City of Detroit

Marion County, Oregon

WASTEWATER FEASIBILITY STUDY

September 2014

Project No. 2006-07-11

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City of Detroit
Wastewater Feasibility Study

EXECUTIVE SUMMARY

ES.1 BACKGROUND

Currently, all wastewater generated in the City of Detroit is treated using individual, onlot systems. The lack of a community wastewater infrastructure has contributed to the relatively low rate of development in the area and acted as an impediment to economic growth. Limited available land makes it difficult, if not impossible, to expand or repair existing systems that are not functioning properly. These problems are compounded during the peak tourist season that places excessive strains on wastewater infrastructure (i.e. septic systems) in the area. The lack of a community wastewater system is perhaps the largest obstacle to economic development facing the City of Detroit.

The City lies in the North Santiam Basin, which is governed by Oregon's "Three Basin Rule" (OAR 340-041-0350). This rule prohibits new or increased waste discharges to surface water in the Clackamas, McKenzie (above RM 15) or the North Santiam Rivers. This severely limits the options for wastewater disposal in these area. Additional barriers to developing a community wastewater system include the significant cost of the system as well as physical constraints such as high rainfall and lack of suitable lands.

A community wastewater system is needed in order to sustain the City's commercial and economic vitality. Since developing such a system will require significant investment by the City as well as public support, the City has secured funding from the Oregon Infrastructure Finance Authority to investigate the project's engineering and financial feasibility.

The purpose this of *Feasibility Study* is to assess the viability of developing a community wastewater system for the City of Detroit. This system is needed to address the short and long term economic and environmental challenges that are associated with the lack of a reliable sewerage infrastructure. In order for a new wastewater system to be feasible, it must be able to operate within the regulatory constraints imposed by the Three Basin Rule (OAR 340-041-0350) as well as onsite treatment requirements stipulated by OAR 340 Division 71, without placing too high of a financial burden on the City and its residents.

ES.2 STUDY AREA

The City of Detroit is located in Marion County along scenic Highway 22 adjacent to Detroit Lake, approximately 50 miles east of Salem. The City is home to approximately 205 residents as well as a high influx of tourists and part-time residents. Previous estimates have projected that during the peak of tourist season, the City's population increases by nearly 5 times. The city limits, which also represents the Detroit urban growth boundary (UGB), encompasses approximately 600 acres.

The physical characteristics of the area directly impact the development of a community wastewater systems. A summary of key factors is provided below with further details provided in Section 2.

- Climate: The climate of this area is temperate, characterized by dry summers and wet winters. The area receives an average of 89 inches of precipitation per year, most of which is in the form of rainfall (82%). Typical average summer temperatures range from 52°F to 76°F and average winter temperatures vary from 34°F to 45°F.
- Topography: The study area is located on the western slopes of the Cascade Mountain Range in flooded river valley with steep side slopes ranging in elevation from approximately 1500 to 1800 feet. Most of the slopes in the study area have a gradient of 15% or more.
- Geology: The geologic characteristics of the study are have been influenced significantly by volcanic and glacial processes. Detroit's underlying geology is made up of various kinds of andesitic and basaltic flow rock, and volcanic sedimentary rocks.
- Water Resources: The most significant water resources in the vicinity of Detroit are Detroit Lake and the North Santiam River. There are also a number of small streams and drainages in the vicinity.

ES.3 REGULATORY ENVIRONMENT

Many different regulations are in effect controlling the way sewage may be managed in the study area. These regulations are directed at protecting surface water, groundwater, public health, land use, and the overall environment. Primary regulations and rules governing a wastewater system in the City include:

Three Basin Rule

The North Santiam River basin is one of three watersheds that are regulated by the Three Basin Rule (3-B Rule) (OAR 340-041-0470). The 3-B Rule prohibits new and increased waste discharges to surface waters including wastewater outfalls (except under very limited conditions). Consequently, the only acceptable forms of wastewater disposal for the City of Detroit are subsurface discharge or effluent reuse.

Water Pollution Control Facilities Permit (WPCF)

The Clean Water Act (CWA) as delegated to the State of Oregon and enforced through Oregon Revised Statues (ORS 468B), requires a Water Pollution Control Facilities (WPCF) permit for all discharges of wastes and wastewater onto or beneath the ground surface.

Rules for Onsite Wastewater Systems

Oregon Department of Environmental Quality (DEQ) regulates the construction, alteration, repair, operation, and maintenance of onsite wastewater treatment systems through Oregon Administrative Rules (OAR) Chapter 340, Divisions 71 and 73 as well as some portions of Divisions 45 and 52. The purposes of these rules are to restore and maintain the quality of public waters and to protect the health and general welfare of the public.

Further discussion of the regulatory environment affecting the design and operation of a community wastewater system is provided in Section 3.

ES.4 WASTEWATER FLOWS & LOADING

Preliminary estimates of wastewater flows and loading were develop to establish the sizing criteria for the City's wastewater system. This analysis was completed in Section 4 of this Study. The preliminary estimates developed therein should be updated and modified as part of future pre-design or facilities report.

ES.4.1 Equivalent Dwelling Units

A dwelling unit is defined as one typical single-family residence. Non-residential users (commercial, industrial, public facility, etc.) can be described as an equivalent number of dwelling units (EDUs) based on their water consumption compared to the average consumption of a dwelling unit. Capacity of a system can be defined based on its ability to serve a certain number of EDUs. This enables future checks on system capacity to be made at any time regardless of the growth patterns.

EDUs for multi-family and commercial users were calculated based on the average maximum monthly single-family residential use of 165 gpd. The following table provides an inventory of the City's EDUs based on the type of customer usage. Currently, there are an estimated 494.0 EDUs served by the Detroit water system.

Table 4-1 - Inventory of System EDUs

Type	Accounts	EDUs
Residential		
Single-Family Residential	274	274.0
Multi-Family Residential	35	50.4
Total Residential	**309**	**324.4**
Commercial		
Motel	2	20.5
RV Park	1	3.2
RV Park & Marina	1	21.0
Marina	1	18.4
Gas Station	1	6.8
Market	2	17.9
Restaurants	3	17.5
Offices, Small Stores, Misc.	39	60.4
Total Commercial	**50**	**169.6**
Total System EDUs	**359**	**494.0**

ES.4.2 Wastewater Flows

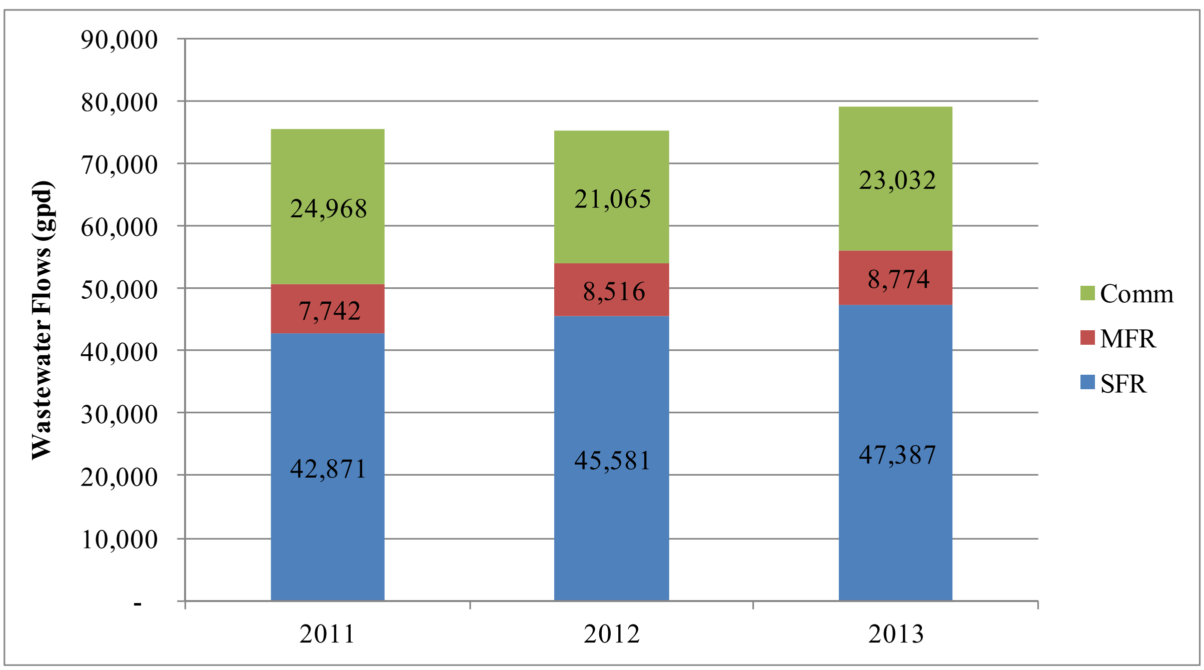
For the purposes of this study, it was assumed that wastewater flows equaled water consumption. Water meter data from January 2011 through December 2013 was used to determine average day flows as well as the daily average during peak month. Wastewater systems' hydraulic capacity are designed based on maximum monthly flows. In the case of Detroit, maximum flows typically occur in July or August. This corresponds to the peak of the area's tourist season.

Table ES-2- Estimated Wastewater Flow Based on Customer Water Usage

Year	Average Daily Flow (gpd)	Maximum Monthly Flow (gpd)
2011	32,339	82,645
2012	30,523	75,162
2013	33,640	79,193
Average	**32,167**	**79,000**

The primary constituents that would be served by a community wastewater system include single-family residential (SFR), multi-family residential (MFR), and commercial (Comm) accounts. The maximum monthly wastewater generated (i.e. water usage) by each of these sectors is shown in Figure ES-1. SRF accounts currently represent 59% of peak usage while MFR and Comm contribute 11% and 30%, respectively.

Figure ES-1 - Flows per Customer Sector



ES.4.3 Wastewater Loading

For the purposes of this Feasibility Plan, the BOD_5 and TSS are the primary constituents of concern when determining loading of the wastewater system. Since there is no available information on organic loading generated by the existing system, typical loading rates have been used. It is strongly recommended that the City begin collecting samples, particularly for commercial users.

Table 4-3 - Estimated Wastewater Loading

User	BOD		TSS	
	mg/L	lbs/day	mg/L	lbs/day
Residential				
Single Family	450	170	525	198
Multi-Family	600	42	630	44
Total Residential		212		242
Commercial				
Office	600	56	630	59
Markets	1,050	38	1,050	38
Marinas	1,050	65	1,050	65
Lodging	1,200	36	1,400	42
Restaurant	2,100	54	1,400	36
Total Commercial		249		240
Total System		**460.62**		**481.99**

ES.5 STUDY FINDINGS & RECOMMENDATIONS

Final recommendations from this Study are presented in Section 6 and includes proposed system design, project phasing, estimated cost and financial impact, land requirements, and schedule. Ultimately, the feasibility of developing a community wastewater system for the City of Detroit will be dependent on its affordability and whether or not sufficient suitable land is available.

ES.5.1 Alternative Analysis & Preliminary System Recommendations

A community wastewater system is composed of three major components: (1) Collection & Conveyance (Sewer) System, (2) Wastewater Treatment System, and (3) Disposal System. There are a number of alternatives for each of these components. These alternative vary in construction cost, operation and maintenance (O&M) needs, performance, land requirements, etc.

A brief analysis of common alternatives was provided in Section 5 of this Study. Based on this analysis, the following preliminary wastewater system design has been recommended. However, final design will ultimately be determined through a *Wastewater Facility Plan*.

Collection System

This Study considered use of a conventional gravity as well as grinder pump and septic tank effluent pump (STEP) systems for collecting and transporting wastewater. The high construction costs and risk of increasing flows due to I/I make a conventional gravity system inadvisable for the City. A grinder pump system may also be a feasible solution but due to the higher energy costs and increased TSS loading it was not part in the preliminary design recommendations. Consequently, a STEP pressure sewer is the recommended option for the City's collection system.

An STEP system is comprised of on-site and off-site components. On-site components of a new STEP pressure system will include an septic/interceptor tanks, grease tanks (for some commercial applications), pump vault with high-head efficient pump, control panel, and service connection. The onsite equipment will convey the wastewater to the off-site pressure system comprised of small-diameter pipelines (2"-4" diameter).

Treatment System

The STEP system will provide preliminary treatment of wastewater which to reduce BOD_5 and TSS by 30-50% and 60-80%, respectively. This treated effluent is pumped through the pressure sewer to a centralized facility final treatment. This study considered use of activated sludge, membrane bioreactor, lagoon, and pack-bed media filter treatment systems. Due to lower costs and land requirements, a series of recirculating media filters is recommended. In addition to the packaged filter, the system will also require instrumentation and controls for operation as well as system telemetry. The facility will also likely require a small building to house some of the components including electrical control panels, supplies, and controls.

Disposal System

Disposal options for treated wastewater effluent are limited due to the prohibition of surface water discharge in the North Santiam River Basin as stipulated by the Three Basin Rule. Consequently, subsurface disposal appears to be the only viable alternative. Although there are a number of subsurface disposal methods, for the purpose of this *Feasibility Study* a drip dispersal system is recommended. The advantages of a drip system include less site disturbance and ability to adapt to irregular shaped lots, however installation costs can be higher compared to other methods and also requires regular O&M. It should also be noted that design (and therefore cost and land requirements) of subsurface disposal is heavily dependent on specific site conditions.

ES.5.2 Project Phasing

Due to the scope of the project, the City may wish to develop a community wastewater system using a phased approach. Developing a wastewater system in phases will allow the City to first address the most critical areas and expand the system as additional need requires and/or financing is available The suggested service areas for project phasing are provided below:

Service Area A All properties west of Hwy 22 and north of Santiam Ave W as well as the commercially-zoned areas located along Breitenbush Rd and Frontage Rd. This area may be further divided into commercial and residential subsections.

Service Area B The remaining portion of the City not located in service area A.

In order to accommodate a phased approach, preliminary hydraulic and organic loading criteria have been established for each service area. In order to reflect this onsite pretreatment, system loading rates were based on septic tank effluent (STE) and not the raw wastewater strength.

Table ES-4 - Preliminary Design Criteria

	Service Area A		Service Area B	Entire City
	Commercial	Residential		
Connections	47	132	180	359
EDUs	163	147	184	494
Average Day Flow (gpd)	9,200	11,000	11,500	31,700
Maximum Monthly Flow (gpd)	31,000	24,000	27,000	82,000
BOD_5 (lbs/day)[1]	45	80	35	160
TSS (lbs/day)[1]	35	25	16	76

[1] Septic tank effluent

ES.5.3 Project Costs

Preliminary construction and O&M costs were estimated for each of the proposed service areas. These costs are intended as an order-of-magnitude cost for preliminary planning purposes and should be updated as additional information and analysis are obtained.

Estimated construction costs are provided in the table below and include costs for collection, treatment, and disposal systems associated with each phase of the project. Each estimate includes a standard 20% construction contingency as well as an additional 20% for engineering and 5% for administrative/legal costs. Tabulated unit costs are based on recently constructed, publicly bid community projects as well as engineering experience.

Table ES-5 - Estimated Construction costs

	Service Area A		Service Area B	Entire City
	Commercial	*Residential*		
Collection System	$ 758,160	$ 1,527,240	$ 2,333,760	$ 4,619,160
Treatment System	$ 840,000	$ 858,000	$ 696,000	$ 2,394,000
Disposal System	$ 276,000	$ 259,500	$ 247,500	$ 783,000
Total Costs	**$ 1,874,160**	**$ 2,644,740**	**$ 3,277,260**	**$ 7,796,160**
Cost per EDU	*$ 11,498*	*$ 17,991*	*$ 17,811*	*$ 16,194*

The phase 1 cost to provide wastewater service to the commercial sector of Service Area A is projected at $1.87 million. An addition $2.6 million is required to extend service to the residential users in this service area. The final phase of construction cost to provide service to the remaining parts of the City (Service Area B) is estimated at $3.28 million. The overall project cost is nearly $7.8 million. Estimated cost per EDU ranges from approximately $11,500 to $18,000.

Although capital costs for construction represent the largest financial requirement for the system, it is also important to consider the operation and maintenance (O&M) costs of the system. O&M costs include routine maintenance, regular inspections, electricity, and replacement costs. Estimated monthly O&M costs are estimated in Table ES-6.

Table ES-6 - Estimated Monthly O&M Costs

	Effluent Sewer System ($/EDU/Month)	Advanced Treatment/Disposal ($/EDU/Month)	Total O&M ($/EDU/Month)
Routine O&M	$5.00	$5.00	$10.00
Repair & Replacement	$3.00	$2.00	$5.00
Administration	$2.50	$2.50	$5.00
Total Estimated O&M	**$10.50**	**$9.50**	**$20.00**

One option for funding the new wastewater system would be through user fees to cover project financing as well as O&M costs. The required fee would be dependent on a number of factors, including payment structure, financial terms, and project phasing. The following provides an estimate of the potential financial impact of a community wastewater system. For the purpose of this analysis, the capital costs of the project have been assumed to be 100% financed through loans. The monthly amount required to service this debt is combined with the estimated O&M costs to determine the average monthly user rate required on an EDU basis. Monthly repayment was calculated using a 3% interest rate for a 20-yr loan.

The estimated monthly cost to service debt repayment as well as cover O&M costs for a community wastewater system is provided in Table ES-7. This amount could be reduced if grant funding was obtained as part of the project funding. Information on potential funding sources, including grants, is provided in Section 7.

Table ES-7 - Estimated Monthly Impact of Wastewater System on Rate Payers

	Service Area A		Service Area B	Entire City
	Commercial	*Residential*		
Monthly Loan Repayment	$ 11,233	$ 15,851	$ 19,642	$ 46,726
Monthly O&M	$ 3,260	$ 2,940	$ 3,680	$ 9,880
Total Monthly Cost	$ 14,493	$ 18,791	$ 23,322	$ 56,606
Monthly Cost per EDU	**$ 88.91**	**$ 127.83**	**$ 126.75**	**$ 114.59**

It should be noted that potential cost savings could be accomplished by reusing existing onlot equipment (e.g. septic tanks) that is in good condition. Future planning/design should develop criteria to use in the evaluation of existing equipment and identify tanks in each respective service area that may remain in use. This would allow development to occur without the risk of having to pay twice for a septic tank.

ES.5.4 Land Requirements

Due to the limited available land, the required sizing for the treatment and disposal systems will have a significant impact on determining the feasibility of the project. Sizing criteria for disposal systems are calculated based on the allowable mass loading rate of the soil, which is site specific and must be approved by Oregon Department of Environmental Quality (DEQ). In addition to the primary treatment field, DEQ typically requires sufficient land to be available for a replacement drainfield.

The following table estimates the amount of land required for siting wastewater treatment and disposal systems. For the purposes of this *Feasibility Study*, the design loading rate for the soil has been assumed to be 0.6 gpd/ft^2. In addition, it is assumed a typical 42ft x 7ft filter bed can treat a flow of approximately 6,500 gpd. However, both of these assumptions may need to be revised as part of a *Wastewater Facilities Plan.*

Table ES-8 - Treatment & Disposal System Size Requirements

	Service Area A		Service Area B	Entire City
	Commercial	***Residential***		
Treatment System (ft^2)	3,500	4,000	3,000	10,500
Primary Disposal System (ft^2)	50,000	75,000	60,000	185,000
Replacement Field (ft^2)	50,000	75,000	60,000	185,000
Total Land Requirements (ft^2)	103,500	154,000	123,000	380,500
Total Land Requirements (acre)	**2.38**	**3.54**	**2.83**	**8.75**

As previously noted, there a relatively few sites that are suitable for siting a community wastewater system in the City. This is due to a combination of physical site constraints (e.g. steep topography), regulatory restrictions, and lack of undeveloped properties. Three potential sites have been identified:

Tax Lot 105E02AD00100110 — The site commonly referred to as the "Old School Property" is located at 110 Patton Road S and contains a total of 2.69 acres. It is situated in the center of Service Area A and is owned by the City. This property has been previously investigated and a site evaluation indicated that soil conditions are favorable for subsurface disposal.

Tax Lot 105E01CB11900 — The 3.05-acre property at 430 Santiam Avenue is currently bank owned, however, the City has shown interests in purchasing the lot. A recent site evaluation performed by DEQ indicated that due to high groundwater at this location, the property is not conducive for developing a drainfield.

Tax Lot 105E0100500	This 40-acre, federally-owned property is located outside the city limits. The site has sufficient land available to meet the land requirements for treatment and disposal systems serving the entire community, however, it is unclear if the City could obtain approval for developing a wastewater system at the site.

Although the Santiam property is not suitable for a drainfield, it is the preferred location to site the treatment portion of the wastewater system. This would allow the treatment system to be developed in a multi-phased approach, but ensure the all components of the treatment system (filters, controls, etc.) could be located at the same site. Treated effluent would then have to be pumped offsite to the drainfield(s).

At this time, the "Old School" property is the only available site to develop a community drainfield. This site could be developed in the first phase of the project to serve the commercial sector in Service Area A. Eventually as the City expands its wastewater system, additional land suitable for developing a subsurface disposal system will need to be obtained.

ES.5.5 Future Planning Needs & Consideration

The level of planning represented by this *Feasibility Study* required a number of assumptions to develop preliminary design criteria and system cost. Subsequent planning efforts should provide a higher level of detail and analysis. In order to provide sufficient data to develop final design and system requirements, the City should collect/obtain the following information:

- The City may wish to conduct a survey of its property owners in order to determine who may be interested in connecting to a community wastewater system. Results of this survey may be used to revise the proposed service area boundaries.
- Assessment of individual septic system to determine most critical as well as identify tanks that maybe retrofitted and reused.
- Collect and analyze effluent samples from large commercial users.
- Determine if any State or Federally owned land in the project vicinity may be used for future expansion of wastewater system.

Implementation of a wastewater system will also require the development of a number of ordinances and programs including sewer use ordinance, engineering standards, system development charge (SDC) methodology, fats, oils and grease (FOG) control program, and ongoing public education.

ES.5.5 Implementation Schedule

The scope of work required to implement a community wastewater system for the City of Detroit is substantial. For this reason, it is important to outline the required task and provide an estimate of the timeframe required. A summary of the anticipated tasks and respective timeframes is provided in the following table. Based on this preliminary schedule, the earliest the first phase of the wastewater system could be expected to be on line is five years.

Table ES-9 - Preliminary Project Schedule

Required Task	Timeframe
Public Education to Secure Community "Buy In"	On-Going
Secure Santiam Property	6 months
Secure Financing for Wastewater Facilities Plan (WWFP) & Environmental Report	1-2 year
Complete WWFP	1.5-3 years
Obtain WPCF Permit	2-3 years
Environmental Review	3-4 years
Develop Ordinances Governing Wastewater System	3-4 years
Secure Financing for Phase 1 Design/Construction	3-4 years
Design/Approval/Construct Phase 1	4-6 years
Obtain Land for Phase 3	5-8 years
Secure Financing for Design/Construction of Remaining Phases	6-8 years
Design/Approval/Construct Phase of Remaining Phases	8-12 years

City of Detroit
Wastewater Feasibility Study

SECTION 1
Introduction

1.1 Background

The City of Detroit is located in Marion County along scenic Highway 22 adjacent to Detroit Lake, approximately 50 miles east of Salem (Figure 1-1). The City is home to approximately 205 residents. In addition to its full-time residents, the City's relatively close proximity to a metropolitan center combined with the variety of recreational opportunities of the surrounding area has led to a high influx of tourists and part-time residents. Previous estimates have projected that during the peak of tourist season, the City's population increases by nearly 5 times.

The community is completely served by individual septic systems. Lack of a community wastewater infrastructure has contributed to the relatively low rate of development in the area and acted as an impediment to economic growth. Limited available land makes it difficult, if not impossible, to expand or repair systems that are not functioning properly. These problems are compounded during peak tourist season which places excessive strains on existing wastewater infrastructure (i.e. septic systems) in the area. The lack of a community wastewater system is perhaps the largest obstacle to economic development facing the City of Detroit.

The City lies in the North Santiam Basin, which is governed by Oregon's "Three Basin Rule" (OAR 340-041-0350). This rule prohibits new or increased waste discharges to surface water in the Clackamas, McKenzie (above RM 15) or the North Santiam Rivers. This severely limits the options for wastewater disposal in the area. Additionally, high rainfall and lack of suitable lands further reduce viable alternatives.

A community wastewater system is needed in order to sustain the City's commercial and economic vitality. Since developing such a system will require significant investment of City resources as well as public support, the City has secured funding from the Oregon Infrastructure Finance Authority to investigate its engineering and financial feasibility.

1.2 Purpose & Need

The purpose this of *Feasibility Study* is to assess the viability of developing a community wastewater system for the City of Detroit. This system is needed to address the short and long term economic and environmental challenges that are associated with the lack of a reliable sewerage infrastructure.

In order for a new wastewater system to be feasible, it must be able to operate within the regulatory constraints imposed by the Three Basin Rule (OAR 340-041-0350) as well as onsite treatment requirements stipulated by OAR 340 Division 71, without placing too high of a financial burden on the City and its residents.

1.3 Previous Studies

A number of previous studies have been conducted in the past related to developing a community wastewater system in Detroit. These studies were reviewed and pertinent information was incorporated into this *Feasibility Study*. Previous studies include the following:

- City of Detroit, Wastewater Feasibility Study by HBH Consulting Engineers, Inc. (May 2009)
- City of Detroit/City of Idanha, Pre-Design Report - Regional Wastewater Treatment Facility & Sewage Collection System Improvements by Curran-McLeod, Inc. Consulting Engineers (December 2001)
- Upper North Santiam River Canyon, Sewage Treatment Feasibility Study by Curran-McLeod, Inc. Consulting Engineers (October 1996).

1.4 Authorization

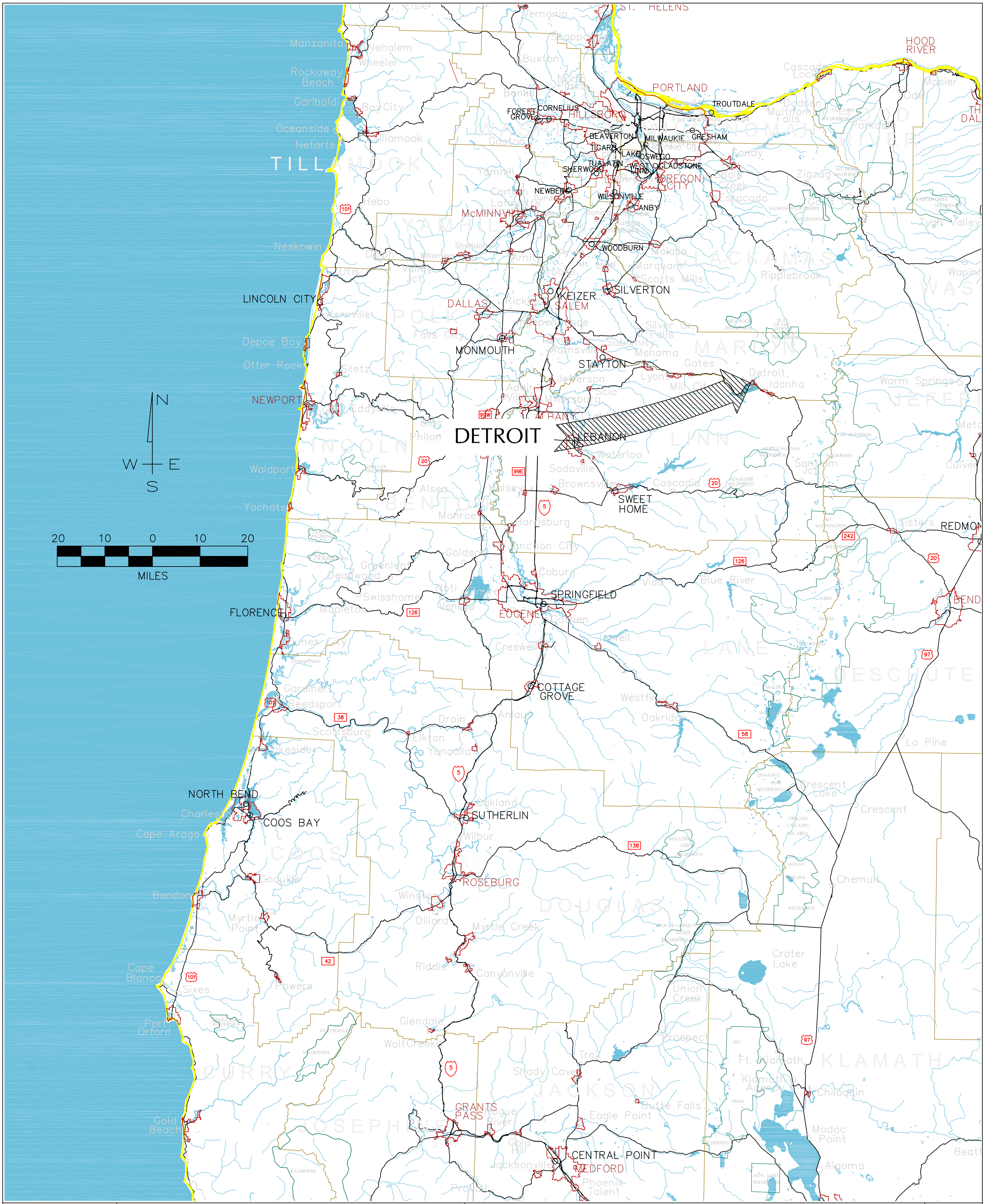
The City of Detroit authorized the firm of HBH CONSULTING ENGINEERS, INC. to develop a Wastewater Feasibility Study by a contract dated December 24, 2013. Services are in accordance with this professional services contract and the HBH proposal for the project which was presented to the City in December 2013.

1.5 Acknowledgement

This Plan is the result of contributions made by a number of individuals and agencies. In particular, the following persons should be acknowledged for the important roles they played in the preparation, review, and development of this Study:

Christine Pavoni .... City of Detroit, City Recorder
Renata Wakeley .... Mid Willamette Valley Council of Governments

In addition to these key personnel, we wish to thank the Detroit City Council, Sewer Committee, and management staff for providing support and input on the project.



H B H Consulting Engineers	City of Detroit *WASTEWATER FEASIBILITY STUDY*	LOCATION MAP City of Detroit Marion County, Oregon	FIG. 1-1

SECTION 2
Study Area

2.1 Physical Environment

2.1.1 Location

The City of Detroit is located in southeast Marion County along Oregon Route-22 between the City of Gates and the City of Idanha. The City is situated on the northeast side of Detroit Lake in the North Santiam River basin, approximately 50 miles southeast of Salem. The City lies in Township 10 South, Range 5 East W.M. The city limits, which also represents the Detroit Urban Growth Boundary (UGB), encompasses approximately 600 acres. The City and surrounding area are shown in Figure 2-3.

2.1.2 Climate

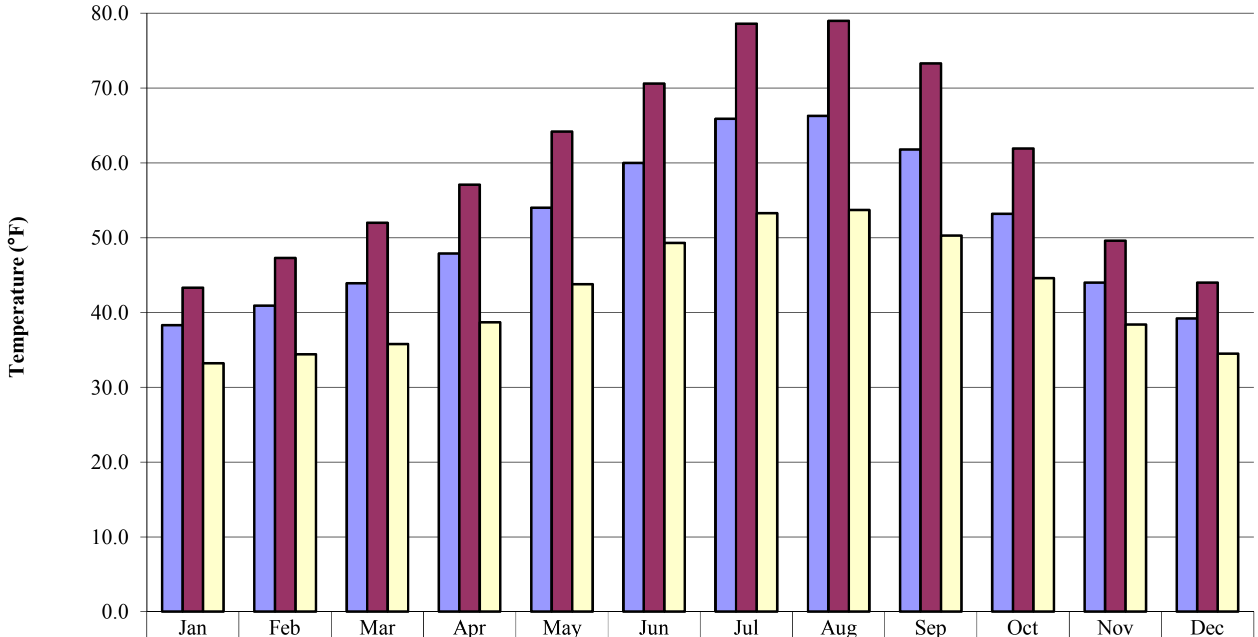
The climate of this area is temperate, characterized by dry summers and wet winters. Climate information for Detroit was obtained using records collected at the nearby weather station at the Detroit Dam. The area generally has mild summers and winters. Typical average summer temperatures range from 52°F to 76°F and average winter temperatures vary from 34°F to 45°F (Figure 2-1). The average annual temperature is 51.3°F. The record high temperature of 107°F occurred on September 3, 1988. The record low was 5°F, which occurred on December 9, 1972.

The area receives an average of 89 inches of precipitation per year (Figure 2-2). Most of this is in the form of rainfall with an average annual snowfall of 16.2 inches. Almost half of yearly precipitation occurs during the winter months. The highest annual precipitation recorded was 138.61 inches in 1996. The driest year was 1976 with 60.54 inches of precipitation. On April 28, 1990 a record of 5.56 inches of rain fell in one day.

2.1.3 Topography

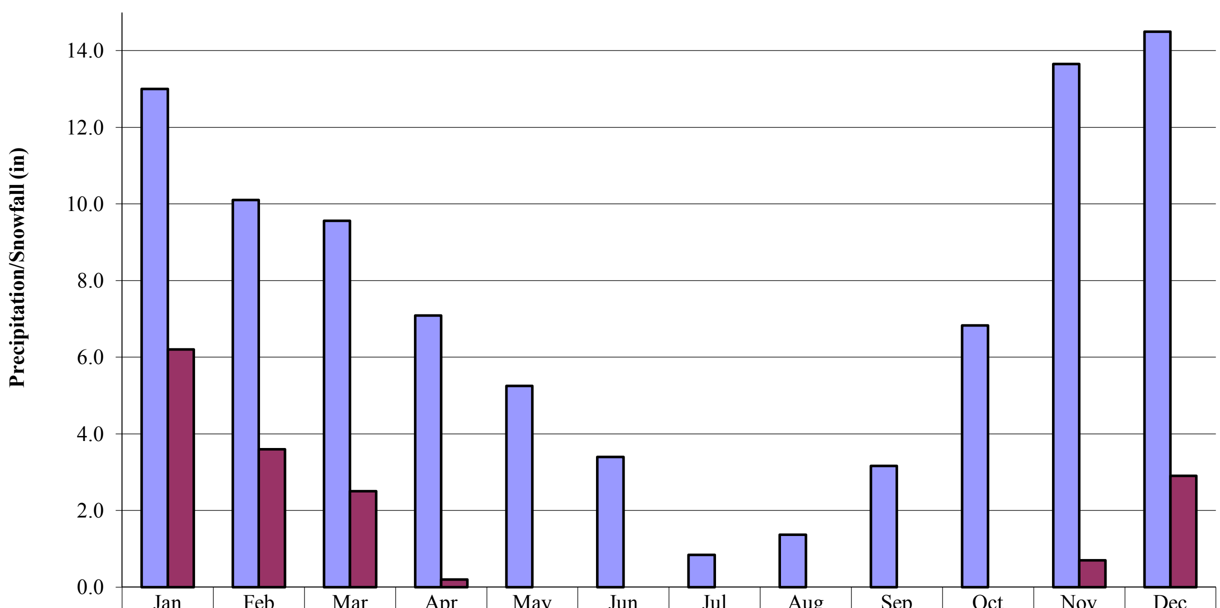
The study area is located on the western slopes of the Cascade Mountain Range with elevations ranging from approximately 1500 to 1800 feet. The study area is a flooded river valley with steep side slopes. The original flat land at the bottom of the valley has been covered by Detroit Lake. Most of the slopes in the study area have a gradient of 15% or more. The area's topography is shown in Figure 2-3.

Figure 2-1 – Average Monthly Temperatures



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average	38.3	40.9	43.9	47.9	54.0	60.0	65.9	66.3	61.8	53.2	44.0	39.2
Avg. Max.	43.3	47.3	52.0	57.1	64.2	70.6	78.6	79.0	73.3	61.9	49.6	44.0
Avg. Min.	33.2	34.4	35.8	38.7	43.8	49.3	53.3	53.7	50.3	44.6	38.4	34.5

Figure 2-2 – Average Monthly Precipitation



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Precip.	13.0	10.1	9.6	7.1	5.3	3.4	0.8	1.4	3.2	6.8	13.7	14.5
Avg. Snow	6.2	3.6	2.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.7	2.9

2.1.4 Geology

Information on the area's geology in this discussion was derived using the *1989 Geologic Map of Salem 1º by 2º Quadrangle, Western Oregon* by George W. Walker and Robert A. Duncan. The geologic characteristics of the study are have been influenced significantly by volcanic and glacial processes. Detroit's underlying geology is made up of various kinds of andesitic and basaltic flow rock, and volcanic sedimentary rocks. Specifically, the City is shown to be underlain by "Qal" alluvium (Holocene), "Tu" tuffaceous sedimentary rocks, basalt flows, and tuffs, undivided (Miocene and Oligocene), and "Tut" welded to nonwelded ash-flow tuff. Further description of these geologic elements is provided below:

- Qal - Clay, silt, sand, and gravel in river and stream channels.
- Tut - Mostly vitric crystal and vitric ash-flow tuff. Glass in tuff is largely altered to clay, zeolites, and secondary silica materials.
- Tu - Heterogeneous assemblage of continental, largely volcanogenic deposits and basalt and basaltic andesite, including flows and breccias, complexly interstratified with epiclastic and volcanoclastic deposits of basaltic to rhyodacitic composition.

2.1.5 Water Resources

The most significant water resources in the vicinity of Detroit are Detroit Lake and the North Santiam River. There are also a number of small streams and drainages in the vicinity.

Detroit Lake

The large impoundment of the North Santiam River, known as Detroit Lake, was formed by the construction of Detroit Dam during the late 1940s and early 1950s. When full, the lake is about 9 miles long and one mile wide. Its shoreline extends for approximately 33 miles. The dam itself is over 460 feet high. Although the dam supplies hydroelectric power and irrigation water, its primary purpose if for flood control. Its construction was authorized by the US Congress under the terms of the 1938 Flood Control Act. The US Corps of Engineers manages the dam for flood control by drawing the water surface down during the fall and winter to make room for spring runoff. The elevation of the water surface behind the dam fluctuates more than 100 feet from a maximum elevation of 1,563 to a minimum surface of 1,450 feet.

North Santiam River

The City of Detroit and the surrounding area lies in the North Santiam River basin. The North Santiam River rises in the high Cascades in eastern Linn county in the Willamette National Forest. The river drains approximately 766 square miles of the Cascade Range on the eastern side of the Willamette Valley traveling 92-miles before discharging to the main stem of the Santiam River approximately 10 miles east of the confluence of the Santiam and the Willamette River. The average discharge rate for the river, at the gauging station below Idanha, is approximately 1,000 cubic feet per second (cfs). Maximum flows at the is location have been as high as 3,800 cfs and minimum flows as low as 310 cfs.

2.1.6 Vegetation & Wildlife

Vegetation in the study area is typical of that found at other locations on the west slope of the Cascade Mountains. The larger trees consists of conifers such as Douglas fir, western hemlock, and western red cedar. Smaller deciduous trees include big leaf maple, alder, and willows. Shrubs such as Oregon grape, blackberry, rhododendron, and vine maple are also found in the area as well as several species of ferns and grasses.

The area supports a diverse population of fish and wildlife. Fish found in Detroit Lake include: rainbow, brook, and cutthroat trout; kokanee, and catfish. Most of the fish found in the tributaries are native rainbow and cutthroat trout. Several species of raptors inhabit the area such as bald eagles, osprey, and peregrine falcons. The raptor especially like the area known as Blowout Cliff, located on the far side of Detroit Lake. Black-tailed deer and Roosevelt Elk are also found in the study area.

2.2 Existing Wastewater Facilities

The City of Detroit does not have a wastewater collection or treatment facility. Currently wastewater treatment within the City limits and urban growth boundary (UGB) consist of individual onsite systems. Some of the original system constructed when the town was relocated in the 1950s are still in operation including system that utilize seepage pits, cess pools, and rock-lined pits. More recent systems primarily consists septic tanks and drainfields.

As noted in previous studies, periodic failure of septic systems have been reported in the City. The area between Detroit Lake and Hwy 22 is most problematic. This area has the highest percentage of older septic system that may not been properly designed or constructed. Furthermore, the area's small lots and relatively high density, make it difficult to repair, replace, or expand system as needed. The increased demands that tourists place on the septic systems make businesses especially susceptible to failure. As a results some owners must rent portable toilets to ensure their system is not overloaded.

2.3 Land Use & Development

The City of Detroit has a Comprehensive Plan which was published in July 1978 and updated June 11, 2002. The plan presents the goals and policies of the City regarding natural resources, community resources, community development, citizen involvement, urban growth boundaries, and other topics requiring ongoing attention by the City.

There are a total 603 acres in the City’s UGB, of which 268-acres are underwater. Of the remaining 335-acres on land, most is zoned for single-family residential use (66.3%). A summary of the existing land use is shown below in Table 2-1. Current zoning in and around the UGB is shown in Figure 2-4.

Table 2-1 – City of Detroit Land Use Zoning

Zoning	Acres	Percent of UGB	Percent of Land
Residential, Single Family	222	36.8%	66.3%
Residential, Multi Family	17	2.8%	5.1%
Commercial	45	7.5%	13.4%
Public	51	8.5%	15.2%
Lake & Rivers	268	44.4%	NA
Total	**603**		

2.4 Demographics

Population data for the City of Detroit is available from the US Census and the Portland State University Population Research Center (PRC). PRC certified Detroit's 2013 population at 205 persons. The overall population has remained relatively unchanged since 2010, however it is nearly 22% lower than reported in the 2000 US Census of 262 persons. The average household size in Detroit is 2.1, based on the 2010 US Census.

In addition to the citizens that consider Detroit their primary residence, the City has a large population of seasonal residents. The 2010 US Census reports that 73.9% of the houses in Detroit are characterized as vacation units. Assuming that the occupancy size of these vacation units is twice the average household size in the City, the estimated population in the City during the peak tourist season is approximately at 1,293 people.

Marion County's published coordinated population growth rate for Detroit is 1.5%, however based on recent population trends, it is assumed that the future growth in the City will be 1.0%. The City estimates that the part-time population will grow at a rate of twice that of the full-time residents or an annual growth rate of 2.0%. The following table shows the current and projected populations for the-full time and part-time City residents.

Table 2-2– Projected System Population

Year	Population		
	Full Time Residents[1]	Part Time Residents/Tourists[2]	Total
2014	205	1,088	1,293
2019	215	1,201	1,417
2024	226	1,326	1,553
2029	238	1,464	1,702
2034	250	1,617	1,867

[1] *Average Annual Growth Rate, Full Time Population = 1.0%*

[2] *Average Annual Growth Rate, Part Time Population = 2.0%*

2.5 Economic Conditions and Trends

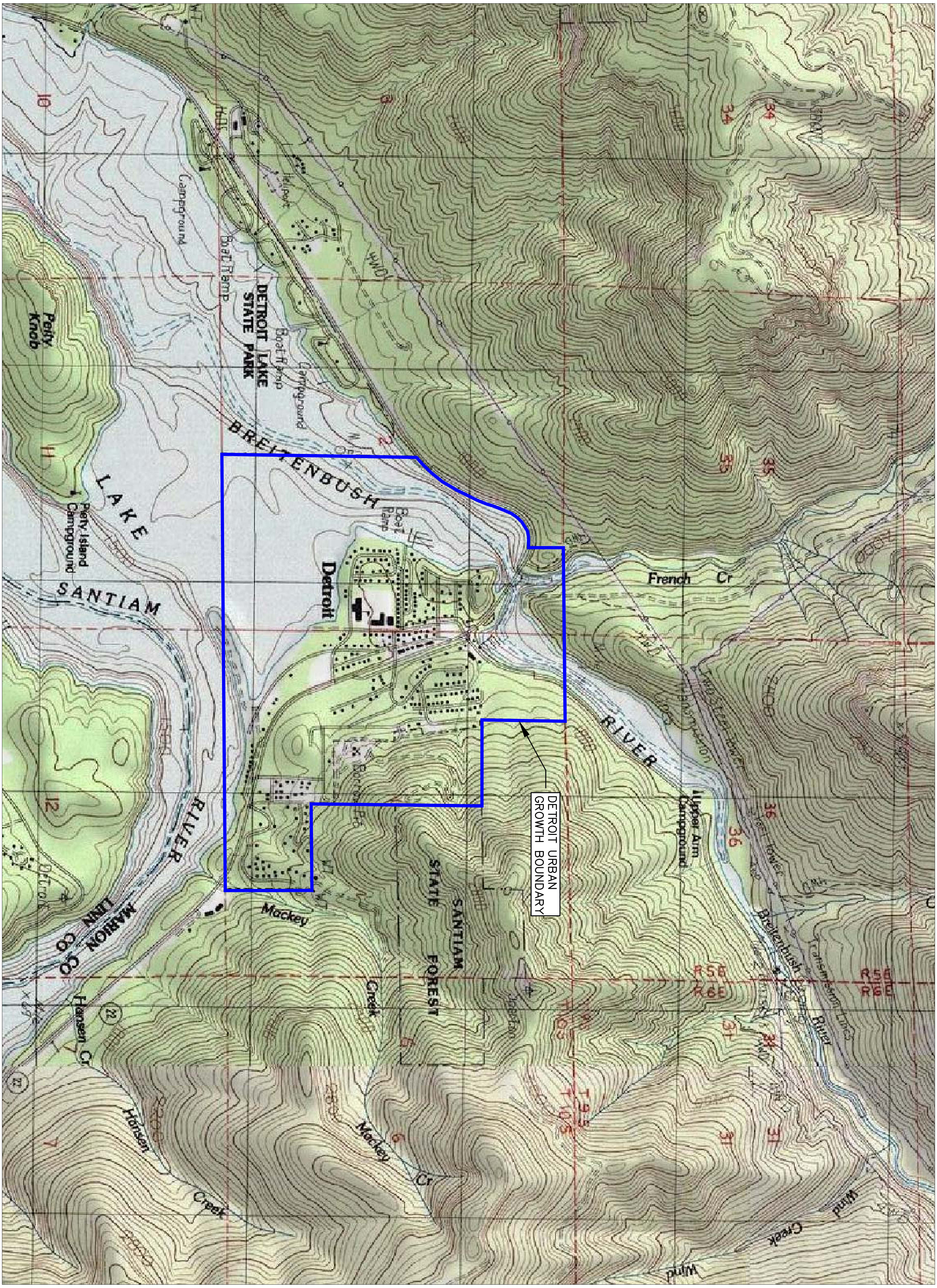
The Detroit area offers summer boating and water recreation, snowmobiling, fishing and other outdoor recreational activities. It is within one hour from the Salem/Stayton area and about 1½ to 2 hours from the Portland metro area.

Much of the economy in Detroit is driven by tourism. There is no industry in the area to support increased full-time economic growth. Also, there is minimal space for developing service or manufacturing industry.

Major businesses affected by tourism include:

- Marinas
- RV Parks
- Restaurants & Food Service
- Motels
- Markets
- Gas Station

As previously noted, the number of part-time residents and tourists visiting the area is expected to continue to grow. As a result there will be an increased demand for services provided by the types of businesses listed above. However, without a community wastewater treatment system, the actual potential for these businesses to accommodate increased tourism demand may be limited.



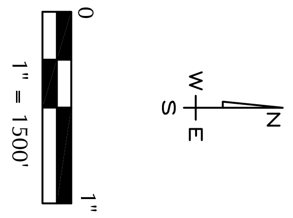


FIG. 2-3	DRAWN BY: CLL DATE: May 2014	VICINITY MAP	City of Detroit *WASTEWATER FEASIBILITY STUDY*

HBH Consulting Engineers

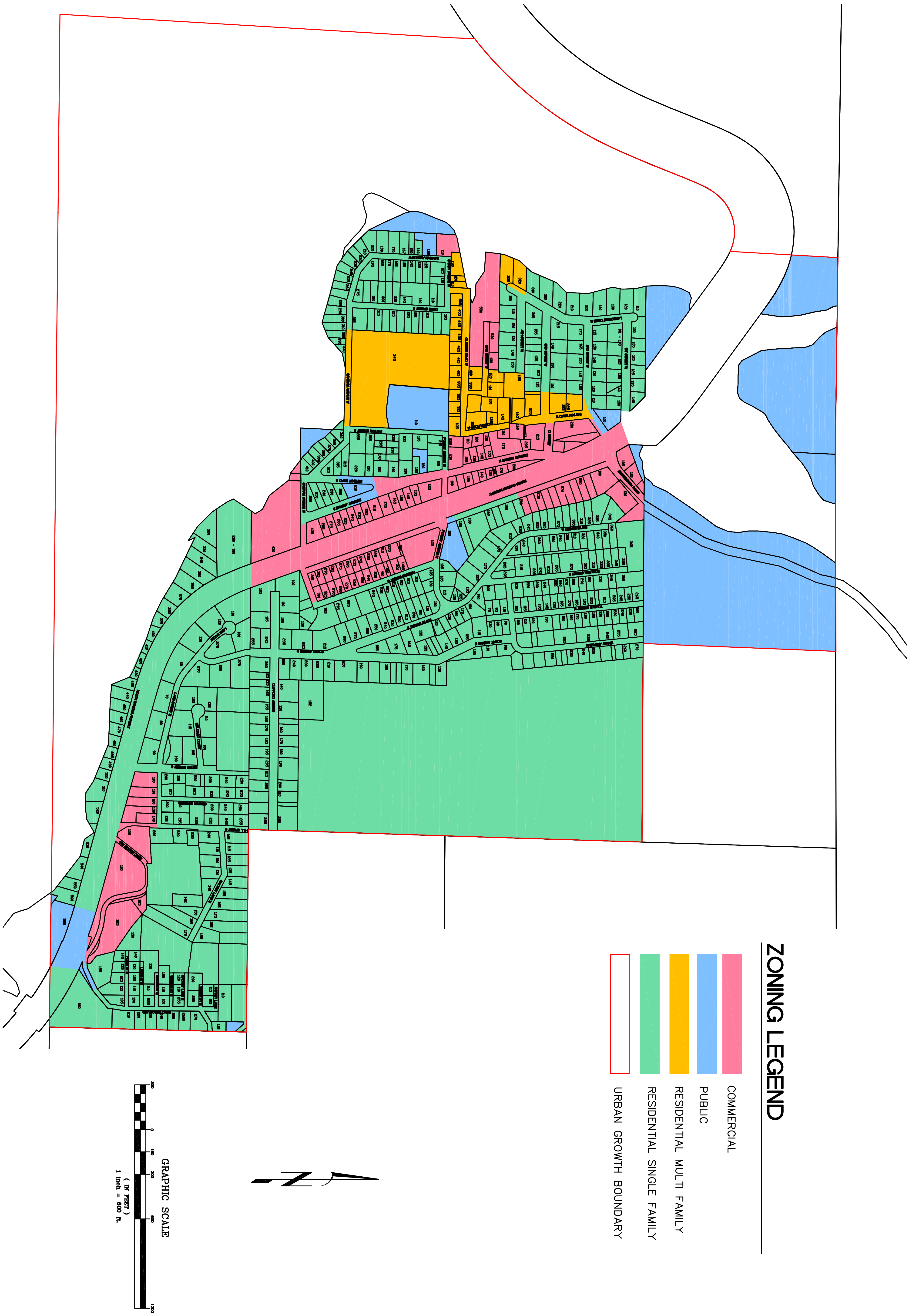


FIG. 2-4	DRAWN BY: CLL DATE: May 2014	LAND USE MAP	City of Detroit *WASTEWATER FEASIBILITY STUDY*

H B H Consulting Engineers

City of Detroit
Wastewater Feasibility Study

SECTION 3
Regulatory Environment

Many different regulations are in effect controlling the way sewage may be managed in the study area. These regulations are directed at protecting surface water, groundwater, public health, land use, and the overall environment.

3.1 Three Basin Rule (340-041-0470)

The North Santiam River basin is one of three watersheds that are regulated by the Three Basin Rule (3-B Rule) (OAR 340-041-0470). The other basins include the watersheds of the Clackamas River and the McKenzie River (above RM 15). The 3-B Rule was adopted in 1977 to protect the pristine watersheds of these three subbasins, which provide 17% of the drinking water in Oregon as well as providing critical habitat for many sensitive species of plants, fish, and wildlife.

The 3-B Rule prohibits new and increased waste discharges to surface waters including wastewater outfalls (except under very limited conditions). Consequently, the only acceptable forms of wastewater disposal for the City of Detroit are subsurface discharge to absorption fields or irrigation of areas away from the rivers with spray-head mechanisms.

Originally the 3-B Rule only addressed surface water discharges. In 1995, however, the rule was substantially rewritten to include regulations on Water Pollution Control Facilities (WPCF) as well as National Pollutant Discharge Elimination System (NPDES) permits. This rule now requires the Environment Quality Commission (EQC) to review all applications for new, expanded or improved domestic sewage treatment facilities large enough (> 5,000 gpd) to be subject to the 3-B rule. The primary provisions of the 3-B Rule are summarized below:

- New NPDES permits for industrial, Concentrated Animal Feed Operations (CAFOs) or domestic wastewater treatment plants (WWTPs) are specifically prohibited (7)(a). Exceptions include:
  - Short-term lowering of water quality to respond to emergency situations
  - Individual NPDES permits for existing log ponds and fish hatcheries at time of renewal of general permits 300 & 400
  - Industrial, CAFO or domestic waste land application at agronomic rates
  - New General Permits 1200C, 1200CA, 1500, 100, 200, 500, 700 (outside designated scenic waterways)
  - CWA Section 401 Certifications
  - General and individual stormwater permits

- Renewal or transfer of existing NPDES or WPCF permits, new WPCF permits for STPs less than 5000 gpd, and individual onsite systems are specifically allowed without EQC approval (2)(a).

- New industrial or CAFO WPCF permits may issue by DEQ without approval by EQC (7)(b) assuming the following conditions are satisfied:
  - No discharge to surface water and
  - Meet all Groundwater requirements

- New domestic WWTP WPCF permit may be issued by DEQ after approval by EQC: (7)(c) assuming the following conditions are satisfied:
  - No discharge to surface water,
  - EQC finding that WWTP is a preferable to individual onsite systems, and
  - Individual permit
  - Certified operator
  - Annual reporting

- Repair of individual onsite system(>5000 gpd) under WPCF, improved treatment at WWTP are not specifically addressed

3.2 Water Pollution Control Facilities Permit (WPCF)

The Clean Water Act (CWA) as delegated to the State of Oregon and enforced through Oregon Revised Statues (ORS 468B), requires a Water Pollution Control Facilities (WPCF) permit for all discharges of wastes and wastewater onto or beneath the ground surface. Examples of systems that require WPCF permits include: land irrigation systems, evapotranspiration lagoons, industrial seepage pits, onsite sewage disposal systems designed for wastewater flows greater than 2,500 gallons per day, and some types of underground injection systems. No discharge to waters of the State is allowed under a WPCF permit.

To obtain a WPCF permit, an applicant must submit a completed application and pay the appropriate fees. As part of this process, the applicant must submit a site evaluation and preliminary engineering report or Facility Plan. These submittals must conform to all relevant State requirements. The WPCF permits are subject to periodic review and updating.

3.3 Rules for Onsite Wastewater Systems

Oregon Department of Environmental Quality (DEQ) regulates the construction, alteration, repair, operation, and maintenance of onsite wastewater treatment systems through Oregon Administrative Rules (OAR) Chapter 340, Divisions 71 and 73 as well as some portions of Divisions 45 and 52. The purposes of these rules are to restore and maintain the quality of public waters and to protect the health and general welfare of the public.

3.4 Rules for Effluent Reuse

Effluent reuse includes the recycling of treated wastewater for beneficial purposes such as irrigation. The Oregon Department of Environmental Quality implements a statewide program that encourages water reuse in a manner to protect public health and the environment. This program is regulated by OAR Chapter 340, Division 55. The State recognizes four classes of recycled water, based on various levels of treatment, that can be reused for specific beneficial purposes. Municipal or industrial wastewater treatment facilities are required to manage and operate water reuse projects under a reuse management plan. These plans are specific to each facility and part of a facility's National Pollutant Discharge Elimination System or WPCF water quality permit. Site-specific conditions, such as application rates, setbacks to sensitive features, signage and other limitations may be required to ensure protection of public health and the environment.

3.5 Groundwater Quality Protection

Groundwater quality is regulated by OAR 340-40. Neither effluent irrigation nor subsurface disposal can be practiced in an area or in a way that harms the quality of the groundwater. Wastewater must be treated properly before it is applied to the land and additional treatment must occur on the land or in the soil prior to the wastewater reaching the groundwater. Nitrogen is usually the most important constituent in municipal wastewater requiring proper control to protect groundwater quality. Nitrate contamination is prevented by properly treating and applying municipal wastewater to the land.

In land application, the amount of nitrogen present in reused effluent should not exceed the nitrogen needs of the crop that is irrigated. When treated effluent is applied in the manner, all the nitrogen in the wastewater is used by the crops and none is available to leach into the groundwater. This rate of application of wastewater (called the agronomic rate) generally establishes the size of irrigation area needed for a given system. For instance, if treated effluent is applied to timber, it should be applied over an area and at a rate that matches the nitrogen needs of the trees (and other harvestable vegetation) growing on the irrigation site.

Subsurface disposal systems are designed and operated in such a way that nitrogen is removed through the treatment process and/or in the drain field prior to reaching the groundwater. Nitrogen is removed through uptake of plants and bacteria growing in the soil and also through a natural process called de-nitrification. In de-nitrification, nitrogen in the form of nitrate is transformed into nitrogen gas which escapes into the atmosphere.

3.6 Land Use Compatibility

Any new wastewater treatment system would have to meet the requirements of the applicable community land use master plan. DEQ requires all applicants for discharge permits to have a Land Use Compatibility Statement from the governing jurisdiction.

3.7 Environmental Review

Environmental assessments (EAs) and Environmental Impact Statements (EISs) are completed to evaluate the potential environmental impacts of projects that have any connection to the federal government, including projects have any percentage of federal funds, or are constructed on federal property. These environmental reviews are required by the National Environmental Protection Act (NEPA) of 1976.

EAs are required when the environmental impacts associated with the proposed projects are not expected to be significant, according to the federal definition of significant, or for projects limited in scope. EISs are usually reserved for controversial projects, projects where a significant impact to the environment is expected, or large projects where there is considerable opportunity for impacts to occur.

In its simplest form, an EA consists of a description of the study area, a description of alternatives being considered (including “no action” alternative), an evaluation of the potential impacts of the alternatives, and a discussion of ways to mitigate impacts. Sponsors of the project identify a “recommended alternative” from the list of alternatives under consideration. After opportunity for public review and comment, a Finding of No Significant Impact (FONSI) can be issued by the appropriate NEPA Administrator.

An EIS is similar to an EA except it is usually prepared in much greater detail than an EA. It would include all of the same elements. The biggest difference is the level of detail and documentation and hence the amount of time required to complete the environmental review. An EA can typically be completed in less than six months. An EIS may take from 1-2 years to complete.

City of Detroit
Wastewater Feasibility Study

SECTION 4
Wastewater Flows & Loading

The purpose of this section is to establish preliminary flows and loading design criteria for a wastewater system serving the City of Detroit. Estimates for wastewater system flows and loading were developed using a combination of sources, including water usage reports, customer inventory, zoning maps, and technical references.

4.1 WASTEWATER FLOWS

Wastewater flows have been estimated using customer account and consumption data. The following key assumptions have been made for this analysis:

- Wastewater flows equal water usage. Although a portion of water consumption (typically 15-20%) is not discharged through sewers, this assumption will provide a factor of safety that is recommended for this stage of planning.
- All connections in areas zoned as commercial are assumed to be commercial users. In many cases commercially zoned land is currently used as residential, however, this use could change in the future, particularly if the project increases economic development in the area.

These assumptions may require some modification to better refine projected wastewater flows as part of the system pre-design or facilities report.

4.1.1 Service Connections

The existing water system serves the residents of the City as well as providing service to a number of commercial businesses, part-time residents, and tourists. An inventory of active water accounts in the City between 2011 to 2013 is presented in Table 4-1. Note that the type of account for this analysis is defined based on land use zoning (see Figure 2-4).

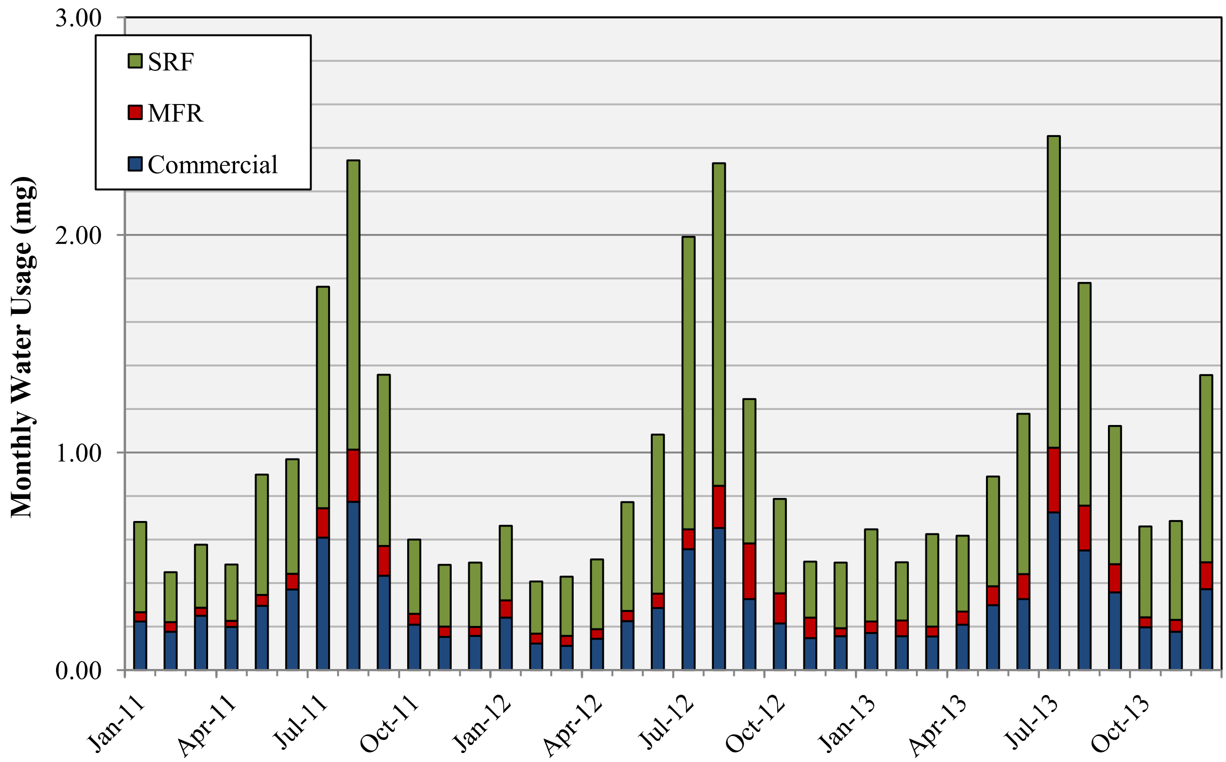
Table 4-1 - Water Account Inventory

Type of Account	2011	2012	2013	AAGR
Single-Family Residential	274	272	274	0.0%
Multi-Family Residential	32	34	35	4.6%
Commercial	47	48	50	3.1%
Total	**353**	**354**	**359**	**0.8%**

4.1.2 Historical Water Usage

The following figure shows the monthly water consumption for each type of user during the three year period analyzed. During this time, water usage varies considerably based on the time of year with peak usage for all sectors occurring in late summer (July or August). The majority of usage in the City is related to single-family residences.

Figure 4-1 - Monthly Water Consumption



A summary of average and maximum monthly water consumption for the City is provided in Table 4-2 and Table 4-3, respectively. As shown in these tables, both average daily demand (ADD) and maximum monthly demand (MMD) have increased over the past three years.

Table 4-2 - Summary of Average Water Use

	Type of Account[1]			Total (gpd)
	Single-Family Residential (gpd)	Multi-Family Residential (gpd)	Commercial (gpd)	
2011	19,297	2,525	10,517	32,339
2012	18,791	3,061	8,671	30,523
2013	20,772	3,320	9,548	33,640
Average	**19,620**	**2,969**	**9,579**	**32,167**

1 Type of account is based on land use zoning and not necessarily on current use.

Table 4-3 - Summary of Maximum Monthly Water Use

	Type of Account[1]			Total (gpd)
	Single-Family Residential (gpd)	Multi-Family Residential (gpd)	Commercial (gpd)	
2011	49,935	7,742	24,968	82,645
2012	45,581	8,516	21,065	75,162
2013	47,387	8,774	23,032	79,193
Average	**47,634**	**8,344**	**23,022**	**79,000**

[1] Type of account is based on land use zoning and not necessarily on current use.

For the overall system the average ratio of peak month water usage compared to average annual usage, also referred to as the peaking factor, has equaled 2.4. This peaking factor was consistent for both single-family and commercial users. Multi-family uses had a higher average peaking factor of 2.8.

4.1.3 Equivalent Dwelling Units

A dwelling unit is defined as one typical single-family residence. Non-residential users (commercial, industrial, public facility, etc.) can be described as an equivalent number of dwelling units (EDUs) based on their water consumption compared to the average consumption of a dwelling unit. Capacity of a system can be defined based on its ability to serve a certain number of EDUs. This enables future checks on system capacity to be made at any time regardless of the growth patterns.

The following table calculates current single-family water usage in the City. Due to the high variability in water usage and the high number of part time users (i.e. homes and businesses only occupied/open for summer), EDUs were calculated based on maximum monthly demands. Over the three-year period analyzed, the maximum monthly demand per single family residence averaged 165 gpd.

Table 4-4 - Average Residential Maximum Monthly Water Usage

	2011	20112	2013
Accounts	274	272	274
MMD (gpd)	42,871	45,581	47,387
MMD Usage (gpd/accnt)	156	168	173

EDUs for multi-family and commercial users were calculated based on the average maximum monthly single-family residential use of 165 gpd. The following table provides an inventory of the City's EDUs based on the type of customer usage. The existing 35 multi-family accounts represent over 50 EDUs. The City's water system provides service to 50 customers within the City's commercially zoned properties, which corresponds to a total of 169.6 EDUs. Currently, there are an estimated 494.0 EDUs served by the Detroit water system.

Table 4-5 - Inventory of System EDUs

Type	Accounts	EDUs
Residential		
Single-Family Residential	274	274.0
Multi-Family Residential	35	50.4
Total Residential	**309**	**324.4**
Commercial		
Motel	2	20.5
RV Park	1	3.2
RV Park & Marina	1	21.0
Marina	1	18.4
Gas Station	1	6.8
Market	2	17.9
Restaurants	3	17.5
Offices, Small Stores, Misc.[1]	39	60.4
Total Commercial	**50**	**169.6**
Total System EDUs	**359**	**494.0**

[1] May include some residential users

4.2 ORGANIC & SOLIDS LOADING

In addition to sewage flows, organic and solid loading rates are also used for sizing and designing sewage treatment facilities. For the purposes of this Feasibility Plan, the BOD_5 and TSS are the primary constituents of concern when determining loading of the wastewater system. These terms are defined as follows:

- Biochemical Oxygen Demand, 5-day (BOD_5): The amount of oxygen required by bacteria to stabilize organic matter under aerobic conditions, is determined entirely by the availability of material in the wastewater to be used as biological food and by the amount of oxygen utilized by the microorganisms during oxidation. The standard length of the BOD test is 5 days.

- Total Suspended Solids (TSS): Solids that float on the surface of, or are in suspension in, water, wastewater, or other liquids, and that are largely removable by laboratory filtering.

The proposed system would serve various types of residential users (i.e. full-time and part-time) as well as a variety of commercial businesses. Each of these sectors will generate different volumes and strengths of wastewater. Residential sewage typically has a BOD concentration of approximately 450 mg/L[1].

[1] Small and Decentralized Wastewater Management Systems, Crites and Tchobanoglous, 1998, p. 180

Organic loading generated from commercial users can vary considerably based on the type of business. For instance, BOD for a restaurant can range from 600 mg/L to over 3,000 mg/L while for a typical office the range is between 900-1,500 mg/L.

There is no available information on organic loading generated by the existing system. In order to provide a rough estimates of wastewater loading generated by City, typical loading rates have been used. The total load or mass of organic material in sewage is estimated by multiplying the sewage flow rate by the sewage concentration and conversion factor. It is strongly recommended that the City begin collecting samples, particularly for commercial users.

Table 4-6 - Estimated Wastewater Loading

User	BOD		TSS	
	mg/L	lbs/day	mg/L	lbs/day
Residential				
Single Family	450	170	525	198
Multi-Family	600	42	630	44
Total Residential		212		242
Commercial				
Office	600	56	630	59
Markets	1,050	38	1,050	38
Marinas	1,050	65	1,050	65
Lodging	1,200	36	1,400	42
Restaurant	2,100	54	1,400	36
Total Commercial		249		240
Total System		**460.62**		**481.99**

SECTION 5
Preliminary Alternative Analysis

A community wastewater system is composed of three major components:

- Collection & Conveyance (Sewer) System - Transports, usually through underground piping, wastewater generated from decentralized points of origins (homes, business, schools, etc.) to a centralized treatment plant or other authorized point of discharge.

- Wastewater Treatment System - Typically a centralized facility that receives wastewater collected from a community and provides treatment, utilizing a combination of physical, chemical, and biological processes, to remove contaminants and produce an environmentally safe fluid- and solid-waste that is suitable for disposal or reuse.

- Disposal System - Safe discharge or reuse of treated wastewater effluent and biosolids generated in the treatment process.

There are a number of alternatives for each of the above listed components. These alternatives vary in construction cost, operation and maintenance (O&M) needs, performance, land requirements, etc. Therefore a preliminary system design is necessary to develop an order-of-magnitude cost estimate for a community wastewater system as well as determine the necessary land, operation, and regulatory requirements.

Recommendations for a preliminary system have been based on a brief analysis of alternatives for collection, treatment and disposal options. Before determining the final design for the wastewater system, the City will be required to complete a detailed *Wastewater Facilities Plan*. This plan will include a more thorough analysis of possible alternatives, which is beyond the scope of this feasibility plan.

5.1 COLLECTION SYSTEM ALTERNATIVES

Wastewater collection systems are typically characterized as convention gravity type sewer or pressure type sewer.

5.1.1 Conventional Gravity Sewer

Conventional gravity collection systems transport sewage from homes or other sources by gravity flow through buried piping systems to a central treatment facility. These systems are usually reliable and consume no power. Use of this type of collection system is most favorable where the topography of land allows for sewer lines to be installed at shallow depths using the minimum recommended design slope.

In order to maintain constant slopes in hilly or flat terrain, deep excavations may be required as well as the addition of sewage pump stations, which can significantly increase the cost of gravity collection systems. Manholes and other sewer appurtenances also add substantial costs to these systems.

Conventional gravity type of sewers are susceptible to infiltration and inflow (I/I). Flows in a wastewater system can increase considerably due to I/I and is a common problem for systems that experience heavy rainfall as occurs in Detroit. Although new collection systems typically experience little I/I, the percentage of flow caused by I/I will typically increase as the system ages. It is not uncommon in some small communities for I/I to represent the largest contributor to peak wastewater flows.

The City of Detroit in a mixture of both flat and hilly terrain. This means the construction of a gravity collection system may require deep excavation as well as at least one large pump station. This would significantly increase system construction as well as O&M costs. In addition, the risk of excessive I/I, which could easily overload the capacity of a treatment and in particularly the disposal system, is a significant concern. For these reasons, a gravity collection system is not recommended as part of the preliminary design.

5.1.2 Pressure Sewer

Pressure sewer systems consists of small diameter pressurized pipes used to convey wastewater from onlot systems (e.g. septic tanks). The onlot systems provide some preliminary treatment before pumping effluent into the collection system. Since the collection system is pressurized, the pipelines generally follow the surface contour of the land, which can reduce excavation and construction costs. The pressurization also results in a watertight system, which essentially eliminates extraneous flows from the system (i.e. I/I). These pressurized sewers also eliminate the need for large manholes or additional pump stations.

There are two common types of pressure sewer systems: (1) septic tank effluent pump (STEP) systems and (2) grinder pump (GP) systems.

<u>Septic Tank Effluent Pump (STEP) Systems</u>

In STEP systems, wastewater flows into a conventional septic tank to capture solids and provide some level of preliminary treatment. The liquid effluent flows to a holding tank containing a pump and control devices. The effluent is then pumped and transferred for treatment.

Advantages:

- Septic tank provides 30-50% removal of BOD and 60-80% removal of TSS
- Lower power requirements for pump compared to grinder pumps
- More tolerance for varied flow conditions that occur in areas with highly fluctuating seasonal occupancy

Disadvantages

- Requires septic tank, which must be periodically be cleaned
- On\lot equipment can represent a significant cost if existing septic tanks cannot be reused

Grinder Pump (GP) Systems

In a GP system, sewage flows to a vault where a grinder pump grinds the solids and discharges the sewage into a pressurized pipe system. GP systems do not require a septic tank but require pumps with greater horsepower compared to STEP systems.

Advantages:
- Does not require septic tank, which may reduce onlot costs

Disadvantages
- Requires more expensive pump
- Does not provide same level of pretreatment compared to STEP system
- Higher energy requirements

Based on the apparent advantages, a STEP pressurized sewer is the preliminary recommendation for a wastewater collection system to serve the City. However, it is recommended that both STEP and GP be evaluated in any upcoming *Wastewater Facilities Plan*.

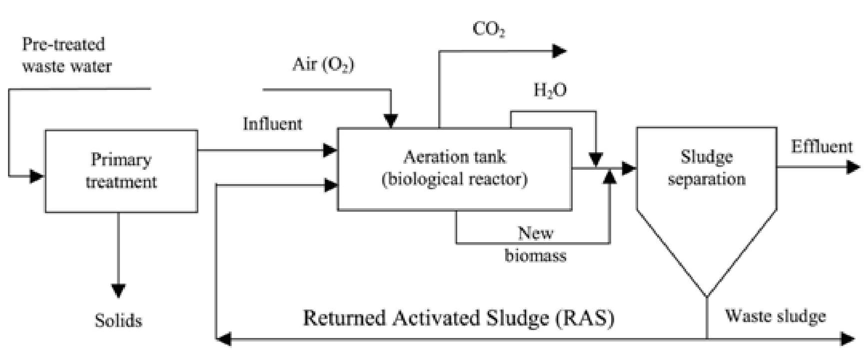
5.2 TREATMENT SYSTEM ALTERNATIVES

There are a number of wastewater treatment systems available for serving small communities. A brief description of common systems has been provided.

5.2.1 Conventional Activated Sludge

Conventional activated sludge (CAS) is the most common type of treatment used for municipal wastewater systems. CAS is an aerobic process that uses suspended microorganism biomass to convert biodegradable organic compounds and nutrients into easily removable byproducts. Wastewater typically enters the plant though a screen and/or grit removal system to a primary clarifier followed by an aeration basin where air is introduced to a mixed liquor. The microorganisms absorb dissolved and suspended constituents in the wastewater and multiply, creating more mixed liquor solids. The mixed liquor is discharged to the secondary clarifier where the solids are settled. A portion of the sludge is recycled back to the aeration basin (RAS) and a portion is processed for disposal (WAS).

Figure 5-1 - Schematic of Typical Conventional Activated Sludge Treatment

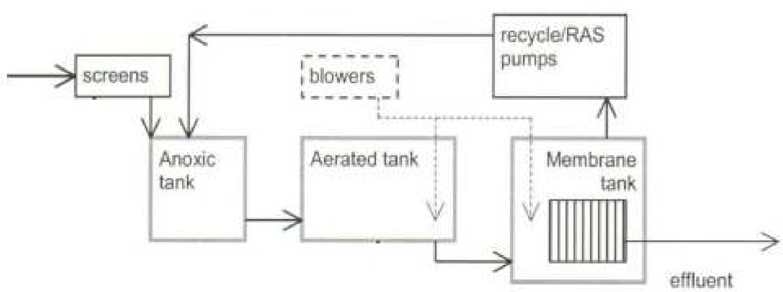


Use of a CAS treatment system in Detroit is not recommended for several reasons including high capital and O&M costs, high-degree of operation oversight required, and land requirements. Additionally, CAS are less suitable for systems having high variability in wastewater flows or treating septic tank effluent.

5.2.2 Membrane Bioreactors

A membrane bioreactor (MBR) system employs a combination of activated sludge with physical filtration. MBRs provide a suspended microorganism biomass to convert biodegradable organic compounds and nutrients in wastewater to more biomass. The biomass is separated from the wastewater using a membrane filter, rather than using a secondary clarifier.

Figure 5-2 - Typical Schematic for Membrane Bioreactor

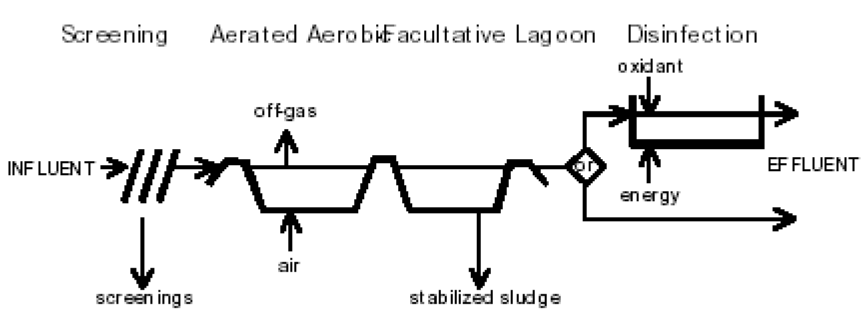


Although membrane reactors produce high quality treated effluent, the associated capital and operation costs typically make these systems financially infeasible for small communities. Unless discharge limits imposed by the State warrant this level of treatment, a MBR are not recommended.

5.2.3 Lagoons

Small communities have used lagoons for wastewater treatment in areas where land is readily available and relatively inexpensive Lagoons may be facultative or aerated systems as shown in Figure 5-3, where oxygen is supplied through mechanical or diffused aeration. Aerated lagoons can reliably produce an effluent with both biological oxygen demand (BOD) and TSS < 30 mg/L if provisions for settling are included at the end of the system.

Figure 5-3 - Typical Schematic for Aerated Lagoon Treatment System

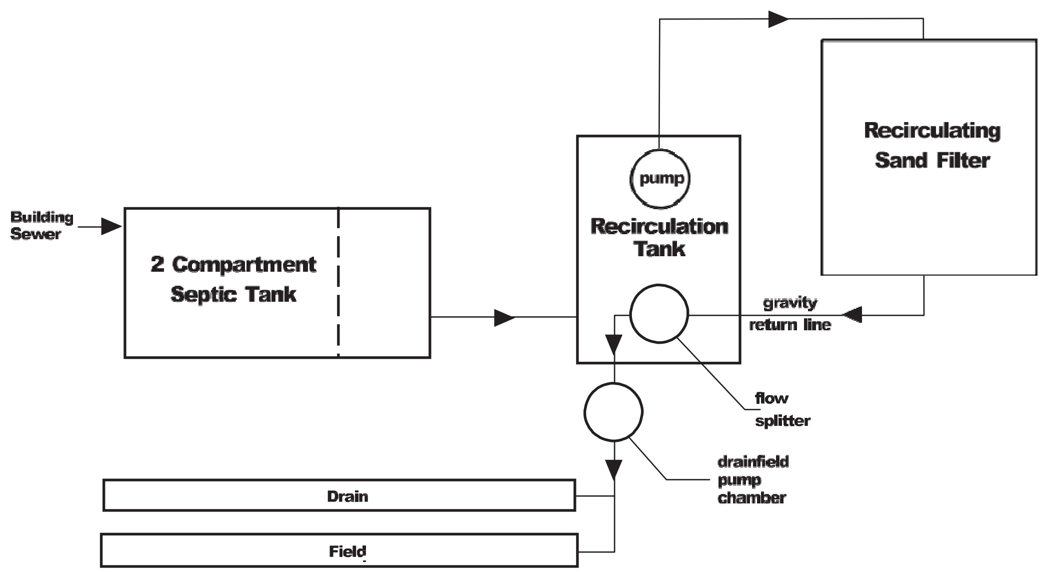


The extensive land requirements for a lagoon system would make finding a suitable site extremely difficult in Detroit. Particularly since the lagoon would have be sized to include rainfall storage. This would significantly increase the discharge volume of the system. Therefore, a lagoon system does not appear to be a feasible option for the Detroit wastewater system, however, it may warrant further investigation in a *Wastewater Facilities Plan*.

5.2.4 Sand/Media Filters

Also referred to as packed bed filter, these systems consists of a watertight structure filled with uniformly sized washed sand or other media placed over an underdrain system. Wastewater is dosed onto the surface of the media through a distribution network and allowed to percolate through the media removing contaminants through physical, biological, and chemical processes. A thin layer of bioslime forms on the media as microorganism growth develops. These microorganisms absorb soluble and colloidal waste material in the wastewater. The underdrain system collects the filtrate for further processing, recycling or disposal. Filters can be single-pass or recirculating. Single-pass filters are primarily used in smaller applications while recirculating filters can be used on a large scale.

Figure 5-4 - Typical Schematic for Recirculating Sand Filter



Sand/media filters, as shown in Figure 5-4, are commonly used to provide advanced treatment of settled wastewater, including septic tank effluent. These systems are relatively compact with lower capital and O&M costs compared to many other treatment systems. Therefore, this recirculating sand/media filter is recommended for the preliminary design. Final treatment selection will be made as part of a *Wastewater Facilities Plan*.

5.3 DISPOSAL SYSTEM ALTERNATIVES

Three disposal options for treated wastewater effluent have been evaluated: surface discharge, storage and reuse, and subsurface disposal.

5.3.1 Surface Discharge

Typically treated municipal wastewater is discharged to a receiving surface water body such as a river, lake, or ocean. However, all surface water disposal of wastewater in the North Santiam River basin is strictly prohibited by the Three Basin Rule as outlined in Section 3. Therefore, surface disposal is not a permissible option for Detroit.

5.3.2 Storage & Reuse

Rather than disposal, wastewater may be beneficially reused in applications such as irrigation. Previous studies have considered treating wastewater in Detroit to produce a Class C quality effluent suitable for land application. When surface water discharge is not an option, reuse systems typically include adequate storage to hold treated wastewater through winter until it can be applied to land. This results in significant land requirements especially considering the amount of rainfall that occurs in the region. Sufficient land does not appear to be available for holding wastewater during the wet season nor has there been adequate land identified that would be suitable for applying reused effluent. Therefore this does not appear to be a viable option, although additional investigation may be warranted as part of a future *Wastewater Facilities Plan*.

5.3.3 Subsurface Disposal

Drainfield or absorption fields are often referred to as subsurface wastewater dispersal systems. Subsurface dispersal systems are located in permeable, unsaturated natural soil or imported fill material so wastewater can infiltrate and percolate through the underlying soil to the ground water. As the wastewater infiltrates and percolates through the soil, it is treated through a variety of physical, chemical, and biochemical processes and reactions.

There are many different design and configurations options for dispersal systems, including trenches, beds, seepage pits, at-grade systems, and mounds. Systems may be gravity fed or utilize a dosing (i.e. pump) dispersal method. In general dosing systems outperform gravity flow systems because distribution is more uniform. In addition, the periods between doses provide opportunities for the subsoil to drain and re-aerate before the next dose. As a result, dosed-flow systems reduce the rate of soil clogging in the subsoil and provide a means to manage wastewater effluent application to the infiltration system.

Due to the restrictions on surface water disposal imposed by the Three Basin Rule as well as limited land availability, subsurface disposal appears to be the only viable option of the City. Final selection of the disposal method will be part of a *Wastewater Facility Plan.*

SECTION 6
Study Recommendations

Previous sections of this *Feasibility Study* have analyzed the study area, regulatory environment, design requirements, and alternative technologies of a wastewater system serving the City of Detroit. Based on these analyzes, recommendations for design, phasing, and implementation strategy are presented in the following pages. This enables an evaluation of the potential financial impact of the project on the City as well as calculating the amount of land necessary for installation. Ultimately, the feasibility of developing a community wastewater system for the City of Detroit will be dependent on its affordability and whether or not sufficient suitable land is available.

6.1 PRELIMINARY SYSTEM DESIGN

Based on the characteristics of the study area and a brief evaluation of system alternatives, preliminary recommendations for a wastewater system design have been developed. As previously noted, final design will ultimately be determined through a *Wastewater Facility Plan*. However, considering the many design constraints imposed on the facility, there are relatively few viable options for the City. Consequently, the following preliminary system is likely to be very similar to the final design and thus give a good estimate of the system's financial impact.

6.1.1 Septic Tank Effluent Pump (STEP) Pressure Sewer

For the purposes of this *Feasibility Study*, a STEP pressure system has been recommended for collection and conveyance of wastewater to the new centralized treatment facility. The high construction costs and risk of increasing flows due to I/I make a conventional gravity system inadvisable for the City. A grinder pump system may also be a feasible solution but due to the higher energy costs and increased TSS loading it was not part in the preliminary design recommendations. However, both a STEP and grinder pump pressure systems should be evaluated in any future Facilities Plan.

An effluent STEP is comprised of on-site and off-site components. On-site components of a new STEP pressure system will include:

- Onsite septic/interceptor tanks
- Grease tanks (for some commercial applications)
- Pump vault with screen
- High-head efficient pump
- Control panel
- Service connection (including ball and check valve.)

The onsite equipment will convey the wastewater to the off-site pressure system comprised of small-diameter pipelines (2"-4" diameter). A preliminary layout of the pressure sewer system is provided in Figure 6-1.

6.1.2 Package Bed Media Filter System

With a STEP system, preliminary treatment of wastewater will be performed in the on-site septic tanks. Typical septic tank BOD_5 removal efficiencies are 30-50% and removal efficiencies for TSS are 60-80%. This treated effluent is pumped through the pressure sewer to a centralized facility that will provide advanced treatment of wastewater. Due to large capital costs, operation & maintenance requirements, and limited operational flexibility, activated sludge and membrane bioreactors were eliminated from consideration. Lagoons are also not recommended for the preliminary design due to large land requirements and discharge concerns. Therefore, this *Feasibility Study* recommends a recirculating media (packed-bed) filter for the preliminary design of the advanced treatment system.

A typical package media filter system consists of a recirculation/dilution (R/D) tank and media filter bed. Effluent from the STEP is discharged to the R/D and mixed with its contents. A timer-controlled pump in the R/D tank periodically doses effluent to the filter bed. Each time the filter is dosed, effluent percolates through the filter media and is treated by naturally-occurring microorganisms that populate the filter. Effluent is then collected in an underdrain pipe at the bottom of the filter and conveyed back to the R/D tank. Depending on the liquid level in the R/D tank, a flow-splitting device either returns all of the flow to the R/D tank or splits the flow so that a portion of the effluent is discharged for final disposal. Effluent typically recirculates four times before final disposal.

In addition to the package bed media filter, the system will also require instrumentation and controls for operation as well as system telemetry. The facility will also likely require a small building to house some of the components including electrical control panels, supplies, and controls.

6.1.3 Subsurface Drip System

Disposal options for treated wastewater effluent are limited due to the prohibition of surface water discharge in the North Santiam River Basin as stipulated by the Three Basin Rule. Consequently, subsurface disposal appears to be the only viable alternative, although effluent reuse may also be investigated as part of a *Wastewater Facilities Plan*.

There are a number of subsurface disposal methods. For the purpose of this *Feasibility Study* a drip dispersal system is recommended. Drip dispersal systems use small diameter drip line tubing equipped with large number of dosing emitters. Additional components include dose tank, pump, supply manifold, return manifold, vacuum release valve, and controller. Treated wastewater effluent is pumped from the dose tank to the supply manifold that feeds each dripline. These lines are typically installed in shallow, narrow, trenches 1 to 2 feet apart. The trench is backfilled without porous media allowing the emitters to be in direct contact with the soil. The return manifold is used to regularly flush the dripline. The advantages of a drip system include less site disturbance and ability to adapt to irregular shaped lots, however installation costs can be higher compared to other methods and also requires regular O&M.

It should also be noted that design (and therefore cost and land requirements) of subsurface disposal is heavily dependent on specific site conditions. A site evaluation will be required to determine system loading rates. For this report, subsurface disposal is based on characteristics of nearby sites and standard design loading rates.

6.2 PROJECT PHASING

6.2.1 Service Areas

Due to the scope of the project, the City may wish to develop a community wastewater system using a phased approach. Developing a wastewater system in phases will allow the City to first address the most critical areas and expand the system as additional need requires and/or financing is available Although the specifics of this approach would be developed through a *Wastewater Facilities Report,* suggested service areas for project phasing are provided below:

- **Service Area A** - Includes all properties west of Hwy 22 and north of Santiam Ave W as well as the commercially-zoned areas located along Breitenbush Rd and Frontage Rd corresponding to approximately size of 94 acres. This area may be further divided into commercial and residential subsections, which contain an estimated 36 acres and 58 acres, respectively.
- **Service Area B** - Includes the remaining portion of the City not located in service area A. This service area contains approximately 238 acres.

The proposed service areas are shown in Figure 6-1.

6.2.2 Design Criteria

In order to accommodate a phased approach, preliminary hydraulic and organic loading criteria have been established for each service area. These criteria were established based on the analysis developed in Section 4 which utilized information on land use classification in conjunction with current usage trends to determine expectant flows and loading from each service area. As previously noted, the STEP system provides pretreatment of wastewater in the onsite septic tank. In order to reflect onsite pretreatment, system loading rates were based on septic tank effluent (STE) and not the raw wastewater strength. A well functioning septic tank will reduce BOD5 and TSS by 40% and 70%, respectively.

The following table summarizes the hydraulic and loading criteria for a wastewater system serving each of the proposed service areas. It should be reiterated that the design criteria presented above are preliminary and based on the level of scope appropriate for this Feasibility Study. Additional study and analysis should be incorporated into future *Wastewater Facilities Plan*. In particular, water sample testing should be conducted for commercial users.

Table 6-1 - Preliminary Design Criteria

	Service Area A		Service Area B	Entire City
	Commercial	Residential		
Connections	47	132	180	359
EDUs	163	147	184	494
Average Day Flow (gpd)	9,200	11,000	11,500	31,700
Maximum Monthly Flow (gpd)	31,000	24,000	27,000	82,000
BOD_5 (lbs/day)[1]	45	80	35	160
TSS (lbs/day)[1]	35	25	16	76

[1] Septic tank effluent

6.3 PRELIMINARY COST ESTIMATE

Preliminary costs for providing wastewater service to the proposed service areas are detailed in the following pages. These costs include estimated construction as well as operation and maintenance costs and are intended as an order-of-magnitude cost for preliminary planning purposes and should be updated as additional information and analysis are obtained.

6.3.1 Construction Costs

Detailed cost estimates for the three phases of the project are shown in Table 6-2 through Table 6-4. Each estimate includes a standard 20% construction contingency. Engineering and administrative/legal costs are set at 20% and 5%, respectively, of total construction cost. Tabulated unit costs are based on recently constructed, publicly bid community projects and engineering experience.

As previously noted, it is anticipated that development of a community wastewater system will be accomplished using a phased approach. The first phase will likely consist of developing a system to serve the commercial sector in Service Area A. Subsequent phases will expand service to the residential customers in Service Area A and ultimately to Service area B. The timing of each phase will be dependent on financial resources, land availability, and need (i.e. septic failures).

Phase 1 cost to provide wastewater service to the commercial sector of Service Area A is projected at $1.87 million (Table 6-2).

Table 6-2 - Estimated Cost for Service Area A - Commercial Wastewater System

Item	Description	Unit	Qnty	Unit Cost	Total Cost
1	Mobilization, Bonding & Insurance (~7%)	LS	1	$ 81,000	$ 81,000
2	Clearing, Grubbing, & Site Restoration	LS	1	$ 37,000	$ 37,000
3	Septic Tank- Type 1	EA	33	$ 4,500	$ 148,500
4	Septic Tank- Type 2	EA	13	$ 7,500	$ 97,500
5	Service Lateral & Connection	EA	46	$ 500	$ 23,000
6	Abandon Existing Tank	EA	46	$ 500	$ 23,000
7	2" Forcemain	LF	6,200	$ 15	$ 93,000
8	4" Forcemain	LF	1,700	$ 20	$ 34,000
9	Cleanouts & Valves	LS	1	$ 15,000	$ 15,000
10	Hwy 22 Crossing	LS	1	$ 5,000	$ 5,000
11	Packaged Media Filter System	LS	1	$ 400,000	$ 400,000
12	Flow Meter	LS	1	$ 8,000	$ 8,000
13	Control Building	LS	1	$ 50,000	$ 50,000
14	Pump Dispersal System	LS	1	$ 75,000	$ 75,000
15	Drip System	SF	50,000	$ 1.50	$ 75,000
16	Electrical & Controls	LS	1	$ 65,000	$ 65,000
		Construction Costs			$ 1,230,000
		Contingency (20%)			$ 246,000
		Construction Subtotal			$ 1,476,000
		Engineering (20%)			$ 324,360
		Legal & Admin. (5%)			$ 73,800
		Total Project Cost			**$ 1,874,160**

Table 6-3 provides a detailed cost estimated for phase 2 of the project which would extend wastewater service to residential customers in Service Area A. The estimated cost for this phase is $2.64 million. The final phase of the community wastewater system will be to provide service to the remaining customers in the City located in Service Area B. This is the largest service area and will provide wastewater service to an additional 180 customers at an estimated cost of $3.28 million (Table 6-4).

Table 6-3 - Estimated Cost for Service Area A - Residential Wastewater System

Item	Description	Unit	Qnty	Unit Cost	Total Cost
1	Mobilization, Bonding & Insurance (~7%)	LS	1	$ 112,500	$ 112,500
2	Clearing, Grubbing, & Site Restoration	LS	1	$ 32,000	$ 32,000
3	STEP System - Type 1	EA	133	$ 4,500	$ 598,500
4	Service Lateral & Connection	EA	133	$ 500	$ 66,500
5	Abandon Existing Tank	EA	133	$ 500	$ 66,500
6	2" Forcemain	LF	7,400	$ 15	$ 111,000
7	4" Forcemain	LF	1,600	$ 20	$ 32,000
8	Cleanouts & Valves	LS	1	$ 20,000	$ 20,000
9	Packaged Media Filter System	LS	1	$ 500,000	$ 500,000
10	Pump Dispersal System	LS	1	$ 50,000	$ 50,000
11	Drip System	SF	60,000	$ 1.50	$ 90,000
12	Electrical & Controls	LS	1	$ 45,000	$ 45,000
		Construction Costs			$ 1,724,000
		Contingency (20%)			$ 344,800
		Construction Subtotal			$ 2,068,800
		Engineering (20%)			$ 472,500
		Legal & Admin. (5%)			$ 103,440
		Total Project Cost			**$ 2,644,740**

Table 6-4 - Estimated Cost for Service Area B Wastewater System

Item	Description	Unit	Qnty	Unit Cost	Total Cost
1	Mobilization, Bonding & Insurance (~7%)	LS	1	$ 137,500	$ 137,500
2	Clearing, Grubbing, & Restoration	LS	1	$ 47,000	$ 47,000
3	STEP System - Type 1	EA	180	$ 4,500	$ 810,000
4	Service Lateral & Connection	EA	180	$ 500	$ 90,000
5	Abandon Existing Tank	EA	180	$ 500	$ 90,000
6	2" Forcemain	LF	18000	$ 15	$ 270,000
7	4" Forcemain	LF	3400	$ 20	$ 68,000
8	Cleanouts & Valves	LS	1	$ 30,000	$ 30,000
9	Hwy 22 Crossing	LS	1	$ 5,000	$ 5,000
10	Packaged Media Filter System	LS	1	$ 400,000	$ 400,000
11	Pump Dispersal System	LS	1	$ 50,000	$ 50,000
12	Drip System	SF	55000	$ 1.50	$ 82,500
13	Electrical & Controls	LS	1	$ 45,000	$ 45,000
		Construction Costs			$ 2,125,000
		Contingency (20%)			$ 425,000
		Construction Subtotal			$ 2,550,000
		Engineering (20%)			$ 599,760
		Legal & Admin. (5%)			$ 127,500
		Total Project Cost			**$ 3,277,260**

Key cost factors not included in the construction estimates are land acquisition, planning, permitting, and environmental review.

6.3.2 Operation & Maintenance Costs

Although capital costs for construction represent the largest financial requirement for the system, it is also important to consider the operation and maintenance (O&M) costs of the system. O&M costs include routine maintenance, regular inspections, electricity, and replacement costs.

O&M requirements for the mainlines of the effluent sewer are relatively small and typically limited to occasional exercising of valves. For the effluent sewer portion of the system, the majority of the O&M costs will be related to maintaining the onlot portion of the system. This will include periodic inspection and cleaning of the STEP components including the filter, pump, floats, and controls. STEP systems will also require occasion tank pumping to remove accumulated solids and slugged. Costs related to repair and replacement of the pump, float, and miscellaneous components should also be considered. Electricity costs for operating onlot equipment is typically the responsibility of the user.

For treatment, the electrical costs are the largest percentage of O&M. One of the advantages of the proposed packed bed filter system, is that these costs are significantly lower than common suspended growth treatment systems. Operation of the treatment of disposal system will require daily inspections and periodic cleaning of components. Replacement costs should be included for equipment such as pumps, controls, instrumentation, and valves.

Estimated monthly O&M costs are presented in Table 6-5. The preliminary estimate for monthly O&M costs for the effluent sewer and treatment systems is $10.50 and $9.50, respectively, per EDU. These costs each include a $2.50 surcharge to cover system administration (e.g. billings, office works, etc.) These O&M cost estimates should be updated as the City determine final system design.

Table 6-5 - Estimated Monthly O&M Costs

	Effluent Sewer System ($/EDU/Month)	Advanced Treatment/Disposal ($/EDU/Month)	Total O&M ($/EDU/Month)
Routine O&M	$5.00	$5.00	$10.00
Repair & Replacement	$3.00	$2.00	$5.00
Administration	$2.50	$2.50	$5.00
Total Estimated O&M	**$10.50**	**$9.50**	**$20.00**

6.3.3 Potential Impact on Rate Payers

The finical impact on system rate payers will be affected by a number of factors, including capital costs, O&M requirements, payment structure, financial terms, and project phasing. The following provides an estimate of the financial impact of a community wastewater system based on the preliminary system recommendations described in this *Feasibility Study*.

For the purpose of this analysis, the capital costs of the project have been assumed to be 100% financed through loans. The monthly amount required to service this debt is combined with the estimated O&M costs to determine the average monthly user rate required on an EDU basis. Monthly repayment was calculated using a 3% interest rate for a 20-yr loan.

The estimated monthly cost to service debt repayment as well as cover O&M costs for a community wastewater system is provided in Table 6-6. Monthly costs vary depending on the phases, but based on this preliminary financial analysis, it appears that a sewer fee of approximately $115/month per EDU would be required if all of the project was paid through financing. The amount could be reduced if grant funding was obtained as part of the project funding.

Table 6-6 - Estimated Monthly Impact on Rate Payers

	Service Area A		Service Area B	Entire City
	Commercial	*Residential*		
Monthly Loan Repayment	$ 11,233	$ 15,851	$ 19,642	$ 46,726
Monthly O&M	$ 3,260	$ 2,940	$ 3,680	$ 9,880
Total Monthly Cost	$ 14,493	$ 18,791	$ 23,322	$ 56,606
Monthly Cost per EDU	**$ 88.91**	**$ 127.83**	**$ 126.75**	**$ 114.59**

It should be noted that potential cost savings could be accomplished by reusing existing onlot equipment (e.g. septic tanks) that is in good condition. Future planning/design should develop criteria to use in the evaluation of existing equipment and identify tanks in each respective service area that may remain in use. This would allow development to occur without the risk of having to pay twice for a septic tank.

Information on potential funding sources is provided in Section 7.

6.4 LAND REQUIREMENTS

There is limited area available to site a new wastewater treatment and subsurface disposal system for the City of Detroit. Much of area's topography consists of steep slopes that are not suitable for construction, particularly for drainfields. In addition, the City is surrounded by Federal Forest lands, which specifically prohibit use for municipal wastewater facilities.

The following provides estimated sizing requirements for the preliminary system design as well identifying potential sites.

6.4.1 System Sizing Requirements

Due to the limited available land, the required sizing for the treatment and disposal systems will have a significant impact on determining the feasibility of the project. Size requirements for each of these systems are highly dependent on the technology utilized in the design. For the purposes of this

Feasibility Study, treatment sizing is based on using a packaged media filter similar to the AdvanTex AX-Max system manufactured by Orenco Systems, Inc. One advantage of this type of system is the compact footprint. It is estimated that each of the 42ft x 7ft units can treat an flow of approximately 6,500 gpd.

Sizing criteria for disposal systems are calculated based on the allowable mass loading rate of the soil. This loading rate must be approved by Oregon Department of Environmental Quality (DEQ) and is primarily based upon specific soil conditions of the site. For the purposes of this *Feasibility Study*, the design loading rate for the soil has been assumed to be 0.6 gpd/ft^2. This will ultimately have to be verified through a site evaluation and approved by DEQ. In addition to the primary treatment field, DEQ typically requires sufficient land to be available for a replacement drainfield.

The following table estimates the amount of land required for siting wastewater treatment and disposal systems. As this table shows, the majority of the land requirement is for the drainfield. It may be possible that DEQ will permit a reduction in this area (i.e. increased loading rate) because advanced treatment of septic tank effluent will be provided. However, this will have be determined as part of the final system design process.

Table 6-7 - Treatment & Disposal System Sizing Requirements

	Service Area A		Service Area B	Entire City
	Commercial	Residential		
Treatment System (ft^2)	3,500	4,000	3,000	10,500
Primary Disposal System (ft^2)	50,000	75,000	60,000	185,000
Replacement Field (ft^2)	50,000	75,000	60,000	185,000
Total Land Requirements (ft^2)	103,500	154,000	123,000	380,500
Total Land Requirements (acre)	**2.38**	**3.54**	**2.83**	**8.75**

Based on the preliminary design and loading criteria, approximately 8.75 acres are required to provide wastewater service to the entire community. However, only 2.4 acres are estimated to serve the commercial section of Service Area A.

6.4.2 Potential Sites

As previously noted, there a relatively few sites that are suitable for siting a community wastewater system. This is due to a combination of physical site constraints (e.g. steep topography), regulatory restrictions, and lack of undeveloped properties. However, three potential sites have been identified. These sites are shown in Figure 6-2 and listed in Table 6-8.

Table 6-8 – Potential Sites for New Wastewater Treatment & Disposal Systems

Tax Lot	Address	Owner	Parcel Size
105E02DA00100	110 Patton Road S	City of Detroit	2.69
105E01CB1190	430 Santiam Avenue W	NA (Bank Owned)	3.05
105E0100500	NA	US Corp of Engineers	40.00

Tax Lot 105E02AD00100110

This site is commonly referred to as the "Old School Property". It is situated in the center of Service Area A and is owned by the City. This property has been previously evaluated as a site for a community wastewater system. A site evaluation was performed by DEQ in 2008 which indicated that soil conditions are favorable for subsurface disposal. The primary disadvantage of this site is its relatively small size, however it may have sufficient area to meet the treatment and disposal area requirements for a system that only served the commercial sector.

Tax Lot 105E01CB11900

The property at 430 Santiam Avenue is currently bank owned, however, the City has shown interests in purchasing the lot. It is conveniently located near the center of the City at the intersection of Hwy 22 and Santiam Avenue.

A site evaluation was performed at this property in September 2014 by DEQ. The results of this investigation indicated that due to high groundwater at this location, it is not possible to develop a drainfield at the property.

Tax Lot 105E0100500

This federally-owned property is located outside the city limits behind the existing ODOT facility. The site has sufficient land available to meet the land requirements for treatment and disposal systems serving the entire community. However, the site has much steeper terrain than the other potential sites that make it slightly less suitable for subsurface disposal. Also, it is unclear if the City could obtain approval for developing a wastewater system at the site.

6.4.3 Siting Recommendations

Although the Santiam property is not suitable for a drainfield, it is the preferred location to site the treatment portion of the wastewater system. This would allow the treatment system to be developed in a multi-phased approach, but ensure the all components of the treatment system (filters, controls, etc.) could be located at the same site. Treated effluent would then have to be pumped offsite to the drainfield(s).

At this time, the "Old School" property is the only available site to develop a community drainfield. This site could be developed in the first phase of the project to serve the commercial sector in Service Area A. Eventually as the City expands its wastewater system, additional land suitable for developing a subsurface disposal system will need to be obtained.

6.5 FUTURE PLANNING NEEDS & CONSIDERATION

6.5.1 Additional Information Needs

As stated throughout this document, this is a *Feasibility Study* and as such required a number of assumptions to develop preliminary design criteria and cost. Subsequent planning efforts should provide a higher level of detail and analysis. In order to provide sufficient data to develop final design and system requirements, the City should collect/obtain the following information:

- The City may wish to conduct a survey of its property owners in order to determine who may be interested in connecting to a community wastewater system. Results of this survey may be used to revise the proposed service area boundaries.
- Assessment of individual septic system to determine most critical as well as identify tanks that maybe retrofitted and reused.
- Collect and analyze effluent samples from large commercial users.
- Determine if any State or Federally owned land in the project vicinity may be used for future expansion of wastewater system.

6.5.2 System Administration

Implementation of a wastewater system will require the development of a number of ordinances and programs including the following:

- Sewer Use Ordinance. The City will need to develop an ordinance that specifies regulations for operating its wastewater system including how services will be charged. The ordinance must also address the manner in which customers are allowed to use the system such as prohibiting certain materials from being discharged.
- Develop Standards for New Septic Tank. Specify requirements of new septic systems so that new tanks can easily be retrofitted into STEP system. This will prevent new users from the potential of having to replace new systems as the City expands its wastewater system.
- Wastewater SDC. Update System Development Charge (SDC) fees to include community wastewater system.
- Establish Fats, Oils & Grease (FOG) control program. Accumulation of FOGs in the collection and treatment systems can impair system performance, increase O&M costs, and reduce the lifespan of system components. The city must developed a program to ensure the emitters of FOGs, particularly food establishments, implement practices to keep FOGs out of the community wastewater system.

Public Education Program/Outreach. Public support for the community wastewater system will be vital to the overall success of the project.. Public meetings should be a regular part of the planning process to ensure that all the needs of all stakeholders are understood and address. Public comments will also be required as part of the environmental review process. In addition, if a STEP collection system is ultimately constructed, the users will need to understand the roles and responsibilities in operating and maintaining these systems

6.6 IMPLEMENTATION SCHEDULE

The scope of work required to implement a community wastewater system for the City of Detroit is substantial. For this reason, it is important to outline the required task and provide an estimate of the timeframe required.

Developing a community wastewater system will entail a significant amount of additional planning. Specifically, a *Wastewater Facilities Plan* (WWFP) will have to be developed and approved by DEQ. The WWFP will include an in-depth analysis of the system requirements, alternatives, and development of pre-design criteria and costs. This effort will likely coincide with the City's application for a WPCF permit which will set discharge limits as well as operating and reporting requirements of the system. In addition to the WWFP, the City will also have to conduct an environmental study of the project. This report will have to evaluate the potential impacts of the project and compare those impacts to alternative approaches, including a "no-action" alternative. During this planning period, the City should also develop ordinances and programs to govern the new wastewater system. The total time required for the necessary planning and project approval can take between 2 to 5 years

Financing for the project design and construction can be secured once the City has approval of the WWFP, received a WPCF permit, and obtained environmental clearance. It is assumed that financing, as with design and construction, will be obtained separately for each phase of the project. The City will also likely require outside funding to complete the required planning activities described above. The process of applying for and obtaining funding varies depending on the program. Typically the process takes between 6 to 18 months. Design and construction activities typically take 2 to 3 years to complete for each phase.

A summary of the anticipated tasks and respective timeframes is provided in the following table. Based on this preliminary schedule, the earliest the first phase of the wastewater system could be expected to be on line is five years.

Table 6-9 - Preliminary Project Schedule

Required Task	Timeframe
Public Education to Secure Community "Buy In"	On-Going
Secure Santiam Property	6 months
Secure Financing for Wastewater Facilities Plan (WWFP) & Environmental Report	1-2 year
Complete WWFP	1.5-3 years
Obtain WPCF Permit	2-3 years
Environmental Review	3-4 years
Develop Ordinances Governing Wastewater System	3-4 years
Secure Financing for Phase 1 Design/Construction	3-4 years
Design/Approval/Construct Phase 1	4-6 years
Obtain Land for Phase 3	5-8 years
Secure Financing for Design/Construction of Remaining Phases	6-8 years
Design/Approval/Construct Phase of Remaining Phases	8-12 years

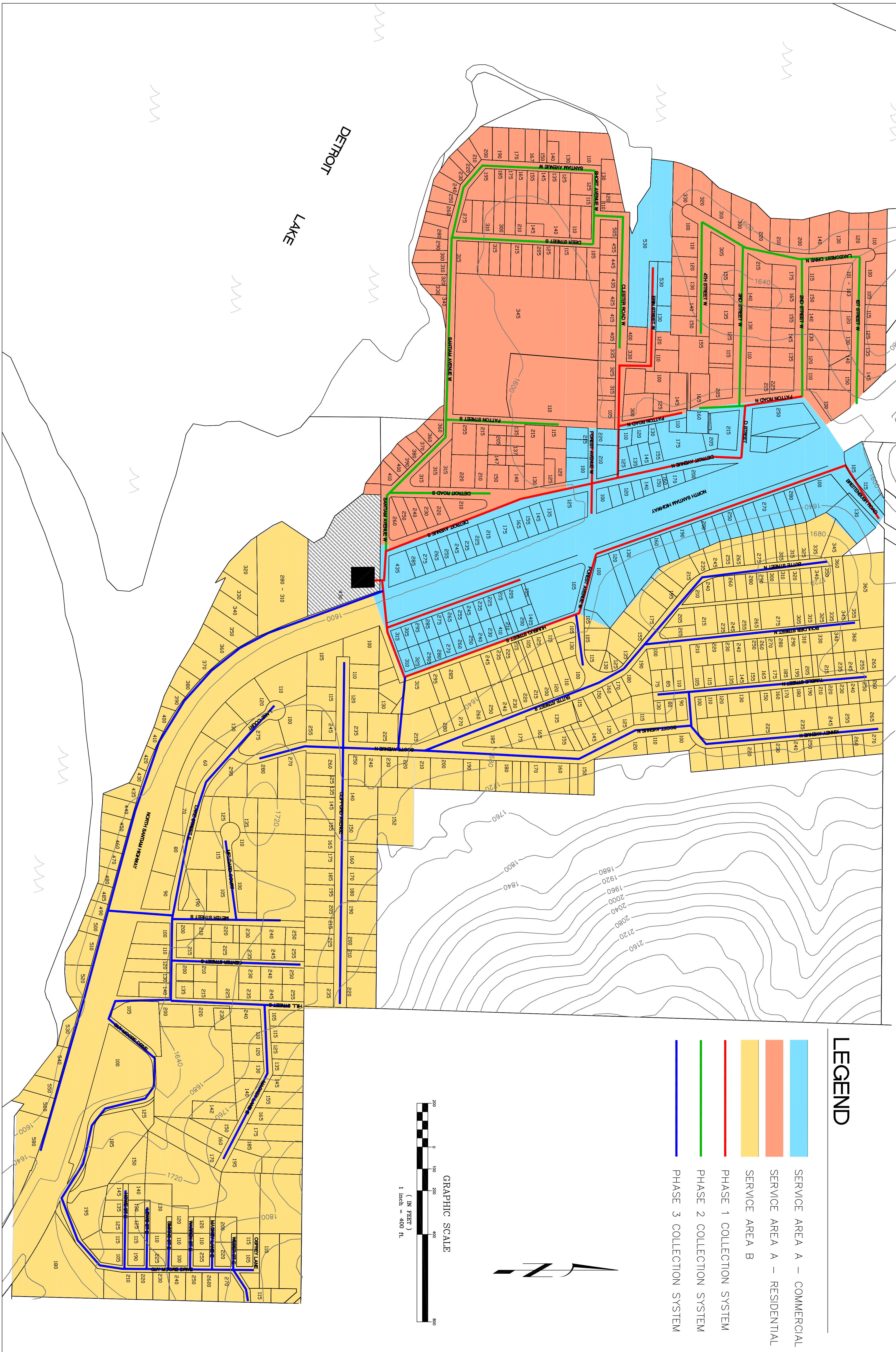


FIG. 6-1	DRAWN BY: CLL DATE: May 2014	PRELIMINARY SYSTEM LAYOUT	City of Detroit *WASTEWATER FEASIBILITY STUDY*

H B H Consulting Engineers

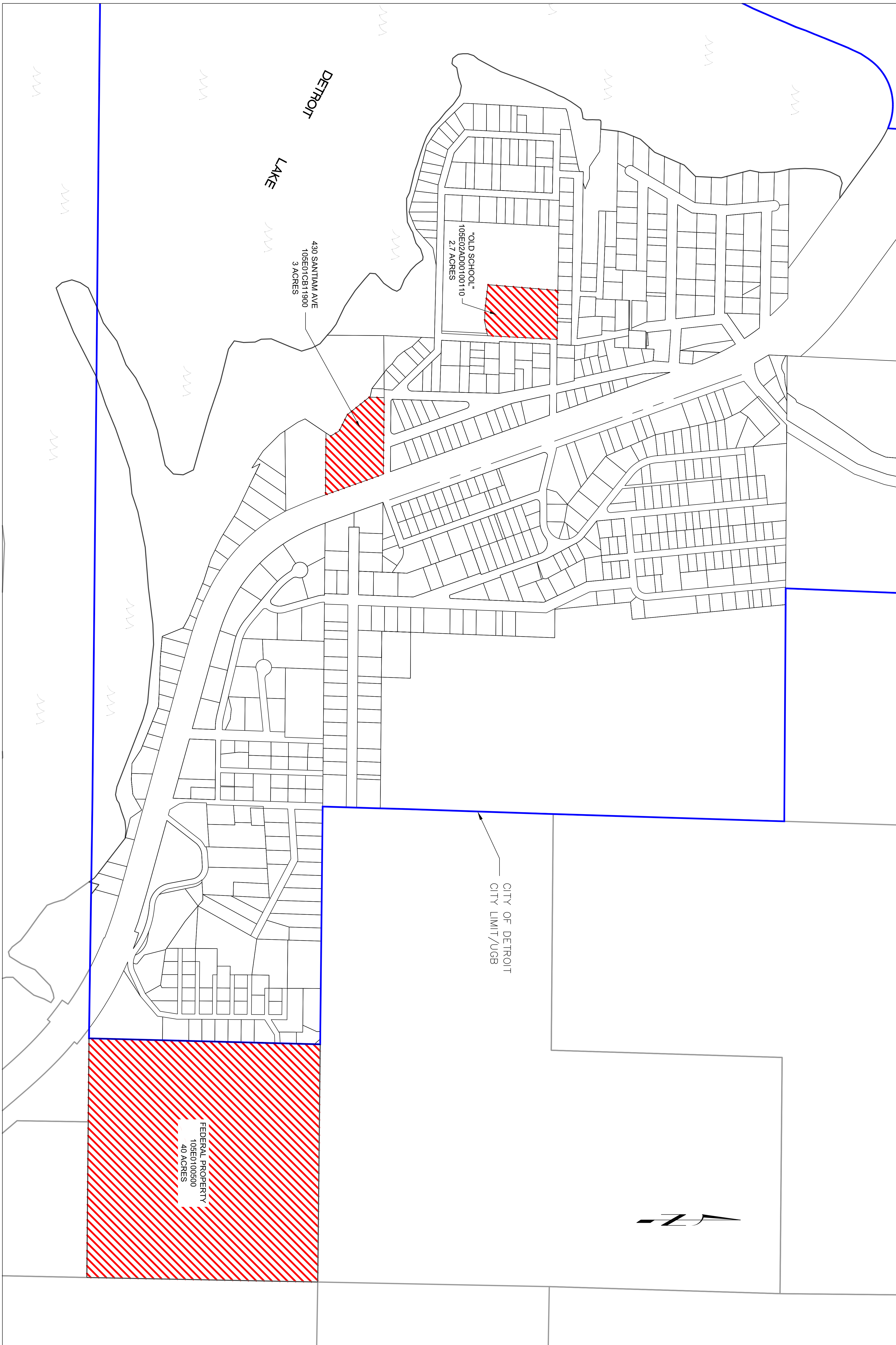


FIG. 6-2	DRAWN BY: CLL DATE: July 2014	POTENTIAL WWTP SITES	City of Detroit *WASTEWATER FEASIBILITY STUDY*	H B H Consulting Engineers

SECTION 7
FINANCING OPTIONS

Most communities are unable to finance major infrastructure improvements without some form of governmental funding assistance such as low interest loans or grants. Below, a number of major Federal/State funding programs and local funding mechanisms are discussed. Projects are usually funded by a combination of grant, loan and local funds. This chapter identifies and analyzes the impact to the rate structure.

7.1 GRANT & LOAN PROGRAMS

A brief description of the major Federal and State funding programs is given below. These are typically utilized to assist qualifying communities in financing infrastructure improvement programs. Each of the government assistance programs has its own particular prerequisites and requirements. These assistance programs promote such goals as aiding economic development, benefiting areas of low to moderate income families, and providing for specific community improvement projects. With each program having its specific requirements, not all communities or projects may qualify for each of these programs.

7.1.1 Oregon Community Development Block Grant (OCDBG) Program

The Oregon Business Development Department Infrastructure Finance Authority (OBDD-IFA) administers the State's annual federal allocation of CDBG funds. Funds for the program come from the U.S. Department of Housing and Urban Development. OCDBG funds under the Public Works category are targeted to water and wastewater systems.

Only non-metropolitan cities and counties in rural Oregon can apply for and receive grants. Cities and counties may undertake projects to improve existing facilities owned by other public bodies, such as water or sanitary districts. A city or county can only have one CDBG application under consideration by the State at any one time. Applications are not accepted when a jurisdiction has three or more administratively open CDBG projects. Applications may be submitted year around.

OCDBG grants are available for each of three phases necessary to complete water and/or wastewater system improvements: preliminary engineering and planning, final engineering, and construction. Engineering costs are limited to 20% of the total budget. No matching funds are required. The maximum grant available for a single project is $2,000,000 or $20,000 per permanent residential connection, whichever is less. This maximum grant allocation covers all aspects of the single project for a five year period. Projects may not be separated into phases in order to apply for more than the maximum grant funding during the five year period.

Grants awarded may be used for the following public works projects:

- Projects necessary to bring municipal wastewater systems into compliance with the requirements of the Clean Water Act by the Oregon Department of Environmental Quality.
- Projects where the municipal system has not been issued a notice of noncompliance from the Department of Environmental Quality, but the department determines that a project is eligible for assistance upon finding that: a recent letter, within the previous twelve months, from the appropriate regulatory authority (DEQ) or their contracted agent, indicating a high probability that within two years the system will be notified of non-compliance, and department staff deems it reasonable and prudent that program funding will assist in bringing the wastewater system into compliance with current regulations or requirements proposed to take effect within the next two years.
- Planning, design and construction projects necessary for the provision of dependable and efficient wastewater collection, treatment, and disposal/re-use.
- The acquisition of real property, including permanent easements, necessary for the proposed wastewater project.

Projects eligible for funding must be to solve problems faced by current residents, not projects intended to provide capacity for population and economic growth. CDBG funds may be used in projects that are needed to benefit current residents but which will be built with capacity for future development. In these cases, the CDBG participation is limited to that portion of the project cost that is necessary to serve the current population.

In order to be eligible for CDBG, a system must serve at least 51% permanent residents who are characterized as low or moderate income based on the most recent OBDD Method of Distribution and the monthly user rate at construction completion must meet program threshold rate criteria. The Threshold rate criteria states that by completion of the proposed project, the average system annual sewer rate is equal to or exceeds 1.25% of the current MHI as defined by the most recent American Community Survey 5-Year Estimate.

7.1.2 Clean Water State Revolving Fund (CWSRF)

The Clean Water State Revolving Fund (CWSRF) Loan Program administered by the Oregon Department of Environmental Quality (DEQ) provides low-cost loans for the planning, design and construction of a variety of projects that address water pollution. The loans through the CWSRF program are available to Oregon's public agencies, including cities, counties, sanitary districts, soil and water conservation districts, irrigation districts and various special districts.

There are six different types of loans available within the program. These include traditional planning, design and construction loans. There are also loans available for emergencies, urgent repairs and local community projects. Each of these loan types has different financial terms and is intended to provide communities with choices when financing water quality improvements. Interest rates are based on the nation's bond buyer index and fluctuate quarterly. The interest rates of the various loans are substantially discounted from the bond rate.

Eligible projects include water quality related planning or studies, septic system repairs, wastewater reuse, various non-point source best management practices, stormwater control, riparian or wetland restoration, wastewater treatment projects, irrigation improvements, interim financing for some USDA programs, major sewer replacement and rehabilitation, infiltration and inflow correction, estuary management activities, and others.

All eligible proposed projects are ranked based upon their application information and entered on the program's Project Priority List. Points are assigned based on specific ranking criteria. Newly ranked projects are integrated into the priority list on a regular basis. The Project Priority Lists is incorporated within DEQ's annual Intended Use Plan that indicates the proposed use of the funds each year.

Projects are funded based on the availability of loan monies. If monies are insufficient to fund all the approved projects, funds are distributed to as many projects as possible based on the Project Priority List. Each time new monies become available, those monies are allocated to as many unfunded or partially funded projects as possible.

7.1.3 Water/Wastewater Financing Program

The 1993 Legislature created the Water/Wastewater Financing Program for communities that must meet Federal and State mandates to provide safe drinking water and adequate treatment and disposal of wastewater. The legislation was intended to assist local governments in meeting the Safe Drinking Water Act and the Clean Water Act. The fund is capitalized with lottery funds appropriated each biennium and with the sale of state revenue bonds. The Oregon Business Development Department Infrastructure Financing Authority (OBDD-IFA) administers the program.

Program eligibility is limited to projects necessary to ensure compliance with the Safe Drinking Water Act or the Clean Water Act where a Notice of Non-Compliance has been issued. Cities, counties, districts and other public entities may apply to the program. Eligible activities include the following:

- Water source, treatment, storage, and distribution improvements.
- Wastewater collection and capacity.
- Storm system.
- Purchase of rights of way and easements necessary for infrastructure development.
- Design and construction engineering.

The grant/loan amounts are determined by a financial analysis based on demonstrated need and the applicant's ability or inability to afford additional loans (debt capacity, repayment sources and other factors). The program guidelines, project administration, loan terms, and interest rates are similar to the Special Public Works Fund program. The maximum loan term is 25 years; however, loans are generally made for 20-year terms. Loans are generally repaid with utility revenues, general funds, or voter approved bond issues. Borrowers that are "credit worthy" may be funded through sale of state revenue bonds.

7.1.4 Oregon Special Public Works Fund

The Special Public Works Fund (SPWF) program provides financing to municipalities (cities, districts, tribal councils, etc.) to construct, improve, and repair infrastructure in order to support local economic development and create new jobs locally, especially family wage jobs. In order to be eligible, the following conditions must be satisfied:

- The existing infrastructure must be insufficient to support current or future industrial or eligible commercial development; and
- There must be a high probability that family wage jobs will be created or retained within: 1) the boundary to be served by the proposed infrastructure project or 2) industrial or eligible commercial development of the properties served by the proposed infrastructure project.

The SPWF program is capitalized through biennial appropriations from the Oregon Lottery Economic Development Fund by the Oregon State Legislature, through bond sales for dedicated project funds, through loan repayments and other interest earnings. The Oregon Business Development Department Infrastructure Authority (OBDD-IFA) administers the fund. The following criteria are used to determine project eligibility.

The SPWF is primarily a loan program. Grant funds are available based upon economic need of the municipality. The maximum loan term is 25 years, though loans are generally made for 20-year terms. The grant/loan amounts are determined by a financial analysis based on a demonstrated need and the applicant's ability or inability to afford additional loans (debt capacity, repayment sources and other factors). Borrowers that are "credit worthy" may be funded through the sale of state revenue bonds. Loans are generally repaid with utility revenues, local improvement districts (LID's), general funds, or voter approved bond issues.

Determination of the final amount of financing and the loan/grant/bond mix will be based on the financial feasibility of the project, the individual credit strength of an applicant, the ability to assess specially benefited property owners, the ability of the applicant to afford annual payments on loans from enterprise funds or other sources, future beneficiaries of the project, and six other applicable issues.

The maximum SPWF loan per project is $10 million, if funded from SPWF revenue bond proceeds. Projects financed directly from the SPWF may receive up to $1 million. The maximum SPWF grant is $500,000 for a construction project and cannot exceed 85% of the total project cost. Grants are made only when loans are not feasible.

Technical Assistance grants and loans may finance preliminary planning and engineering studies and economic investigations to determine infrastructure feasibility. Up to $10,000 in grant funds and $20,000 in additional loan funds may be awarded to eligible applicants with fewer than 5,000 persons living within the City.

7.1.5 Water and Waste Disposal Loans and Grants (RUS)

The Rural Utilities Service (RUS) is one of three entities that comprise the USDA's Rural Development mission area. Administered by the USDA Rural Development office, the RUS supports various programs that provide financial and technical assistance for development and operation of safe and affordable water supply systems and sewer and other forms of waste disposal facilities.

Rural Development has the authority to make loans to public bodies and non-profit corporations to construct or improve essential community facilities. Grants are also available to applicants who meet the median household income (MHI) requirements. Eligible applicants must have a population less than 10,000. Priority is given to public entities in areas smaller than 5,500 people to restore a deteriorating water supply, or to improve, enlarge, or modify a water facility and/or inadequate waste facility.

Preference is given to requests that involve the merging of small facilities and those serving low-income communities. In addition, borrowers must meet the following stipulations:

- Be unable to obtain needed funds from other sources at reasonable rates and terms.
- Have legal capacity to borrow and repay loans, to pledge security for loans, and to operate and maintain the facilities.
- Be financially sound and able to manage the facility effectively.
- Have a financially sound facility based on taxes, assessments, revenues, fees, or other satisfactory sources of income to pay all facility costs including operation and maintenance, and to retire the indebtedness and maintain a reserve.
- Water and waste disposal systems must be consistent with any development plans of State, multi-jurisdictional area, counties, or municipalities in which the proposed project is located. All facilities must comply with Federal, State, and local laws including those concerned with zoning regulations, health and sanitation standards, and the control of water pollution.

Loan and grant funds may be used for the following types of improvements:

- Construct, repair, improve, expand, or otherwise improve water supply and distribution facilities including reservoirs, pipelines, wells, pumping stations, water supplies, or water rights.
- Construct, repair, improve, expand, or otherwise improve waste collection, pumping, treatment, or other disposal facilities. Facilities to be financed may include such items as sewer lines, treatment plants, including stabilization ponds, storm sewer facilities, sanitary landfills, incinerators, and necessary equipment.
- Acquire needed land, water supply or water rights.
- Legal and engineering costs connected with the development of facilities.
- Other costs related to the development of the facility including the acquisition of right-of-way and easements, and the relocation of roads and utilities.
- Finance facilities in conjunction with funds from other agencies or provided by the applicant.
- Interim commercial financing will normally be used during construction and Rural Development funds will be available when the project is completed. If interim financing is not available or if the project cost is less than $50,000, multiple advances of Rural Development funds may be made as construction progresses.

The maximum term on all loans is 40 years. However, no repayment period will exceed any statutory limitation on the organization's borrowing authority or the useful life of the improvement facility to be financed. Interest rates are set quarterly and are based on current market yields for municipal obligations. Current interest rates may be obtained from any Rural Development office.

There are other restrictions and requirements associated with these loans and grants. If the City becomes eligible for grant assistance, the grant will apply only to eligible project costs. Additionally, grant funds are only available after the City has incurred long-term debt resulting in an annual debt service obligation equal to 0.5% of the MHI. To receive a RDA loan, the City must secure bonding authority, usually in the form of general obligation or revenue bonds.

RDA will advise the applicant as to how to assemble information to determine engineering feasibility, economic soundness, cost estimates, organization, financing, and management matters in connection with the proposed improvements. If financing is provided, the RDA will also make periodic inspections to monitor project construction.

7.1.6 Rural Community Assistance Corporation (RCAC) Financial Services

The mission of RCAC's Financial Services is to manage resources, develop programs and participate in collaborative efforts, enabling RCAC to provide suitable and innovative solutions to the financial needs of rural communities and disadvantaged populations. In 1996, RCAC was designated a Community Development Financial Institution by the US Treasury to help address the capital needs of rural communities and has since added other loan programs. These programs include community facilities (housing, educational centers, public buildings, etc.) as well as lending for water and wastewater improvements.

Long-term loans are made in communities with a population of 20,000 or fewer. The Community Facility Loan Guarantee Program from USDA Rural Development enables RCAC to make low interest loans with amortization periods of up to 25 years. The primary goal of Financial Services is to serve low- and very-low income rural residents. The primary borrowers are nonprofit organizations and municipalities.

7.2 LOCAL FUNDING SOURCES

The amount and type of local funding obligations for infrastructure improvements will depend, in part, on the amount of grant funding anticipated and the requirements of potential loan funding. Local revenue sources for capital expenditures include ad valorem taxes, various types of bonds, service charges, connection fees, and system development charges. The following sections identify those local funding sources and financing mechanisms that are most common and appropriate for the improvements identified in this study.

7.2.1 General Obligation Bonds

A general obligation (G.O.) bond is backed by the full faith and credit of the issuer. For payment of the principal and interest on the bond, the issuer may levy ad valorem general property taxes. Such taxes are not needed if revenue from assessments (user charges or some other sources) is sufficient to cover debt.

Oregon Revised Statutes limit the maximum term to 40 years for cities. Except in the event that Rural Development Administration will purchase the bonds, the realistic term for which general obligation bonds should be issued is 15 to 20 years. Under the present economic climate, the lower interest rates will be associated with the shorter terms.

Financing of sewer system improvements by general obligation bonds is usually accomplished by the following procedure:

- Determination of the capital costs required for the improvement.
- An election authorizing the sale of general obligation bonds.
- Following voter approval, the bonds are offered for sale.
- The revenue from the bond sale is used to pay the capital costs associated with the projects.

From a fund raising viewpoint, general obligation bonds are preferable to revenue bonds in matters of simplicity and cost of issuance. Since the bonds are secured by the power to tax, these bonds usually command a lower interest rate than other types of bonds. General obligation bonds lend themselves readily to competitive public sale at a reasonable interest rate because of their high degree of security, their tax-exempt status, and their general acceptance.

These bonds can be revenue-supported wherein a portion of the user fee is pledged toward payment of the debt service. Using this method, the need to collect additional property taxes to retire the obligated bonds is eliminated. Such revenue-supported general obligation bonds have most of the advantages of revenue bonds, but also maintain the lower interest rate and ready marketability of general obligation bonds. Because the users of the sewer system pay their share of the debt load based on their sewer rates, the share of that debt is distributed in a fair and equitable manner.

Advantages of general obligation bonds over other types of bonds include:

- The laws authorizing general obligation bonds are less restrictive than those governing other types of bonds.
- By the levying of taxes, the debt is repaid by all property benefited and not just the system users.
- Taxes paid in the retirement of these bonds are IRS deductible.
- General obligation bonds offer flexibility to retire the bonds by tax levy and/or user charge revenue.

The disadvantage of general obligation bond debt is that it is often added to the debt ratios of the underlying municipality, thereby restricting the flexibility of the municipality to issue debt for other purposes. Furthermore, general obligation bonds are normally associated with the financing of facilities that benefit an entire community and must be approved by a majority vote and often necessitate extensive public information programs. A majority vote often requires waiting for a general election in order to obtain an adequate voter turnout. Waiting for a general election may take years, and too often a project needs to be undertaken in a much shorter amount of time.

7.2.2 Ad Valorem Taxes

Ad valorem property taxes are often used as revenue source for utility improvements. Property taxes may be levied on real estate, personal property or both. Historically, ad valorem taxes were the traditional means of obtaining revenue to support all local governmental functions. A marked advantage of these taxes is the simplicity of the system; it requires no monitoring program for developing charges, additional accounting and billing work is minimal, and default on payments is rare. In addition, ad valorem taxation provides a means of financing that reaches all property owners that benefit from a sewer system, whether a property is developed or not. The construction costs for the project are shared proportionally among all property owners based on the assessed value of each property.

Ad valorem taxation, however, is less likely to result in individual users paying their proportionate share of the costs as compared to their benefits. In addition, the ability of communities to levy property taxes has been limited with the passage of Ballot Measure 5 and other subsequent legislation. While the impacts of the various legislative efforts are still unclear, capital improvement projects are exempt from property tax limitations if new public hearing requirements are met and an election is held.

7.2.3 Revenue Bonds

The general shift away from ad valorem property taxes and toward a greater reliance on user fees makes revenue bonds a frequently used option of long term debt. These bonds are an acceptable alternative and offer some advantages to general obligation bonds. Revenue bonds are payable solely from charges made for the services provided. These bonds cannot be paid from tax levies or special assessments; their only security is the borrower's promise to operate the system in a way that will provide sufficient net revenue to meet the debt service and other obligations of the bond issue.

Many communities prefer revenue bonding, as opposed to general obligation bonding because it insures that no tax will be levied. In addition, debt obligation will be limited to system users since repayment is derived from user fees. Another advantage of revenue bonds is that they do not count against a municipality's direct debt, but instead are considered "overlapping debt.” This feature can be a crucial advantage for a municipality near its debt limit or for the rating agencies, which consider very closely the amount of direct debt when assigning credit ratings. Revenue bonds also may be used in financing projects extending beyond normal municipal boundaries. These bonds may be supported by a pledge of revenues received in any legitimate and ongoing area of operation, within or outside the geographical boundaries of the issuer.

Successful issuance of revenue bonds depends on the bond market evaluation of the revenue pledged. Revenue bonds are most commonly retired with revenue from user fees. Recent legislation has eliminated the requirement that the revenues pledged to bond payment have a direct relationship to the services financed by revenue bonds. Revenue bonds may be paid with all or any portion of revenues derived by a public body or any other legally available monies. In addition, if additional security to finance revenue bonds was needed, a public body may mortgage grant security and interests in facilities, projects, utilities or systems owned or operated by a public body.

Normally, there are no legal limitations on the amount of revenue bonds to be issued, but excessive issue amounts are generally unattractive to bond buyers because they represent high investment risks. In rating revenue bonds, buyers consider the economic justification for the project, reputation of the borrower, methods and effectiveness for billing and collecting, rate structures, provision for rate increases as needed to meet debt service requirements, track record in obtaining rate increases historically, adequacy of reserve funds provided in the bond documents, supporting covenants to protect projected revenues, and the degree to which forecasts of net revenues are considered sound and economical.

Municipalities may elect to issue revenue bonds for revenue producing facilities without a vote of the electorate (ORS 288.805-288.945). In this case, certain notice and posting requirements must be met and a 60-day waiting period is mandatory. A petition signed by 5% of the municipality's registered voters may cause the issue to be referred to an election.

7.2.4 Improvement Bond

Improvement (Bancroft) bonds can be issued under an Oregon law called the Bancroft Act. These bonds are an intermediate form of financing that is less than full-fledged general obligation or revenue bonds, but is quite useful especially for smaller issuers or for limited purposes.

An improvement bond is payable only from the receipts of special benefit assessments, not from general tax revenues. Such bonds are issued only where certain properties are recipients of special benefits not accruing to other properties. For a specific improvement, all property within the improvement area is assessed on an equal basis, regardless of whether it is developed or undeveloped. The assessment is designed to apportion the cost of improvements, approximately in proportion to the afforded direct or indirect benefits, among the benefited property owners. This assessment becomes a direct lien against the property, and owners have the option of either paying the assessment in cash or applying for improvement bonds. If the improvement bond option is taken, the City sells Bancroft improvement bonds to finance the construction, and the assessment is paid over 20 years in 40 semi-annual installments with interest. Cities and special districts are limited to improvement bonds not exceeding 3% of true cash value.

With improvement bond financing, an improvement district is formed, the boundaries are established, and the benefited properties and property owners are determined. The engineer usually determines an approximate assessment, either on a square foot or a front-foot basis. Property owners are then given an opportunity to object to the project assessments. The assessments against the properties are usually not levied until the actual cost of the project is determined. Since this determination is normally not possible until the project is completed, funds are not available from assessments for the purpose of making monthly payments to the contractor. Therefore, some method of interim financing must be arranged, or a pre-assessment program, based on the estimated total costs, must be adopted. Commonly, warrants are issued to cover debts, with the warrants to be paid when the project is complete.

The primary disadvantage to this source of revenue is that the property to be assessed must have a true cash value at least equal to 50% of the total assessments to be levied. As a result, a substantial cash payment is usually required by owners of undeveloped property. In addition, the development of an assessment district is very cumbersome and expensive when facilities for an entire community are contemplated. In comparison, general obligation bonds can be issued in lieu of improvement bonds, and are usually more favorable.

7.2.5 Capital Construction (Sinking) Fund

Sinking funds are often established by budgeting for a particular construction purpose. Budgeted amounts from each annual budget are carried in a sinking fund until sufficient revenues are available for the needed project.

A City may wish to develop sinking funds for each sector of the public services. The fund can be used to rehabilitate or maintain existing infrastructure, construct new infrastructure elements, or to obtain grant and loan funding for larger projects.

The disadvantage of a sinking fund is that it is usually too small to undertake any significant projects. Also, setting aside money generated from user fees without a designated and specified need is not generally accepted in a municipal budgeting process.

7.2.6 User Fees

User fees can be used to retire general obligation bonds, and are commonly the sole source of revenue to retire revenue bonds and to finance operation and maintenance. User fees represent monthly charges of all residences, businesses, and other users that are connected to the applicable system. These fees are established by resolution and can be modified, as needed, to account for increased or decreased operating and maintenance costs.

7.2.7 Connection Fees

Most municipalities charge connection fees to cover the cost of connecting new development to water and wastewater systems. Based on recent legislation, connection fees can no longer be programmed to cover a portion of capital improvement cost.

7.2.8 System Development Charges

System development charges (SDC) are essentially a fee collected as each piece of property is developed, and which is used to finance the necessary capital improvements and municipal services required by the development. Such a fee can only be used to recover the capital costs of infrastructure. Operating, maintenance, and replacement costs cannot be financed through system development charges.

The Oregon Systems Development Charges Act was passed by the 1989 Legislature (HB 3224) and governs the requirements for systems development charges effective July 1, 1991. Two types of charges are permitted under this act: 1) improvement fees, and 2) reimbursement fees. SDCs charged before construction are considered improvement fees and are used to finance capital improvements to be constructed. After construction, SDCs are considered reimbursement fees and are collected to recapture the costs associated with capital improvements already constructed or under construction. A reimbursement fee represents a charge for utilizing excess capacity in an existing facility paid for by others. The revenue generated by this fee is typically used to pay back existing loans for improvements.

Under the Oregon Systems Development Charges Act, methodologies for deriving improvement and reimbursement fees must be documented and available for review by the public. A capital improvement plan must also be prepared which lists the capital improvements that may be funded with improvement fee revenues and the estimated cost and timing of each improvement. However, revenue from the collection of SDCs can only be used to finance specific items listed in a capital improvement plan. The projects and costs developed in this Wastewater System Master Plan may be used for this purpose. In addition, SDCs cannot be assessed on portions of the project paid for with grant funding.

7.2.9 Local Improvement District (LID)

A local improvement district (LID) or multiple LIDs can be formed by the City to be responsible for securing and repaying the debt. A LID incorporates property owners within a defined boundary who agree to fund all or a portion of an improvement project. LID projects are best suited for improvements that benefit a limited number of users rather than the entire system. The City may be required to assist in the LID process through facilitation and administration of the project. Agreements should be prepared detailing who will pay for engineering and planning costs, administration costs, interim financing, and other costs related to a public works project. The LID formation process requires public hearings, at which, a remonstrance (no vote) of two thirds of the influenced area can halt the process. A successful LID area would result in liens against the LID properties at the end of the project or a full payment from all or some of the property owners.

Disadvantages to a LID include the requirement of a significant amount of time and interest from the City if they choose to administer the LID. It is not uncommon to have some or many within the LID boundary that are opposed to the project. Those in opposition to the project must either rally enough support to derail the project or work for some other compromise. The political and administrative fall out is often borne by the City.

7.2.10 Assessments

Under special circumstances, the beneficiary of a public works improvement may be assessed for the cost of a project. For example, the City may provide some improvements or services that directly benefit a particular development. The City may choose to assess the industrial or commercial developer to provide up-front capital to pay for the administered improvements.