Bar

Restaurant Stength (750 mg/L BOD, 500 mg/L TSS, 50 mg/L NH3, 25 mg/L P)

Estimated Design Peak Flow	11,430
lbs/day BOD	71.5
lbs/day TSS	47.7
lbs/day NH3	4.8
lbs/day P	2.4

Office/Bank

Assume Typical Residential Strength

Estimated Flow	4726 gpd
lbs/day BOD	8.7
lbs/day TSS	8.7
lbs/day NH3	1.0
lbs/day P	0.3

Retail Store

Assume Typical RAW residential strength

Estimated Flow	5809
lbs/day BOD	10.7
lbs/day TSS	10.7
lbs/day NH3	1.2
lbs/day P	0.4

Hotel

Hotel Stength (750 mg/L BOD, 500 mg/L TSS, 50 mg/L NH3, 25 mg/L P)

Estimated Flow	2930
lbs/day BOD	18.3
lbs/day TSS	12.2
lbs/day NH3	1.2
lbs/day P	0.6

Church

Assume typical RAW residential strength

Estimated Flow	2,260
lbs/day BOD	4.1
lbs/day TSS	4.1
lbs/day NH3	0.5
lbs/day P	0.2

Day Spa

Assume Typical Residential Strength

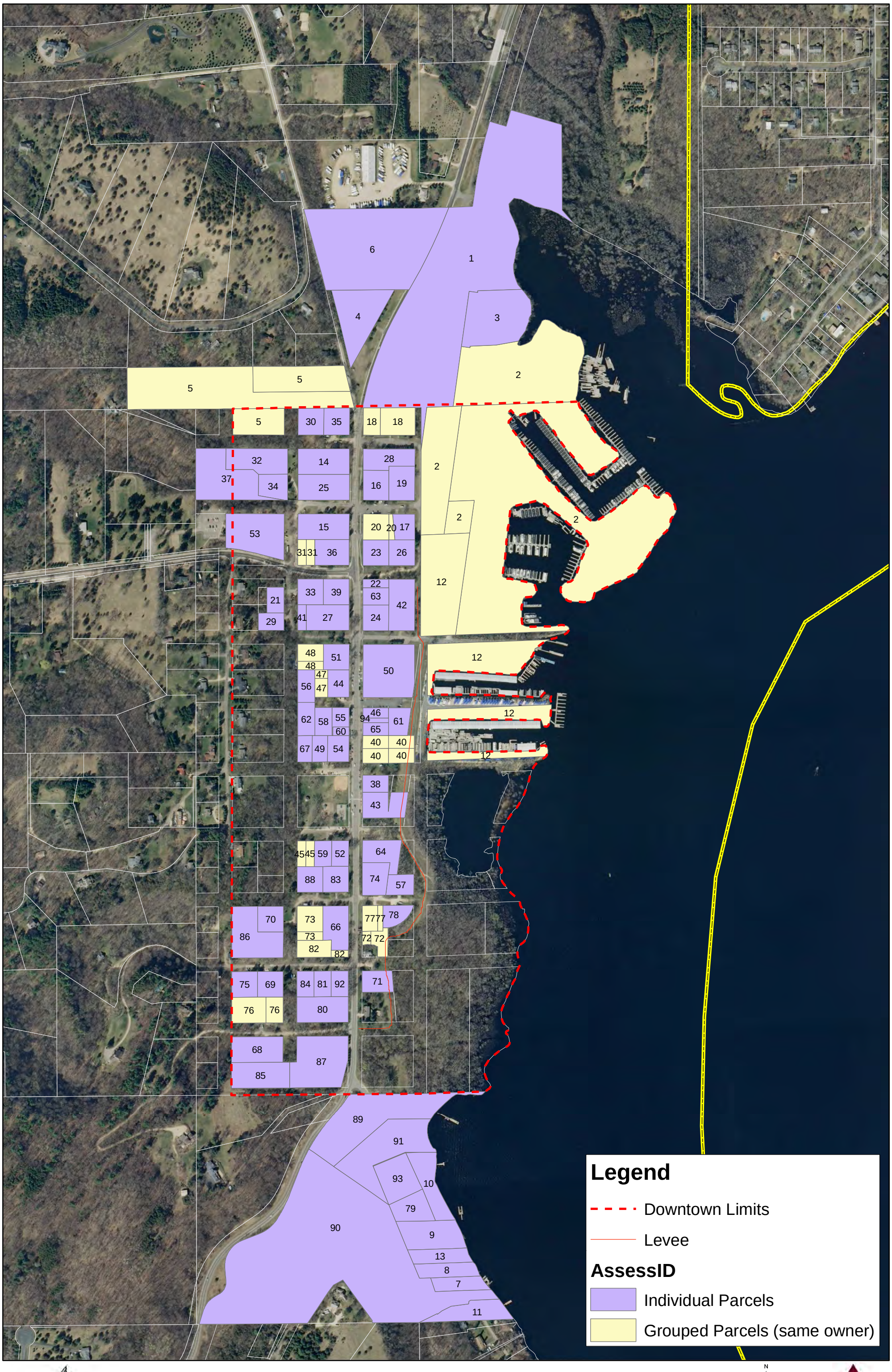
Estimated Flow	1194
lbs/day BOD	2.2
lbs/day TSS	2.2
lbs/day NH3	0.2
lbs/day P	0.1

Per Metcalf & Eddy (medium)

Parameter	Typical Raw Value (mg/L)
BOD	220
TSS	220
NH3	25
P	8

Flow Chec 28,349

TOTAL COMMERCIAL FLOW BOD	**115.4**	**lb**
TOTAL COMMERCIAL FLOW TSS	**85.5**	**lb**
TOTAL COMMERCIAL FLOW NH3	**8.9**	**lb**
TOTAL COMMERCIAL FLOW NH4	**3.9**	**lb**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Legend
Downtown Limits
Levee
AssessID
Individual Parcels
Grouped Parcels (same owner)
City of Afton
Afton Assessment Map
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650
1,300
Feet
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WSB
& Associates, Inc.

City of Afton - Estimated Flow & Loadings with Vacant Parcels

2/8/2013
EMB
2656-03

Average linear feet of gravity sewer (mile)	2.50		
Average gravity sewer diameter (inch)	8	Revisions:	2/13/2013
# Households	77		2/19/2013

FLOW

Population (including growth)	**206**	2.67 persons per household (2010 US Census)
Residential Flow, gpd	18,544	
Commercial Flow, gpd	28,349	
Subtotal (gpd)	46,893	
Inflow/Infiltration Allowance (200 gpd/in. dia./mi), (gpd)	4,000	
Total ADWWF (ADBF + I/I), gpd	50,893	

LOADINGS	Domestic	Commercial	Total
BOD @ 0.18 lb/cap/day , lb/day	37.0	115.4	152.4
TSS @ 0.20 lb/cap/day, lb/day	41.1	85.5	126.6
NH3 @ 0.007 lb/cap/day, lb/day	1.4	8.9	10.3
P @ 0.008 lb/cap/day, lb/day	1.6	3.9	5.5

Appendix E

Cost Estimates

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	Drawdown Year 2	Drawdown Year 3	Drawdown 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	Replacement Second	Replacement Third	Replacement Fourth	Replacement 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 Denitrification Filter

Feb-13 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	76,500	GAL	1.50	114,750.00		31,422	83,328
2	Equalization tank	50	25,000	GAL	1.50	37,500.00		10,269	27,231
3	ATU precast concrete tank	50	12	EA	15,000.00	180,000.00		49,290	130,710
4	Blower pad	50	11	EA	200.00	2,200.00		602	1,598
5	Dose tank	50	25,000	GAL	1.50	37,500.00		10,269	27,231
6	Aluminum hatches	20	6	EA	750.00	4,500.00		0	4,500
7	4-inch "curb-stop" valves	20	4	LS	1,000.00	4,000.00		0	4,000
8	Underground treatment piping	40	500	LF	15.00	7,500.00		1,711	5,789
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	20	1	LS	10,000.00	10,000.00		0	10,000
14	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
15	Treatment tank protective fencing	20	800	LF	12.50	10,000.00		0	10,000
16	Electrical & control equipment installation	20	1	LS	45,000.00	45,000.00		0	45,000
17	**Supplier quote (see below)**	20	1	LS	468,750.00	468,750.00		0	468,750
	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%)								
18	ATU related component installation	20	1	LS	117,187.50	117,187.50		0	117,188
19	Magnetic flowmeter	20	1	LS	5,000	5,000.00		0	5,000
20	Portable generator	20	1	LS	35,000	35,000.00		0	35,000
	Pressurized Seepage Cells								
21	Distribution piping within cell	40	17,000	LF	5.00	85,000.00		19,396	65,604
22	Distribution rock media	50	1,900	CY	25.00	47,500.00		13,007	34,493
23	Distribution rock media installation	20	1,900	CY	7.50	14,250.00		0	14,250
24	Geotextile fabric	20	6,750	SY	3.00	20,250.00		0	20,250
25	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
26	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
27	Distribution lateral flush box	20	20	EA	500.00	10,000.00		0	10,000
28	Topsoil (strip & reuse)	20	1,500	CY	3.00	4,500.00		0	4,500
29	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
30	Valve vault	50	2	EA	12,500.00	25,000.00		6,846	18,154
31	Electronically actuated valve	20	20	EA	1,500.00	30,000.00		0	30,000
32	Manual valve	20	20	EA	500.00	10,000.00		0	10,000
33	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
34	Seepage cell protective fencing	20	2,000	LF	12.50	25,000.00		0	25,000
	PROJECT SUBTOTAL					**1,543,137.50**			
35	**CONTINGENCY (10%)**	20	1	LS		154,313.75			154,314
	Non-Construction								
36	Design & construction engineering (18%)	20	1	LS	305,541.23	305,541.23			305,541
37	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
38	Wetland delineation	20	1	LS	7,500.00	7,500.00			7,500
39	Hydrogeologic/Mounding investigation	20	1	LS	7,500.00	7,500.00			7,500
40	Legal & administration (2%)	20	1	LS	33,949.03	33,949.03			33,949
41	Land acquisition	20	5	ACRE	0.00	0.00			0
	ANNUAL O, M, & R COSTS								
42	Operator costs	20	1	LS	9,360.00		9,360		127,205
43	Supplies	20	1	LS	3,000.00		3,000		40,771
44	Reporting, analytical, & monitoring	20	1	LS	4,000.00		4,000		54,361
45	Electrical utility	20	1	LS	23,820.00		23,820		323,722
46	Insurance	20	1	LS	750.00		750		10,193
47	MPCA permitting	20	1	LS	1,000.00		1,000		13,590
48	Telephone	20	1	LS	480.00		480		6,523
49	Sludge hauling	20	1	LS	4,000.00		4,000		54,361
50	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
51	Emergency repair & service	20	1	LS	1,000.00		1,000		13,590
52	Short-term equipment replacement	20	1	LS	1,000.00		1,000		13,590
53	Annual preventative maintenance	20	1	LS	1,000.00		1,000		13,590
54	Equipment replacement fund	20	1	LS	16,162.50		16,163		219,654
Total						**2,066,941.50**	68,573	163,806	**2,835,058**

Opinion of Probable Construction Costs - Present Worth Analysis

City of Afton

Washington County, MN

Submerged Attached Growth Bioreactor

Feb-13 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	62,500	GAL	1.50	93,750.00		25,672	68,078
2	SAGB reactor tank #1	50	30,000	GAL	1.50	45,000.00		12,322	32,678
3	SAGB clearwater tank #1	50	18,750	GAL	1.50	28,125.00		7,702	20,423
4	SAGB reactor tank #2	50	4,000	GAL	1.50	6,000.00		1,643	4,357
5	SAGB clearwater pump tank #2	50	31,250	GAL	1.50	46,875.00		12,836	34,039
6	SAGB Plus reactor	20	1	LS	444,000.00	444,000.00		0	444,000
7	SAGB Plus reactor installation	20	1	LS	222,000.00	222,000.00		0	222,000
8	Aluminum hatches	20	6	EA	750.00	4,500.00		0	4,500
9	Underground treatment piping	40	500	LF	15.00	7,500.00		1,711	5,789
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	20	1	LS	10,000.00	10,000.00		0	10,000
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	45,000.00	45,000.00		0	45,000
18	Magnetic flowmeter	20	1	LS	5,000.00	5,000.00		0	5,000
19	Portable generator	20	1	LS	35,000.00	35,000.00		0	35,000
	Pressurized Seepage Cells								
20	Distribution piping within cell	40	17,000	LF	5.00	85,000.00		19,396	65,604
21	Distribution rock media	50	1,900	CY	25.00	47,500.00		13,007	34,493
22	Distribution rock media installation	20	1,900	CY	7.50	14,250.00		0	14,250
23	Geotextile fabric	20	6,750	SY	3.00	20,250.00		0	20,250
24	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
25	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
26	Distribution lateral flush box	20	20	EA	500.00	10,000.00		0	10,000
27	Topsoil (strip & reuse)	20	1,500	CY	3.00	4,500.00		0	4,500
28	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
29	Valve vault	50	2	EA	12,500.00	25,000.00		6,846	18,154
30	Electronically actuated valve	20	20	EA	1,500.00	30,000.00		0	30,000
31	Manual valve	20	20	EA	500.00	10,000.00		0	10,000
32	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
33	Seepage cell protective fencing	20	2,000	LF	12.50	25,000.00		0	25,000
	PROJECT SUBTOTAL					**1,467,000.00**			
34	**CONTINGENCY (10%)**	20	1	LS		146,700.00			146,700
	Non-Construction								
35	Design & construction engineering (18%)	20	1	LS	290,466.00	290,466.00			290,466
36	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
37	Wetland delineation	20	1	LS	7,500.00	7,500.00			7,500
38	Hydrogeologic/Mounding investigation	20	1	LS	7,500.00	7,500.00			7,500
39	Legal & administration (2%)	20	1	LS	32,274.00	32,274.00			32,274
40	Land acquisition	20	5	ACRE	0.00	0.00			0
	ANNUAL O, M, & R COSTS								
41	Operator costs	20	1	LS	15,600.00		15,600		212,009
42	Supplies	20	1	LS	4,100.00		4,100		55,720
43	Reporting, analytical, & monitoring	20	1	LS	4,000.00		4,000		54,361
44	Electrical utility	20	1	LS	10,250.00		10,250		139,301
45	Insurance	20	1	LS	750.00		750		10,193
46	MPCA permitting	20	1	LS	1,000.00		1,000		13,590
47	Telephone	20	1	LS	480.00		480		6,523
48	Sludge hauling	20	1	LS	14,500.00		14,500		197,060
49	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
50	Emergency repair & service	20	1	LS	1,000.00		1,000		13,590
51	Short-term equipment replacement	20	1	LS	1,000.00		1,000		13,590
52	Annual preventative maintenance	20	1	LS	1,000.00		1,000		13,590
53	Equipment replacement fund	20	1	LS	15,420.00		15,420		209,563
Total						**1,966,440.00**	72,100	122,129	**2,824,173**

Opinion of Probable Construction Costs - Present Worth Analysis

City of Afton

Washington County, MN

Recirculating Gravel Filter w/ Anoxic Denitrification Filter

Feb-13 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	153,000	GAL	1.50	229,500.00		62,844	166,656
2	Septic tank effluent screen	50	2	EA	1,000.00	2,000.00		548	1,452
3	Anoxic upflow tank	50	20,000	GAL	1.50	30,000.00		8,215	21,785
4	Anoxic upflow components	20	1	LS	25,000.00	25,000.00		0	25,000
5	Recirculation tank	50	30,000	GAL	1.50	45,000.00		12,322	32,678
6	Recirculation tank pumps	20	2	EA	3,000.00	6,000.00		0	6,000
7	Recirc tank pumps guiderails & discharge piping	20	2	EA	2,500.00	5,000.00		0	5,000
8	Recirc tank floats	20	4	EA	100.00	400.00		0	400
9	Dose tank	50	30,000	GAL	1.50	45,000.00		12,322	32,678
10	Dose tank pumps	20	2	EA	5,000.00	10,000.00		0	10,000
11	Dose tank pumps guiderails & discharge piping	20	2	EA	2,500.00	5,000.00		0	5,000
12	Dose tank floats	20	4	EA	100.00	400.00		0	400
13	Aluminum hatches	20	6	EA	750.00	4,500.00		0	4,500
14	Geomembrane	20	16,800	SF	0.75	12,600.00		0	12,600
15	Geotextile	20	1,900	SY	3.00	5,700.00		0	5,700
16	Filter media	50	1,600	CY	25.00	40,000.00		10,953	29,047
17	Coarse stone	50	315	CY	25.00	7,875.00		2,156	5,719
18	PVC distribution laterals	40	5,200	LF	5.00	26,000.00		5,933	20,067
19	RGF force main	40	1,800	LF	15.00	27,000.00		6,161	20,839
20	4" perforated underdrain	40	1,250	LF	15.00	18,750.00		4,279	14,471
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	5,000.00	5,000.00		1,369	3,631
23	3-way splitter valve	20	1	LS	7,500.00	7,500.00		0	7,500
24	Passive denitrification flow splitter	20	1	LS	2,000.00	2,000.00		0	2,000
25	Shut-off valve	20	4	LS	1,000.00	4,000.00		0	4,000
26	Chemical feed equipment	20	1	LS	7,500.00	7,500.00		0	7,500
27	RGF electronic valves w/actuators	20	12	EA	1,500.00	18,000.00		0	18,000
28	RGF zone manual valves	20	12	EA	500.00	6,000.00		0	6,000
29	RGF lateral zone flushing apparatus	20	12	EA	500.00	6,000.00		0	6,000
30	Control panel	20	1	LS	25,000.00	25,000.00		0	25,000
31	Magnetic flowmeter	20	1	LS	5,000.00	5,000.00		0	5,000
32	RGF earthwork	20	2,000	CY	7.50	15,000.00		0	15,000
33	RGF - berm earthwork	20	400	CY	7.50	3,000.00		0	3,000
34	RGF - aggregate installation	20	1,915	CY	7.50	14,362.50		0	14,363
35	RGF water balance test	20	1	EA	5,000.00	5,000.00		0	5,000
36	Underground treatment piping	40	250	LF	15.00	3,750.00		856	2,894
37	Control building	50	1	EA	50,000.00	50,000.00		13,692	36,308
38	Control building furnishings	20	1	LS	5,000.00	5,000.00		0	5,000
39	Mobilization	20	1	LS	25,000.00	25,000.00		0	25,000
40	Silt Fence	20	2,500	LF	1.50	3,750.00		0	3,750
41	Electrical service	20	1	LS	10,000.00	10,000.00		0	10,000
42	Site restoration	20	3	ACRE	3,000.00	9,000.00		0	9,000
43	Treatment area protective fencing	20	1,000	LF	12.50	12,500.00		0	12,500
44	Electrical & control equipment installation	20	1	LS	45,000.00	45,000.00		0	45,000
45	Portable generator	20	1	LS	35,000.00	35,000.00		0	35,000
	Pressurized Seepage Cells								
46	Distribution piping within cell	40	17,000	LF	5.00	85,000.00		19,396	65,604
47	Distribution rock media	50	1,900	CY	25.00	47,500.00		13,007	34,493
48	Distribution rock media installation	20	1,900	CY	7.50	14,250.00		0	14,250
49	Geotextile fabric	20	6,750	SY	3.00	20,250.00		0	20,250
50	Excavation	20	7,000	CY	7.50	52,500.00		0	52,500
51	Force main	40	3,200	LF	10.00	32,000.00		7,302	24,698
52	Distribution lateral flush box	20	20	EA	500.00	10,000.00		0	10,000
53	Topsoil (strip & reuse)	20	1,500	CY	3.00	4,500.00		0	4,500
54	Clearing & grubbing	20	2.00	ACRE	4,000.00	8,000.00		0	8,000
55	Valve vault	50	2	EA	12,500.00	25,000.00		6,846	18,154
56	Electronically actuated valve	20	20	EA	1,500.00	30,000.00		0	30,000
57	Manual valve	20	20	EA	500.00	10,000.00		0	10,000
58	Gravel access road	20	1	LS	7,500.00	7,500.00		0	7,500
59	Seepage cell protective fencing	20	2,000	LF	12.50	25,000.00		0	25,000

	PROJECT SUBTOTAL					**1,241,462.50**			
60	**CONTINGENCY (10%)**	20	1	LS		124,146.25			124,146
	Non-Construction								
61	Design & construction engineering (18%)	20	1	LS	245,809.58	245,809.58			245,810
62	Survey - treatment area	20	1	LS	15,000.00	15,000.00			15,000
63	Wetland delineation	20	1	LS	7,500.00	7,500.00			7,500
64	Hydrogeologic/Mounding investigation	20	1	LS	7,500.00	7,500.00			7,500
65	Legal & administration (2%)	20	1	LS	27,312.18	27,312.18			27,312
66	Land acquisition	20	5	ACRE	0.00	0.00			0
	ANNUAL O, M, & R COSTS								
67	Operator costs	20	1	LS	9,360.00		9,360		127,205
68	Supplies	20	1	LS	3,000.00		3,000		40,771
69	Reporting, analytical, & monitoring	20	1	LS	4,000.00		4,000		54,361
70	Electrical utility	20	1	LS	6,000.00		6,000		81,542
71	Insurance	20	1	LS	750.00		750		10,193
72	MPCA permitting	20	1	LS	1,000.00		1,000		13,590
73	Telephone	20	1	LS	480.00		480		6,523
74	Sludge hauling	20	1	LS	4,000.00		4,000		54,361
75	Treatment site mowing/snow removal	20	1	LS	3,000.00		3,000		40,771
76	Emergency repair & service	20	1	LS	1,000.00		1,000		13,590
77	Short-term equipment replacement	20	1	LS	1,000.00		1,000		13,590
78	Annual preventative maintenance	20	1	LS	1,000.00		1,000		13,590
79	Equipment replacement fund	20	1	LS	6,954.00		6,954		94,507
Total						**1,668,730.50**	41,544	188,630	**2,044,697**

CITY OF AFTON FACILITY PLAN
SANITARY SEWER REGIONALIZATION COST ESTIMATE
WSB Project No. 01856-325

Item No.		Item Description	Units	Quantity	Unit Price	Total Price
SCHEDULE A - SANITARY SEWER REGIONALIZATION IMPROVEMENTS						
2	2021.501	MOBILIZATION	LUMP SUM	1	$200,000.00	$200,000.00
3	2105.501	GRADING AND COMMON EXCAVATION	LIN FT	33000	$8.00	$264,000.00
4	2105.601	DEWATERING	LUMP SUM	1	$50,000.00	$50,000.00
5	2451.602	GRANULAR FOUNDATION AND/OR BEDDING	TON	3500	$9.00	$31,500.00
6	2503.603	6" PVC PIPE SEWER DESIGN PRESSURE DR 18	LIN FT	33,000	$42.00	$1,386,000.00
7	2503.603	TELEVISE SANITARY SEWER	LIN FT	33,000	$2.00	$66,000.00
8	2506.602	CONNECT TO EXISTING MANHOLE	EACH	2	$4,000.00	$8,000.00
9	2506.603	CONSTRUCT AIR RELEASE MANHOLE	EACH	10	$5,000.00	$50,000.00
10	2506.603	LIFT STATIONS	EACH	3	$165,000.00	$495,000.00
		TOTAL SCHEDULE A - SANITARY SEWER REGIONALIZATION IMPROVEMENTS:				$2,550,500.00
		TOTAL SCHEDULE A - SANITARY SEWER REGIONALIZATION IMPROVEMENTS:				$2,551,000.00
		SUBTOTAL				**$2,551,000.00**
		CONTINGENCIES (10%)				$255,000.00
		TOTAL ESTIMATED CONSTRUCTION COST				**$2,806,000.00**
		ENGINEERING AND ADMINISTRATION (20%)				$561,000.00
		EASEMENT ACQUISITION				$18,480.00
		MET COUNCIL SAC CHARGES				$462,000.00
		TOTAL ESTIMATED PROJECT COST				**$3,847,480.00**

**THIS ESTIMATE IS TO BE ADDED TO THE COLLECTION SYSTEM COST

WASTEWATER - REGIONALIZATOIN

ANALYSIS PARAMETERS

20- YEAR PRESENT WORTH COST SUMMARY

Title	Capital Cost	2012 O&M	Present Worth	Equivalent Annual Cost
INTERCEPTOR SEWER TO REGIONALIZE	$3,847,480	$82,040	$5,264,064	$387,000

ECONOMIC PARAMETERS

Item	Value	Source/Comment
Base Year	2013	Common for all alternatives.
Commence Construction	2013	Default--adjusted for some alternatives, where noted.
Begin Operation	2013	Default--adjusted for some alternatives, where noted.
Planning Period End	2033	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	20	
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 FACILITY PLAN
20-YEAR PRESENT WORTH COST ANALYSIS
INTERCEPTOR SEWER TO REGIONALIZE

CAPITAL COSTS

Type	Item	2013 Cost	Year of Expenditure	Year in Operation	Drawdown Year 1	Drawdown Year 2	Drawdown Year 3	Drawdown Year 4	Escalated Cost	Present Worth	2013 Dollars Cost of Equip.	Pre-Tax Cost
Site Work	Mobilization	$220,000	2013	2013	100%	0%	0%	0%	$220,000	$220,000	$0	$66,000
Site Work	Grading and Common Excavation	$290,200	2013	2013	100%	0%	0%	0%	$290,000	$290,000	$0	$61,000
Site Work	Dewatering	$55,000	2013	2013	100%	0%	0%	0%	$55,000	$55,000	$0	$124,000
Site Work	Granular Foundation and/or Bedding	$34,500	2013	2013	100%	0%	0%	0%	$35,000	$35,000	$0	$228,000
Piping	4" PVC Pipe Sewer Design Pressure DR 18	$1,525,000	2013	2013	100%	0%	0%	0%	$1,525,000	$1,525,000	$0	$191,000
Piping	Televise	$73,000	2013	2013	100%	0%	0%	0%	$73,000	$73,000	$0	$11,000
Piping	Connect to Existing Manhole	$8,800	2013	2013	100%	0%	0%	0%	$9,000	$9,000	$0	$832,000
Piping	Construct Air Release Manholes	$55,000	2013	2013	100%	0%	0%	0%	$55,000	$55,000	$0	$92,000
Equipment	Controls, Control Panel, and SCADA	$165,000	2013	2013	100%	0%	0%	0%	$165,000	$165,000	$165,000	$150,000
Equipment	Submersible Solids Handling Pumps	$110,000	2013	2013	100%	0%	0%	0%	$110,000	$110,000	$110,000	$100,000
Structures	Lift Station Structures	$269,500	2013	2013	100%	0%	0%	0%	$270,000	$270,000	$0	$245,000
	TOTAL CONSTRUCTION COST	$2,806,000							$2,807,000	$2,807,000	$275,000	
	Engineering, Administration, & Legal (20%)	$561,000	2013					n/a	$561,000	$561,000		
	Geographic Adjustment, (0%)	$0	2013					n/a	$0	$0		
	Easement Acquisition Costs	$18,480								$18,480		
	MCES SAC Fees	$462,000								$462,000		**Sales Tax**
	TOTAL PROJECT COST	**$3,847,480**	2013						$3,368,000	$3,848,480	1.0000	

REPLACEMENT COSTS

Type	Item	Useful Life	Replacement First	Second	Third	Fourth	Fifth	Escalated Cost (First)	Present Cost (First)	First	Second	Third	Fourth	Fifth
	All Items Have Useful Lives of 20 Years or Greater													
	TOTAL													

TERMINAL VALUES

Type	Item	Useful Life (Years)	Useful Life at End of Planning Period	Escalated Terminal Value	Present Worth
Site Work	Dewatering	40	20	$0	0
Site Work	Granular Foundation and/or Bedding	40	20	$0	0
Piping	4" PVC Pipe Sewer Design Pressure DR 18	40	20	$0	0
Piping	Televise	40	20	$0	0
Piping	Connect to Existing Manhole	40	20	$0	0
Piping	Construct Air Release Manholes	40	20	$0	0
Equipment	Controls, Control Panel, and SCADA	20	0	$0	0
Equipment	Submersible Solids Handling Pumps	20	0	$0	0
Structures	Lift Station Structures	40	20	($200,000)	(91,000)
	TOTAL			($200,000)	(91,000)

O&M COSTS

Units	Item	Present Annual Cost	Escalated Annual Cost
2013 - 2033 Estimated O&M Costs		**2013**	**2013**	**2033**
520	FTE Labor - Operators	$13,000	$13,000	$23,000
520	FTE Labor - Maintenance	$13,000	$13,000	$23,000
0	MBTU of Natural Gas	$0	$0	$0
39900	KwHrs of Electricity	$3,990	$3,990	$6,000
$ 250,000	maintenance-materials (% of Equipment Cost)	$15,000	$15,000	$27,000
$ 37,050	MCES wastewater treatment charges	$37,050	$37,050	$55,000
	TOTAL	$82,040	$82,040	$134,000

Present Worth
$1,506,584

USPW Factor 13.5903 (USPW refers to uniform stream present worth factor, 4 percent over 20 years, from 2013 to 2033)

LIFE CYCLE COSTS

TOTAL PRESENT WORTH **Present Worth** **5,264,064**
TOTAL EQUIVALENT ANNUAL COST **Equivalent Annual Cost** **387,000**

USPW Factor 13.5903

2013 Base Year
2.00% Inflation Rate - Materials/Supplies/Energy/Construction/Other
3.00% Inflation Rate - Labor
4.00% Discount Rate

2033 Planning Period End
1.25 Replacement Cost Factor (factor to apply to cost before adjusting for inflation)
2013 Commence Construction
2013 Begin Operation

2033 End of life cycle

	Annual O & M	Annual O&M Labor Only
2013	82040.00	26000.00
2014	84501.20	26780.00
2015	87036.24	27583.40
2016	89647.32	28410.90
2017	92336.74	29263.23
2018	95106.85	30141.13
2019	97960.05	31045.36
2020	100898.85	31976.72
2021	103925.82	32936.02
2022	107043.59	33924.10
2023	110254.90	34941.83
2024	113562.55	35990.08
2025	116969.42	37069.78
2026	120478.51	38181.88
2027	124092.86	39327.33
2028	127815.65	40507.15
2029	131650.12	41722.37
2030	135599.62	42974.04
2031	139667.61	44263.26
2032	143857.64	45591.16
2033	148173.37	46958.89
TOTAL	2352618.89	665225.23
		453526.54
O&M PW - 01	1506584.46	453526.54