WASTEWATER REGIONALIZATION PLAN FOR NORTHERN TOOELE VALLEY

HAL Project No.: 283.02.100

Final report

March 2017

HANSEN ALLEN & LUCE INC
ENGINEERS

TOOELE COUNTY

WASTEWATER REGIONALIZATION PLAN
FOR NORTHERN TOOELE VALLEY

(HAL Project No.: 283.02.100)

Final Report

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March 2017

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CHAPTER 1 - INTRODUCTION

BACKGROUND

The Tooele Valley is located between the Oquirrh and Stansbury Mountains south of the Great Salt Lake. Growth within the valley has been rapid over the past 20 years, and has included significant residential, commercial and industrial development. This growth has placed increasing demand and pressure on available resources and existing infrastructure, and has created the need for additional facilities.

A critical aspect of existing and future development is waste water collection, conveyance and disposal. Waste water treatment plants exist for Tooele City, Grantsville City, Stansbury Park Improvement District (Stansbury Park ID) and the Lake Point Improvement District (LPID). For unincorporated portions of Tooele County that are not within a special district, on-site waste water disposal systems (septic tanks) have been used.

Tooele County recently became concerned that the number of septic tanks within the unincorporated areas of the county will exceed the number of tanks that can be supported by the existing natural geological and biological systems. This concern lead the Tooele County Commission and Health Department to begin investigating the current status of septic tanks within the unincorporated areas of the county and to begin planning for waste water collection, conveyance and disposal.

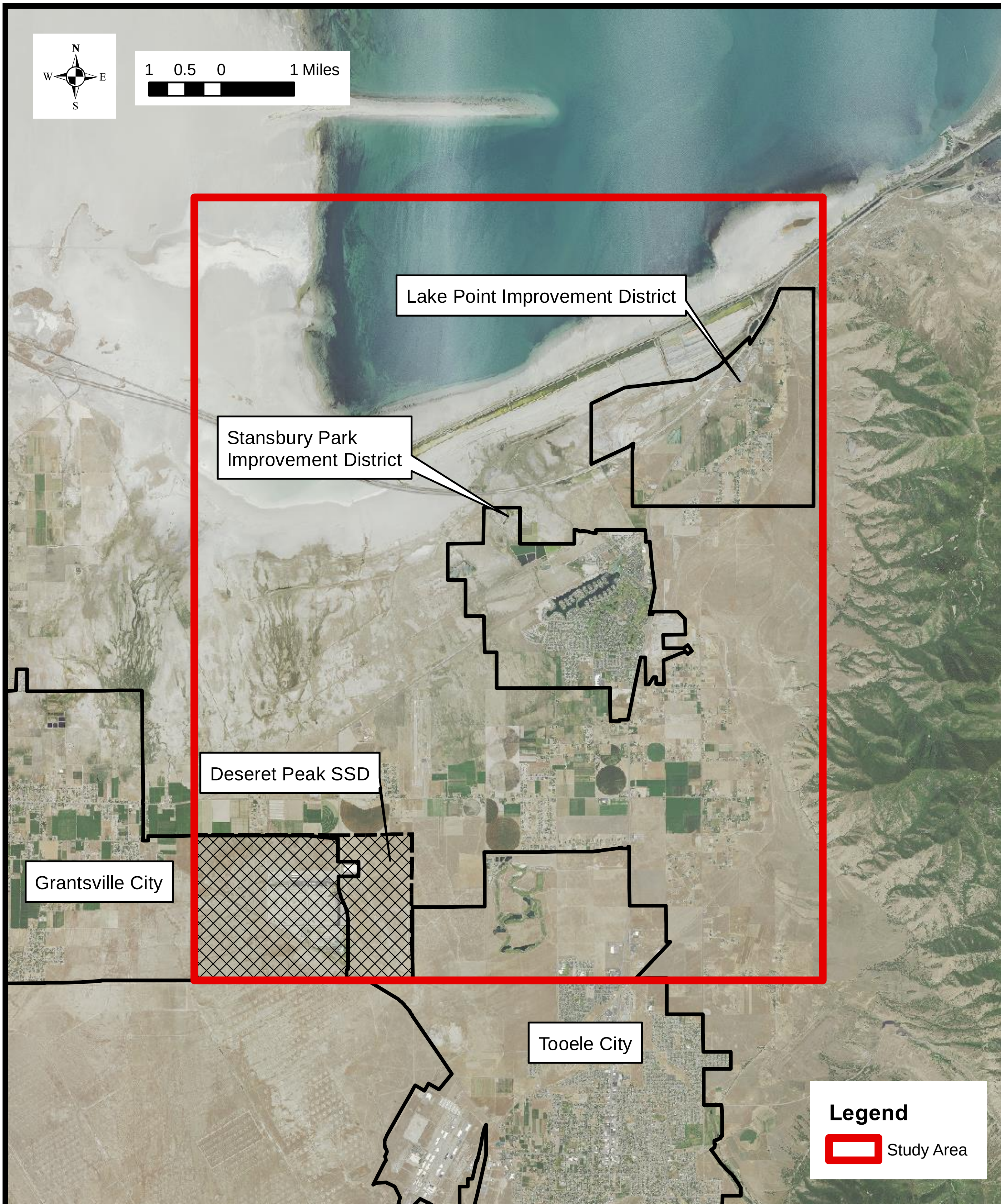
STUDY AREA

The general study area was initially identified by Tooele County as the unincorporated areas not served by a sanitary sewer system within the northern portion of the Tooele Valley. The study area was further refined during the study. A discussion of regionalized treatment has been included for the northern Tooele Valley. A more detailed treatment and conveyance evaluation is provided in the study for specific areas. The Deseret Peak Special Service District area is also included in the study. Figure 1-1 shows the study area, including the areas served by an existing sanitary sewer system.

PURPOSE

The purpose of this study is to evaluate alternatives for providing waste water service to the northern Tooele Valley. The study considers alternative locations and types of treatment, possible service areas, and types and sizes of conveyance. The study also estimates population growth, future population densities and wastewater loading parameters.

The first step of the evaluation, which is described in Chapter 2, is the septic tank density study. The septic tank density study confirmed concerns that ground water is at risk with continued development. Given the identified risk to groundwater, it was decided to explore the possibility of collecting and treating waste water. Stakeholders were contacted to gage support for creation of a waste water collection and treatment system. Several alternative collection and



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TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN
STUDY AREA

FIGURE 1-1

conveyance system layouts were prepared to identify the size and location of pipes, to determine the feasibility of a gravity flow system and to estimate costs.

CHAPTER 2 – SEPTIC SYSTEM DENSITY

SEPTIC SYSTEM DENSITY STUDY

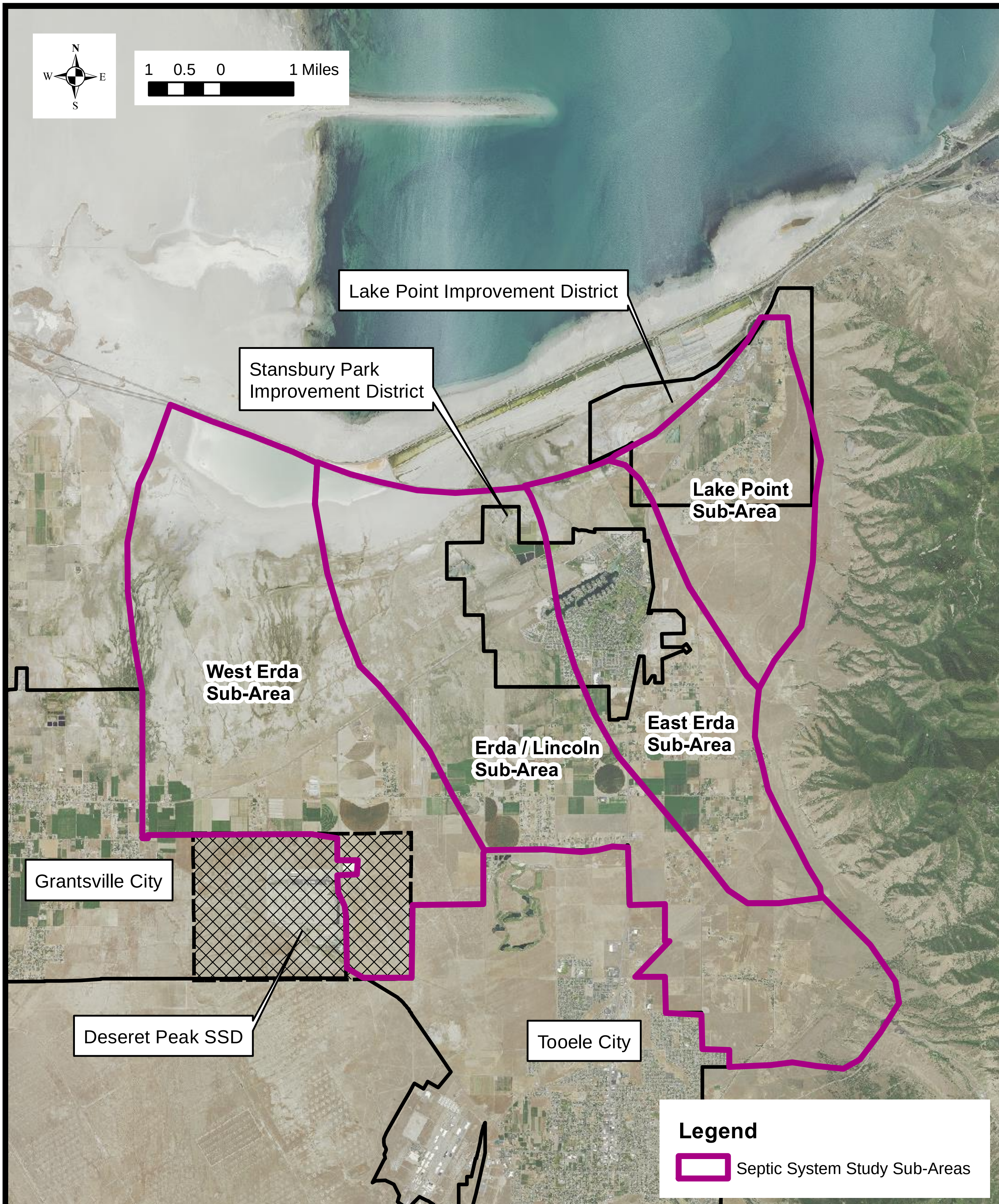
As part of this study, a septic tank density study was prepared under separate cover (HAL, March 2016). A summary of the results and findings of the septic tank density study are as follows:

The septic tank density study report summarizes the results of an evaluation of the impact of septic system discharges into groundwater within the Tooele Valley. The study area includes the unincorporated areas north and east of Tooele City and Grantsville. The purpose of the septic tank report was to recommend septic system densities that will protect groundwater for drinking water supplies.

A review of septic system density related studies demonstrates that throughout the United States, high septic system densities often result in degradation of groundwater quality. Existing regulations promulgated by the Utah Division of Drinking Water and the Division of Water Quality provide a basis for Tooele County to implement septic system density limitations for the protection of groundwater.

Nitrate was used as an indicator of septic system groundwater pollution because it is persistent in the groundwater, is easy to monitor, and because there is a reliable historical record from existing groundwater sources. Groundwater in Tooele Valley has been classified by the U.S. Geological Survey as Class I-A Pristine and Class II Drinking Water quality. Background nitrate concentrations in the mountain areas up gradient from human development in the Tooele Valley are less than 1 mg/L based on available information. Areas within Tooele Valley that are downgradient of development (including septic systems) have nitrate concentrations from 2 to 5 mg/L.

The study area was divided into 4 smaller subareas based upon hydrogeological conditions and groundwater flow paths within the valley. These include the Lakepoint Subarea, East Erda Subarea, Erda / Lincoln Subarea, and West Erda Subarea. Hydrogeological data for each subarea was used in a mass balance approach with risk analysis to determine septic system densities that would prevent nitrate concentrations from degrading to above 5 or 6 mg/L. The recommended septic system density is 6 acres per septic system in the Lakepoint Subarea and 5 acres per septic system in the other 3 subareas. Consideration should be made for existing subdivisions that currently exceed these densities (as dense as 1.2 acres per septic system). The boundaries of each of these subareas are included as Figure 2-1.



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TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN
SEPTIC SYSTEM SUB-AREAS MAP

FIGURE 2-1

CHAPTER 3 – REGIONALIZATION

INTRODUCTION

Given the findings of the septic tank density study, which indicate that prolonged reliance on septic tanks will likely lead to degradation of ground water, it is recommended that alternative waste water treatment technologies be evaluated and considered for implementation. Tooele County agreed with the recommendation and requested that a regionalization study be performed. This regionalization study looks at alternatives for the collection, conveyance and treatment of wastewater by means other than septic tanks.

REGIONALIZATION

Use of Existing Facilities at Neighboring Communities

Several alternatives for regionalized collection and treatment of waste water were considered. Nearby communities with infrastructure were contacted to determine whether they had available excess capacity or expandable facilities. The primary goal was to identify waste water treatment options, but conveyance was also considered, in case any existing pipelines had remaining capacity Since sewer service has not been provided in most of the unincorporated parts of the study area, little conveyance infrastructure is in place for these areas. New sewers will need to be constructed. Detailed descriptions of collection alternatives are included in Chapter 6. A detailed description of treatment alternatives is included in Chapter 7.

Administrative Structure

In order to manage a public waste water collection and treatment system, it is necessary to incorporate waste water system users within a political subdivision (body politic). This allows the collection of fees, management of the system and enactment of policies and ordinances. Given that much of the area within the study area isn't currently being served by a waste water collection system, it will be necessary to create an administrative framework by which to provide service. Tooele County is working with legal counsel to determine how to pursue the administrative structure. The following are potential alternatives for the administrative structure:

New Local District

Areas that are not currently served by a city or existing local district or improvement district could potentially be served by formation of a new local district. The new local district could provide collection services and/or treatment services. A new local district could also manage wastewater collection, but could contract with a city or other local district for treatment services.

Enlargement of an Existing Local District or City

Another alternative to provide waste water service is to expand the service area of an existing district or city. If an existing district or city has excess capacity or the ability to grow, and if they are willing to provide the service, the service boundary could be expanded and service provided.

TRANSITION FROM SEPTIC TANKS TO A WASTE WATER COLLECTION SYSTEM

For areas that are currently served by septic tanks, as development reaches the allowable development density limits, or as developers wish to build to higher densities, it will be necessary to transition from the septic tank system to a piped collection system. The following alternatives for transitioning should be considered:

New Development

Zoning ordinances and/or Health Department policies should be enacted that limit new development densities to the limits recommended by the 2016 HAL Septic Tank Density Study, if the developers and land owners intend to utilize septic tanks. These densities are either 5 acres per typical residential septic tank or 6 acres per typical residential septic tank (See Chapter 2). If greater densities are desired, sewers should be constructed to convey the waste water to treatment facilities.

Service Lateral and Connection Cost

It is anticipated that the cost of connecting to the sewer system will be borne by the developer.

Connection / Impact Fee

It is anticipated that an impact fee for the conveyance system and treatment will be paid by the developer.

Existing Development

It is recommended that once a sewer is installed near an existing developed lot, the lot owner should be required to connect to the sewer. In many communities, a connection will be required once the sewer line is within 300-feet of the sewer.

Service Lateral Cost

When new sewers are installed in a community with septic tanks, often the cost of lateral construction between the existing building and the "after the fact" sewer is borne by the property owner. However, in some instances, the community may provide funding for the connection in the form of a grant or loan.

Connection Fee

It is typical to charge a connection to cover the capital facilities costs. It is anticipated that Stansbury Park ID will charge a connection fee for access to the waste water treatment lagoons. A fee may also be required to pay for portions of the pipelines. However, if existing residents are actively paying off a bond, their contribution should be considered in the fee amount.

Schedule of Improvements

A critical aspect of building a waste water system is construction timing. One option is to obtain funding and then construct the facilities for the entire service area within a short time frame (1 to 3 years). This requires the initial connection of a relatively large number of customers as soon as the construction is done so that adequate fees can be collected and used to fund debt and operating expenses. This approach is effective as long as the number of users is in proper proportion with the capital expense. This approach is often used in small developed cities.

Another approach is to require developers to construct improvements as needed. Often, they are required to install the waste water facilities that are relevant to their development (i.e. sewers required to convey their waste to a connection point with the treatment plant), including facilities as shown in the master plan. When developers construct master planned facilities larger than they need, they may be eligible to receive compensation from later developers. The collection system will spread geographically as development continues. Existing buildings are usually required to connect once a sewer is constructed nearby. This approach often limits development of some properties until the collection system has been expanded to a reasonable distance from the proposed property for development.

STAKEHOLDER CONSULTATION

Key stakeholders were contacted to discuss the wastewater collection, conveyance and treatment needs in the northern Tooele Valley. Meetings or phone conferences were held with the Erda Acres, Grantsville City, Lake Point ID, Stansbury Park ID, Kennecott Utah Copper and Tooele City. Invitations were also extended to the Tooele Valley Airport but they declined to participate. A description of each participating stakeholder and a summary of the discussion is as follows:

Erda Acres

Erda Acres is a private water company in the Erda area. While the company doesn't provide sewer service, it is a key stakeholder because of the effects that a waste water collection system could have on existing and future residents, and because of the significance that a waste water collection system could have on water use and water quality. If a waste water collection system is created, greater land use densities would be possible. This could create a greater demand for water, some of which may be provided by Erda Acres if they approve additional connections.

A meeting was held with the Erda Acres Board of Directors and other interested members of the public. The discussion was informal in that no public vote or resolutions occurred, but several key ideas were expressed. Most Board members expressed an interest in maintaining control over the water system, and also expressed an interest in having a greater degree of input over planning and zoning issues. Some people expressed an interest in maintaining the rural nature of the Erda area and were opposed to higher density development.

Grantsville City

Grantsville is located in the northwestern part of the Tooele Valley. Grantsville provides water and wastewater service to residential, commercial and industrial development. Collection and treatment services are provided, with treatment being provided by wastewater lagoons. The lagoon facility was recently upgraded and has a design capacity of 1.9 million gallons per day (MGD), with current average day loadings of about 0.8 MGD.

Grantsville indicated that with the recent upgrade in capacity, they anticipate that they will have adequate capacity for many years. As a result, they indicated that there isn't a need to partner with other entities at this time. However, they indicated that they are willing to discuss any specific request or proposal related to water or waste water and consider ways they may be able to participate.

Lake Point ID

The Lake Point ID is located in the northeastern portion of the Tooele Valley and provides wastewater collection and treatment for residential and commercial development in the Lake Point area. Treatment is performed with wastewater lagoons. The waste water lagoons are effective in treating the wastewater in accordance with permit requirements. The lagoons have the capacity to serve about 900 equivalent residential units (ERUs). The approximate number of ERUs currently being served is 550.

There is a considerable amount of land available for additional development. Depending on zoning approvals and the real estate market, the future growth could exceed the lagoon capacity. The Lake Point ID has considered expansion of the lagoon system to accommodate the growth but has not prepared specific plans to expand at this time.

The Lake Point ID indicated that they support the idea of a regionalized treatment facility. They recognize that as the existing lagoons age or as additional capacity is needed, it may be beneficial to connect to a regionalized facility.

Stansbury Park ID

The Stansbury Park ID is located at the northern end of the Tooele Valley and provides water and wastewater service to about 12,000 people. The Stansbury Park ID has a collection and treatment system, with treatment being provided by a lagoon system. The lagoon system has been an effective treatment option. The lagoons currently are permitted for a monthly average flow of 1.5 MGD.

The Stansbury Park ID recognizes that their waste water collection system is located at the downstream portion of the Tooele Valley, and is therefore well positioned to receive wastewater from upstream development. The Stansbury Park ID also recognizes that their water sources could be at risk of contamination if the numbers of septic systems continue to increase. Stansbury Park ID indicated that they are willing to accept flow from existing and future development for the northern Tooele Valley. However, a critical aspect of accepting flow from areas outside of the current Stansbury Park ID service area is that current residents not be required to pay costs associated with the new service areas.

Kennecott Utah Copper

Kennecott Utah Copper (UKC) is a major land holder in the northern Tooele Valley. Kennecott was generally supportive of the concept of providing treatment in the area. UKC does not have conveyance or treatment facilities and would possibly participate as any land owner during land development.

Tooele City

Tooele City is located in the southern portion of the valley and provides water and waste water service to residential, commercial and industrial development. Tooele City recently completed an upgrade to the wastewater treatment plant so that the current capacity is approximately 3.4 MGD. Average daily flows are approximately 2.1 MGD.

The Tooele City Waste Water Treatment Plant (WWTP) currently receives flow from the Deseret Peak and Utah Motor Sports Park facilities via lift stations and a force main. It is understood that this may change as additional plans for conveyance and treatment are developed.

Since the Tooele City WWTP is located at the southern end of Tooele Valley, it is higher in elevation than most of the unincorporated area to be served. It may be possible to serve a few areas by gravity conveyance. It is also possible to pump the waste to the treatment plant, but the pumping costs increase substantially with distance from the treatment plant and with elevation.

Tooele City indicated that given the recent upgrades to the City treatment plant and given that the treatment plant is on the uphill side of the valley, it would not likely be feasible to participate in a regional plan. Tooele City has committed the excess treatment capacity to growth within the City so that the capacity won't be available for unincorporated areas. Notwithstanding this discussion, Tooele City is willing to entertain requests from the County and consider ways that they may be able to participate. Tooele City indicated a willingness to consider continuing to receive wastewater from the Deseret Peak and Utah Motor Sports Campus facility on a limited basis, although additional negotiations may be necessary.

Land Development Companies

Several land developers provided input. The developers expressed support for a waste water collection and treatment system since it would allow greater flexibility in development density and since it would allow greater potential for commercial and industrial development.

Overview of Stakeholder View Points

Generally, the stakeholders appeared supportive of the concept of creating a waste water collection and treatment system for northern Tooele Valley. Stansbury Park indicated an interest in protecting the existing groundwater sources that serve as the supply to their public water system. Stansbury Park also indicated that they are willing to expand their boundaries to include the new service area. Tooele City appeared supportive of the concept of providing waste water service to the area, but acknowledged that given Tooele City's location at a higher elevation and given the fact that the City recently completed a long term expansion of their own treatment plant, it would be unlikely that they would participate in any significant way. Grantsville City indicated that the City has recently upgraded their treatment facility, so moving operations to a new location would be unlikely in the near future. Lake Point Improvement District indicated that they have additional capacity, but that they are interested in discussing their potential role in waste water regionalization. Land developers were supportive of the creation of waste water collection infrastructure.

SUMMARY OF REGIONALIZATION ALTERNATIVES

The location of the Stansbury Park Improvement District (Stansbury Park ID) is geographically well suited to provide waste water treatment service, and is well suited to begin maintenance operations of new lines constructed in the study area. The geographical advantage applies both to its relatively low elevation and to its central location. This makes it easier to route flow from upstream sub-basins and will make it easier in the future to receive flow from neighboring communities, if connections with the additional service areas are made.

CHAPTER 4 – GROWTH, DENSITY AND FLOW PROJECTIONS

As noted previously, significant growth pressures exist within Tooele Valley. These pressures are due to the economic growth within the valley and due to pressures from the neighboring Wasatch Front area. While increased residential and commercial growth is occurring as a result of local economic development, growth is also occurring as a result of economic influence from the Wasatch Front. This includes many people who work in Wasatch Front communities and commute from their residences in Tooele Valley.

Because of proximity to the Wasatch Front, the northern Tooele Valley area is expected to continue as a prime growth area. Recognizing this growth pattern and the limited availability of waste water conveyance and treatment facilities in the area, Tooele County requested that this study include estimates of population growth and density. The estimates are not intended to involve complex land planning efforts, but are intended to provide population projections that can serve as basis for hydraulic loading predictions. This allows for pipe sizing estimates and for estimates of waste water treatment capacity expansions.

ASSUMED DENSITIES AND SERVICE AREA

A meeting was held with Tooele County personnel to establish a service area for population estimates. During this meeting, the types of future build-out land use and land use densities were assumed for planning purposes. The meeting focused on unincorporated areas not currently served by a waste water collection system. The land use types and densities were not based on existing land use zoning, since it is recognized that zoning may change. In fact, once a waste water collection system is available, there will likely be increased interest in densities higher than the current zoning. Therefore, Tooele County personnel based estimates on their judgement of possible future land use type and densities. Estimates of existing densities are based on aerial photography.

Figure 4-1 provides the service area, land use types and densities assumed for future build-out conditions in the northern Tooele Valley. Essentially, it is anticipated that there will be an expansion of waste water collection and treatment service for the land area between Stansbury Park ID on the north, Tooele City on the south, SR-36 on the east and Sheep Lane on the West. Additionally, a commercial area along SR-36 between the Stansbury Park ID and the Lake Point ID in included, as is the Deseret Peak Special Service District (including the portion within Grantsville City).

GROWTH PROJECTIONS

The number of existing and build-out (future) equivalent residential units (ERUs) was predicted based on the assumed densities and land areas. An ERU represents the hydraulic loading of the average residence. Commercial and industrial developments are quantified in terms of ERUs so that a single consistent method of loading quantification can be used. Growth projections were prepared so that anticipated densities could be estimated for different time periods. Growth rates were based growth rate estimates included in previous recently prepared master plans. The detailed breakdown and growth assumptions are provided in Appendix A.

Growth projections are primarily based on anticipated ERUs, however, an equivalent population estimate is provided. This is based on the US Census data for Tooele County which identifies the average number of people per household as 3.2. Therefore, it is assumed that an ERU includes 3.2 people.

Table 4-1 provides the estimated number of existing and future buildout ERUs, as well as intermediate years and assumed associated population.

Table 4-1. Estimated Existing and Future Build-Out Equivalent Residential Units

Area[1]	ERUs Existing	ERUs 30 Years	ERUs 50 Years	ERUs Build Out	Equivalent Buildout Population
Erda	518	2,836	4,926	12,874	41,200
Sheep Lane	58	318	552	1,602	5,100
Deseret Peak	549	1,333	2,407	3,449	11,000
TOTAL	1,125	4,487	7,885	17,925	57,300

[1]Area boundaries are provided on Figure 4-1.

It may be observed in Table 4-1 that based on the current projections, build-out may occur beyond a time period of 50 years. The equivalent population is predicted to be 57,300 people.

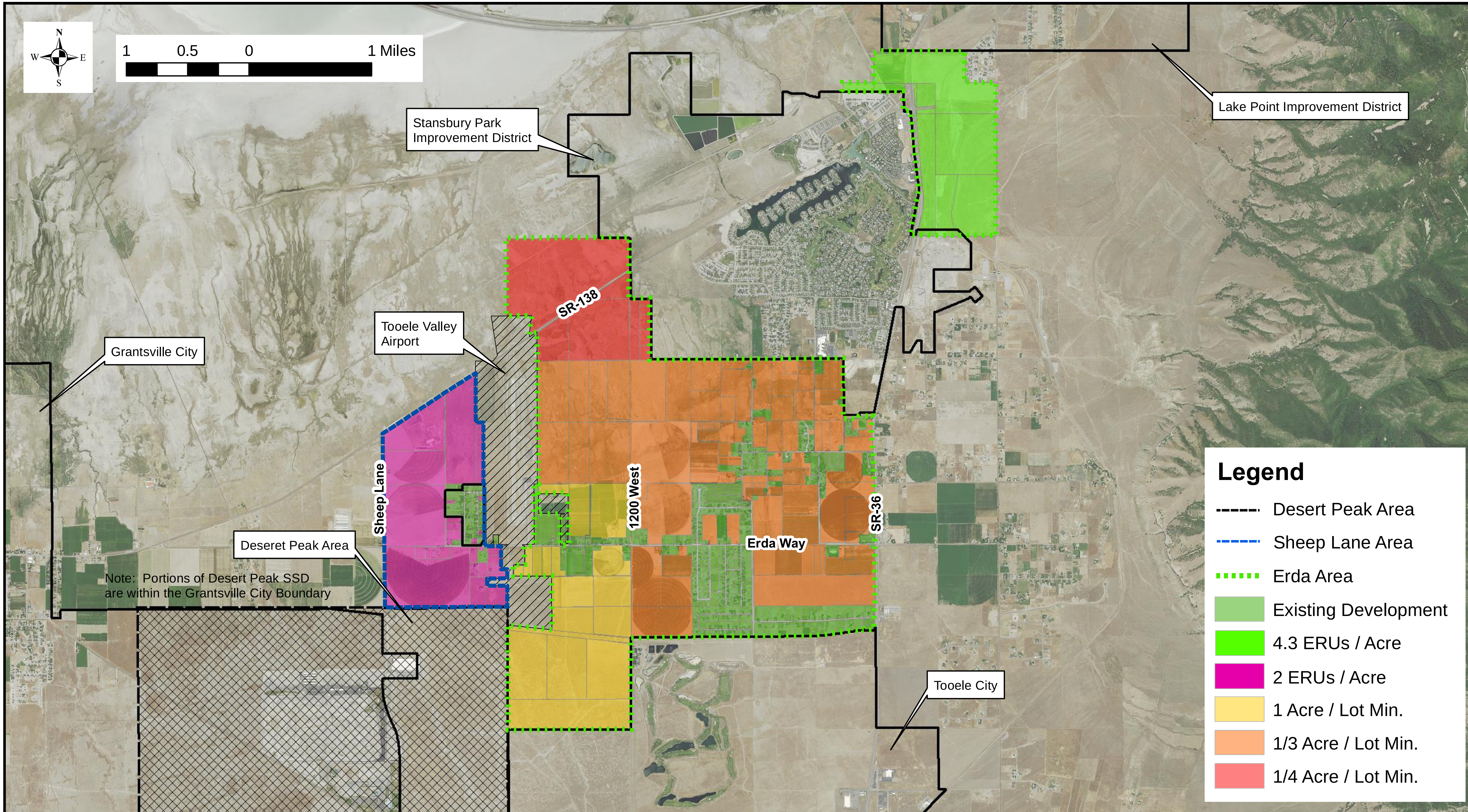
ESTIMATED WASTE WATER LOADING

Based upon the estimated number of ERUs and the population, hydraulic loading values have been calculated. An average hydraulic loading of 100 gallons/person/day is assumed. This information is provided in Table 4-2.

Table 4-2. Average Day Hydraulic Loading for the 50-Year and Build Out Alternatives

Area	Avg. Day Hydraulic Loading (Gal/ERU/Day)	50 Year Avg. Day Hydraulic Loading (MGD)	Build-Out Avg. Day Hydraulic Loading (MGD)
Erda	320	1.58	4.12
Sheep Lane	320	0.18	0.51
Deseret Peak	320	0.77	1.10
TOTAL		2.53	5.73

In Table 4-2, it may be observed that the build-out average day loading is approximately twice the predicted 50-year loading. This is a reflection of the fact that the future planning density is much larger than the existing rural condition of the areas.



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TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN

BUILD-OUT LAND USE DENSITY ESTIMATES
UNINCORPORATED AREAS

FIGURE 4-1

CHAPTER 5 – WASTE WATER CHARACTERIZATION

INTRODUCTION

It is anticipated that the waste water will consist primarily of residential wastes, with minor amounts of commercial and industrial waste. The commercial and industrial wastes are expected to be similar in nature to the residential waste or will be pre-treated.

INDUSTRIAL PRE-TREATMENT

Commercial and industrial facilities that contribute waste water to the conveyance and treatment system, and whose waste is different from typical residential waste, need to participate in an industrial pre-treatment program. This program will establish discharge parameters. The commercial or industrial facility will need to establish its own treatment processes so that the discharge parameters are met and so that the Stansbury Park ID system operations will not be affected.

DAILY FLOW VARIATION

Since a waste water collection system has not been constructed for the service area yet, specific patterns of daily flow variation do not exist. However, similar to other communities, it is anticipated that the flow will vary continuously throughout the day. The minimum flow generally occurs during the early morning between 2:00 and 4:00 AM. Maximum or peak week day flows will likely occur during the morning between 7:00 and 9:00 AM with a smaller peak in the evening between 8:00 and 10:00 PM.

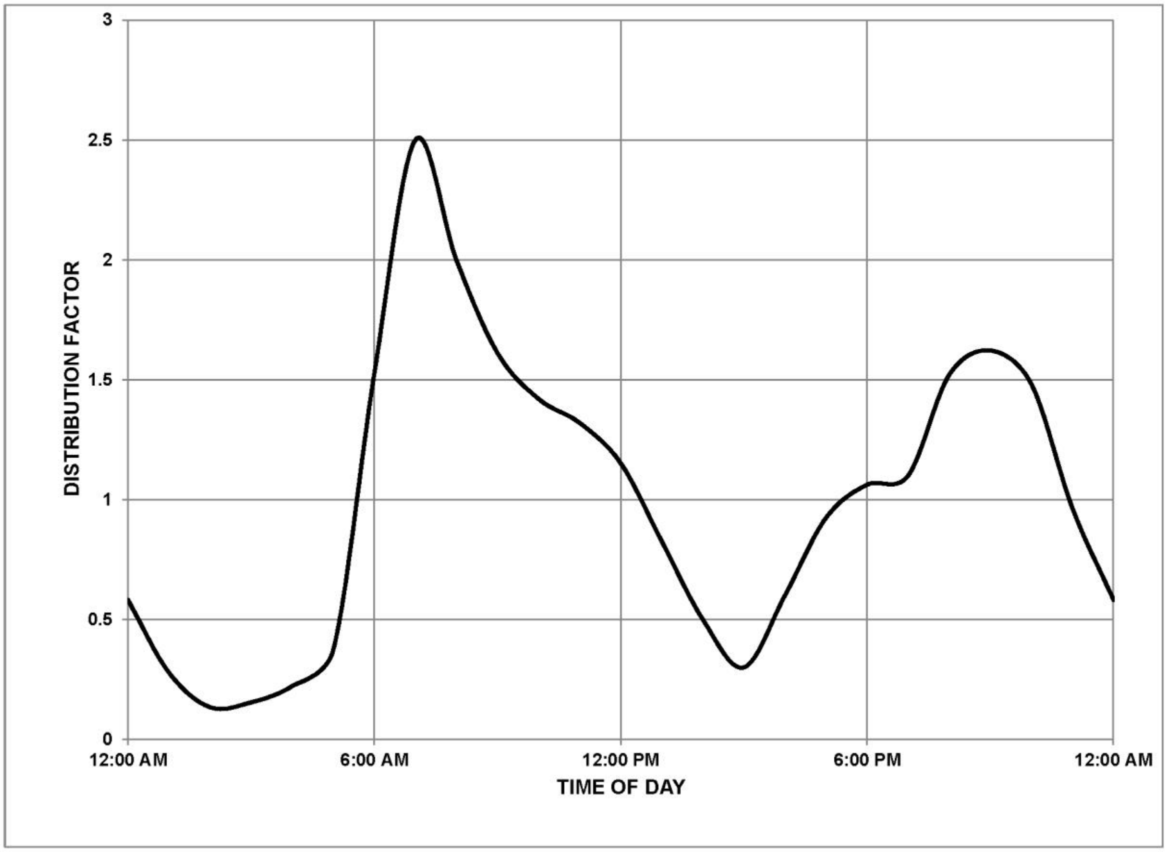
Peaking Factor for Conveyance

The modeled conveyance facilities are considered to be interceptors and outfall sewers. The peaking factor for modeling these facilities was assumed to be 2.5 times the average day values in accordance with state standards {R317-3-2.2 B 2 b U.A.C}.

Hydraulic Flow Distribution

A synthetic hydraulic flow distribution was developed for use in modeling. The flow distribution shape was based on data collected from waste water collection systems at other Utah locations. The shape was adjusted to include the desired peaking factor. The flow distribution is included as Figure 5-1.

Figure 5-1. Synthetic Hydraulic Loading Distribution



The loading distribution provided in Figure 5-1 is the fraction of the average daily flow that occurs at the indicated time. The peak flow of 2.5 times the average day flow occurs at 8:00 am.

ANNUAL FLOW VARIATION

Wastewater systems can experience annual flow variation due to seasonal inflow and infiltration. Each is discussed below.

Infiltration

Infiltration is defined as groundwater which enters a sewer system through pipe joints, cracks in the pipe, and leaks in manholes or building connections. Infiltration rates typically fluctuate throughout the year depending on the level of groundwater. Some cities, particularly in the western United States, where irrigation is commonly practiced, are subject to significant increases in infiltration during the irrigation season. Sewers constructed near irrigation canals and rivers or streams are particularly prone to infiltration. Sewers constructed in areas of high groundwater are susceptible to to infiltration.

Infiltration of groundwater into a waste water collection system can be a significant problem since the water consumes flow capacity of the sewer, increases the amount of waste water that must be treated and increases the volume of water that must be pumped at lift stations (such as at the Stansbury Park ID WWTP headworks). These effects increase the operating costs of the waste water collection and treatment system.

In some instances, a small amount of infiltration can be advantageous as it relates to hydrogen sulfide. The fresh infiltration water can dilute the waste, thereby reducing the risk of H_2S formation. The infiltrated water can also increase flow velocities and reduce transit times.

Groundwater levels in northern Tooele Valley are expected to be high in many locations. Therefore, the risk of infiltration is also expected to be high. While some infiltration is unavoidable, measures should be taken to minimize infiltration rates. Since all of the construction will be new, sewer design and construction practices should be implemented to minimize infiltration. All pipe joints and joints at connections into manholes should be sealed. Manholes section joints should also be sealed.

Inflow

Inflow is defined as surface water that enters a waste water collection system (including building connections) through roof leaders, basements, foundations, yard, and area drains, cooling water discharges, manhole covers, cross connections from storm drains, etc. As noted for infiltration, inflow into a sewer system can be a significant problem since the water consumes flow capacity of the sewer, increases the amount of waste water that must be treated and increases the volume of water that must be pumped at lift stations. These effects increase the operating costs of the waste water collection and treatment system. Items that contribute to inflow should not be allowed to connect to the collection system.

The effects of infiltration and inflows are anticipated to be small enough that they are addressed in the state standard planning rate of 100 gal/day/person as long the pipelines are designed to minimize infiltration.

EXTRAORDINARY FLOWS

Extraordinary flows are anomalous flows, holiday flows or other occasional flows that are higher that typical daily flows. Examples include holiday flows, such as the higher than usual flows that occur on Thanksgiving and Christmas in many Utah communities. Other examples include large discharges from industrial facilities in some communities. Since the northern Tooele Valley waste water collection system has not been constructed, extraordinary flows don’t yet occur. It is assumed that extraordinary flows have been addressed with the current peaking factors.

CHAPTER 6 – COLLECTION AND CONVEYANCE

INTRODUCTION

Collection and conveyance alternatives were developed and evaluated for the service area. The alternatives were based on the anticipated collection areas and treatment locations. For each alternative, a computer model was developed for the selection of pipe sizes and identification of flow velocities and predicted flow depths.

COLLECTION AREAS

The service area was divided into smaller collection areas. A collection area is defined as a geographic area that contributes flow to a common point in the collection system. The purpose of collection areas is to identify the hydraulic loading that is expected for each portion of the service area. This allows the amount of waste water flow and its discharge point into the sewers to be identified. Determination of the size of pipes needed throughout the system is then possible. The prediction of flow velocities and times of waste water travel is also possible. The locations of the collection areas are provided as Figure 6-1.

MODELING

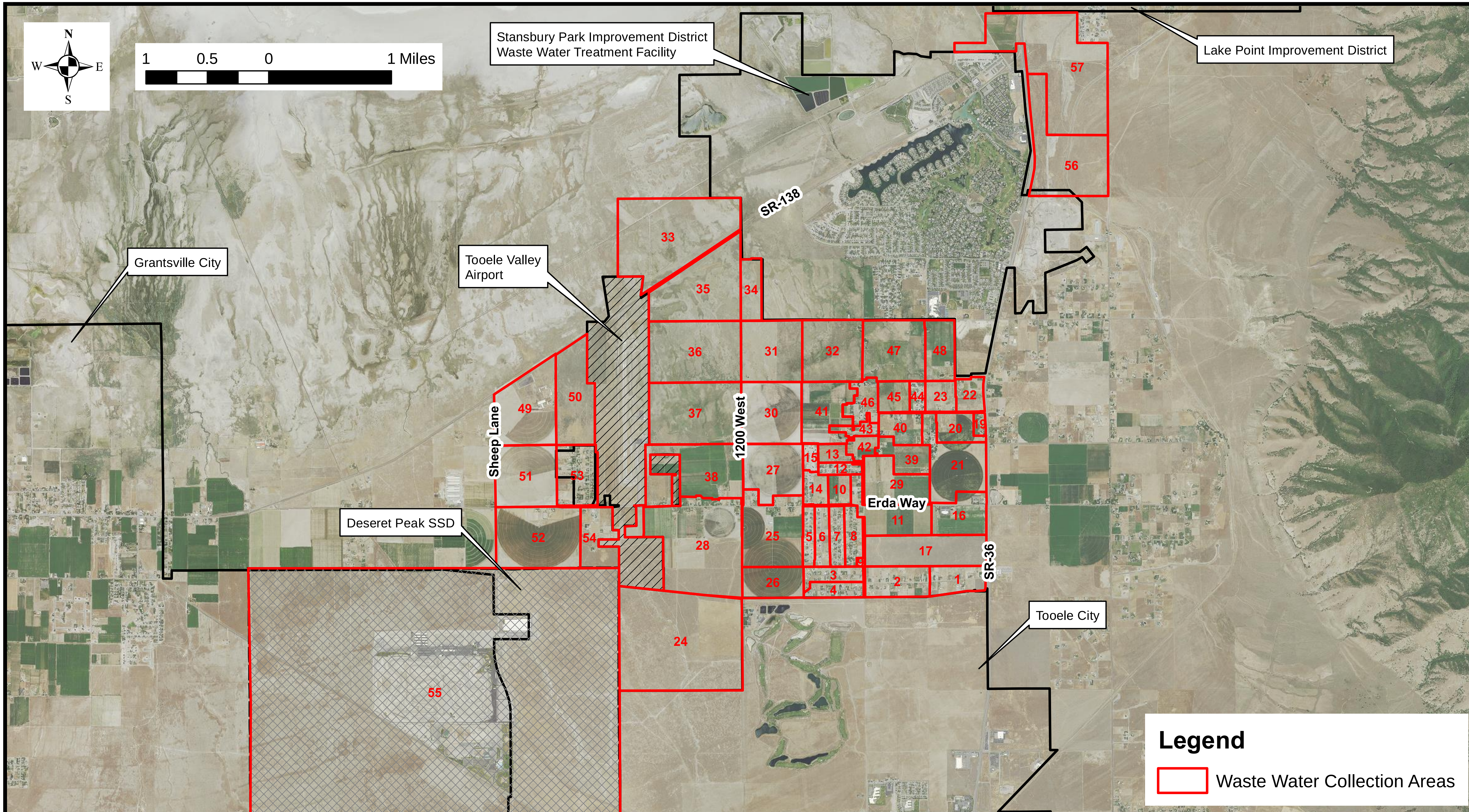
Model Selection

The Autodesk Storm and Sanitary Analysis (SSA) Model was selected by HAL for the modeling. SSA runs on an Environmental Protection Agency (EPA) SWMM Model platform and is free with the purchase of an AutoCAD Civil 3D license. Additionally, the model is readily exportable to the EPA SWMM software package which is available for downloadable from the EPA website without cost. The SSA and SWMM packages are specifically designed for sanitary sewer and storm water flows.

Basis of Elevation Data

The computer hydraulic models required topographic elevation data to determine the relative slopes of the ground surface and the pipes. These slopes, along with the pipe sizes determine the flow carrying capacity of the sewers. For this study, the primary elevation data used is the USGS National Elevation Dataset (NED) 10 Meter data available from the Utah Automated Geographic Reference Center (AGRC). While the elevation data are of good quality, are available at no cost and cover the entire study area, it is not as accurate as field surveying or project specific aerial photography. The accuracy of the data is considered adequate for this regional master plan study. However, land surveying will be required for design and construction. It is also important to note that a land survey may reveal differences between the NED and more accurate elevation data. Adjustments to the modeling may be necessary once more accurate data are obtained for design and construction.

After the study was initiated, Tooele County commissioned a survey of properties along what will be 1200 West, north of Erda Way. The survey also included portions of State Route 138



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TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN

WASTE WATER COLLECTION AREAS

FIGURE 6-1

and key infrastructure at the Stansbury Park ID lagoon headworks. The survey was conducted by Ensign Engineering and provided property boundary and topographic data. Once this data became available, elevations were adjusted to match the NED 10 data datum. Master plan sewer hydraulic modeling was also updated to include the more accurate data where available.

COLLECTION AND CONVEYANCE ALTERNATIVES

Collection and conveyance alternatives were developed in coordination with the Tooele County Board of Commissioners, Tooele County Staff, Stansbury Park Improvement District Board and Staff and the Tooele County Health Department. Alternatives were discussed in meetings and workshops. The key alternatives are provided as follows:

Do Nothing Alternative

The Do Nothing Alternative assumes that a conveyance system will not be constructed and that sewer service will continue to be provided by septic tanks. While this will continue to be the case in many parts of the service area for several years as the collection system is constructed, it is anticipated that septic tanks will function as transitional infrastructure. As indicated in the septic tank density study, the on-site waste water disposal approach is reaching a limit due to the density of development and the ground water aquifer formation's ability to absorb the waste. Therefore, if land development growth is going to continue, it will be necessary to collect and treat the waste. For this reason, the "Do Nothing" Alternative was not selected at the preferred alternative.

Conveyance to a New Local Waste Water Treatment Lagoon

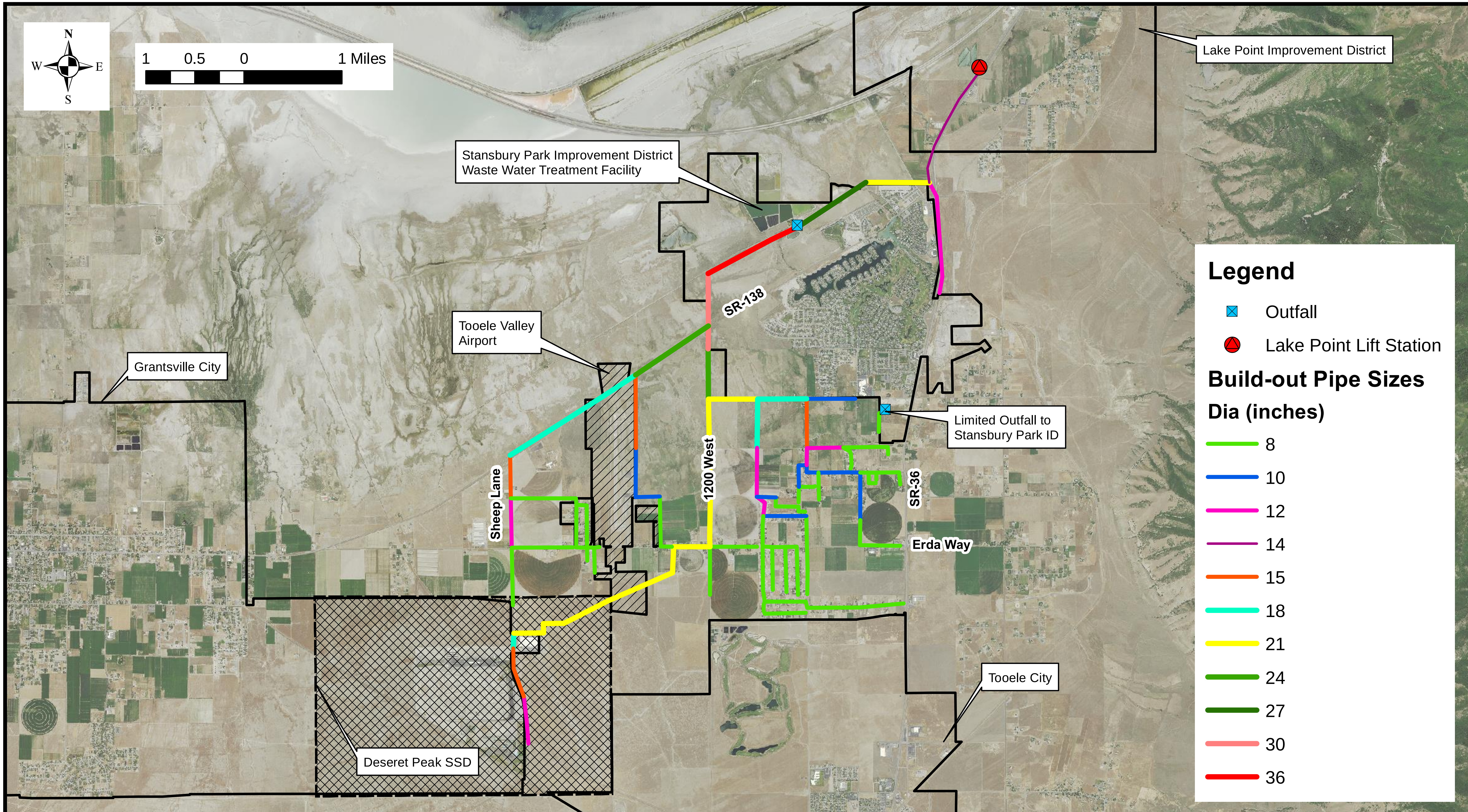
During the initial phases of the study, the possibility of conveying waste water to a new treatment lagoon was considered and a conveyance plan was developed. However, given the early commitment of the Stansbury Park ID Board to accept new flows, this alternative eliminated the need for the considerable additional upfront expenditure of a new lagoon.

Build-Out Alternative

The build-out alternative provides a plan for the collection and conveyance of waste water assuming that development reaches the densities provide as Figure 4-1 and described in Table 4-1 and Table 4-2. The sewer sizes and locations are provided on Figure 6-2. In Figure 6-2, it may be observed that the planned pipe sizes range from a minimum of 8 inches, in accordance with {R317 U.A.C.} to a maximum size of 36-inches for the outfall to the Stansbury Park ID lagoon headworks.

50-Year Alternative

It may be observed in Table 4-1 that the 50-year ERU population projection is approximately half of the build-out projection. Based on this, there was concern that constructing the build-out infrastructure may cause too great of an expense on the initial users (as opposed to the cost of future capacity being paid by future users) and may not be needed within the design life of the



HANSEN ALLEN & LUCE inc ENGINEERS

TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN

CONCEPTUAL COLLECTION AND CONVEYANCE PLAN
BUILDOUT ALTERNATIVE

FIGURE 6-2

facilities. As a result, the 50-Year alternative was developed. This provides a plan for the collection and conveyance of waste water assuming that development reaches the 50-year ERU levels provided in Table 4-1. The sewer sizes and locations are provided as Figure 6-3. In Figure 6-3, it may be observed that the planned pipe sizes range from a minimum of 8 inches, in accordance with {R317 U.A.C.} to a maximum size of 27-inches for the outfall to the Stansbury Park ID lagoon headworks.

50-Year Alternative (Temporary to Existing Stansbury Park ID Collector)

This alternative is the same of the previous alternative except that it recognizes the ability to temporarily utilize the recently installed existing "Basin 7 Sewer Trunk Line" constructed by the Stansbury Park ID. The trunk line was constructed in 2016 and will not be fully utilized for several years. If the trunk line were solely committed to the new study service area, and if growth occurs as projected, the sewer would be adequate for at least 10 years. However, it is more likely that the line capacity will be shared with both the Basin 7 users (as designed) and the new service area users. In this case, the ability to share the line will be less than 10-years although the exact time frame is difficult to predict. The sewer sizes and locations are provided on Figure 6-4. This alternative is the preferred alternative with the understanding that once the Basin 7 Trunk Line is nearing capacity, additional capacity will need to be constructed.

POSSIBLE INITIAL PROJECTS

Two initial projects have been identified that would serve immediate needs and could provide a starting point for the conveyance system. Additional sewer projects would be completed as the need arises. The initial projects are as follows:

1200 West Sewer

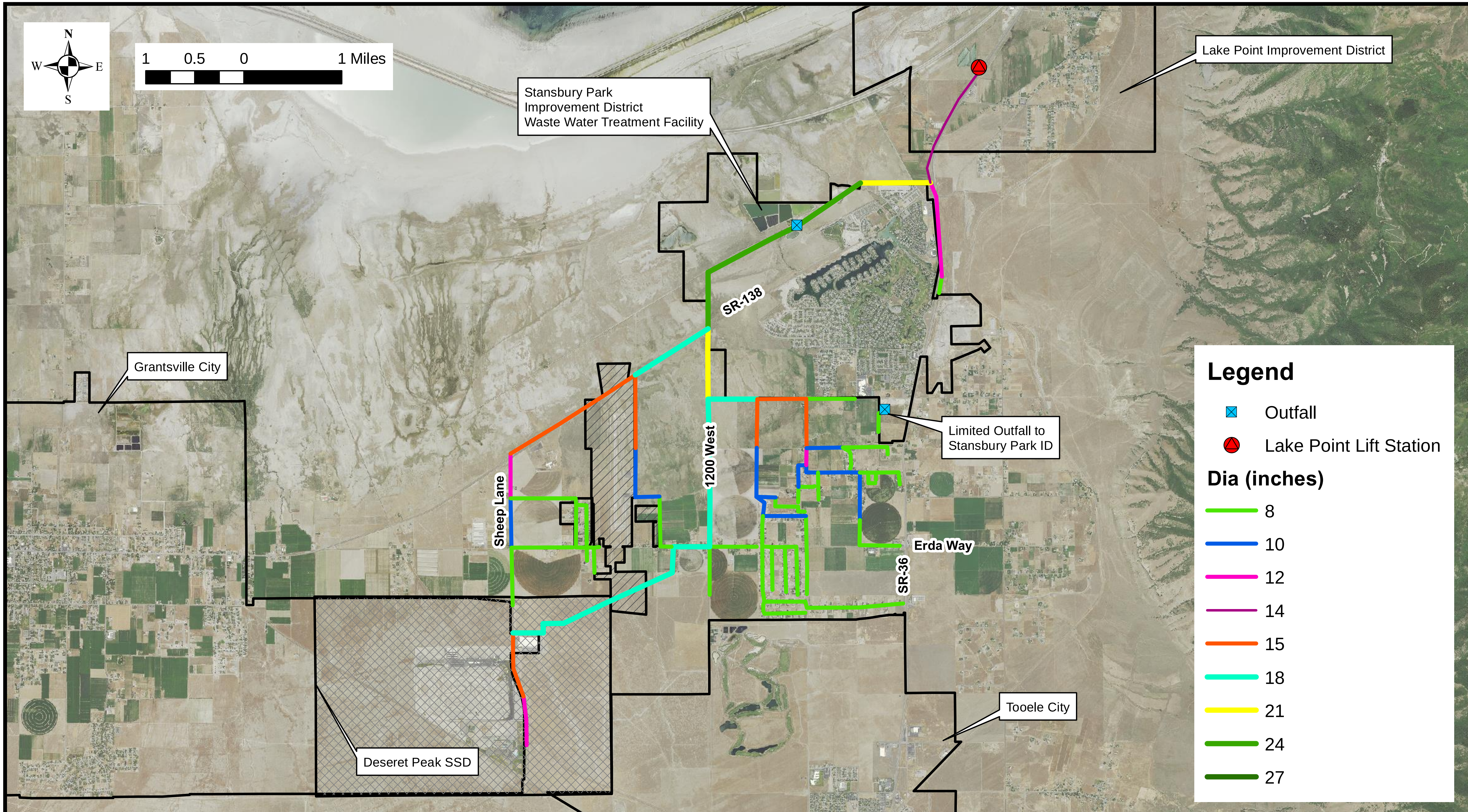
A possible initial project along 1200 West has been identified. This project, the 1200 West sewer would establish a primary collector which could serve as a starting point for the collection and conveyance system. This sewer would go north from 1200 West Erda Way to a connection point with the existing lagoon inlet. As a temporary measure, a connection with the existing Basin 7 Trunk Line in SR-138 could be made. The location of this project is shown on Figure 6-5.

Deseret Peak Connection

One feature of the master plan is a possible connection to the Deseret Peak Special Service District. This project would connect with the above noted 1200 West Sewer, and would continue the sewer to Sheep Lane and provide service to Deseret Peak SSD. The location of this project is shown on Figure 6-5.

ENERGY EFFICIENCY

The efficient use of energy was considered as part of the planning effort. A key goal was to minimize the use of lift stations, a primary consumer of energy in wastewater treatment

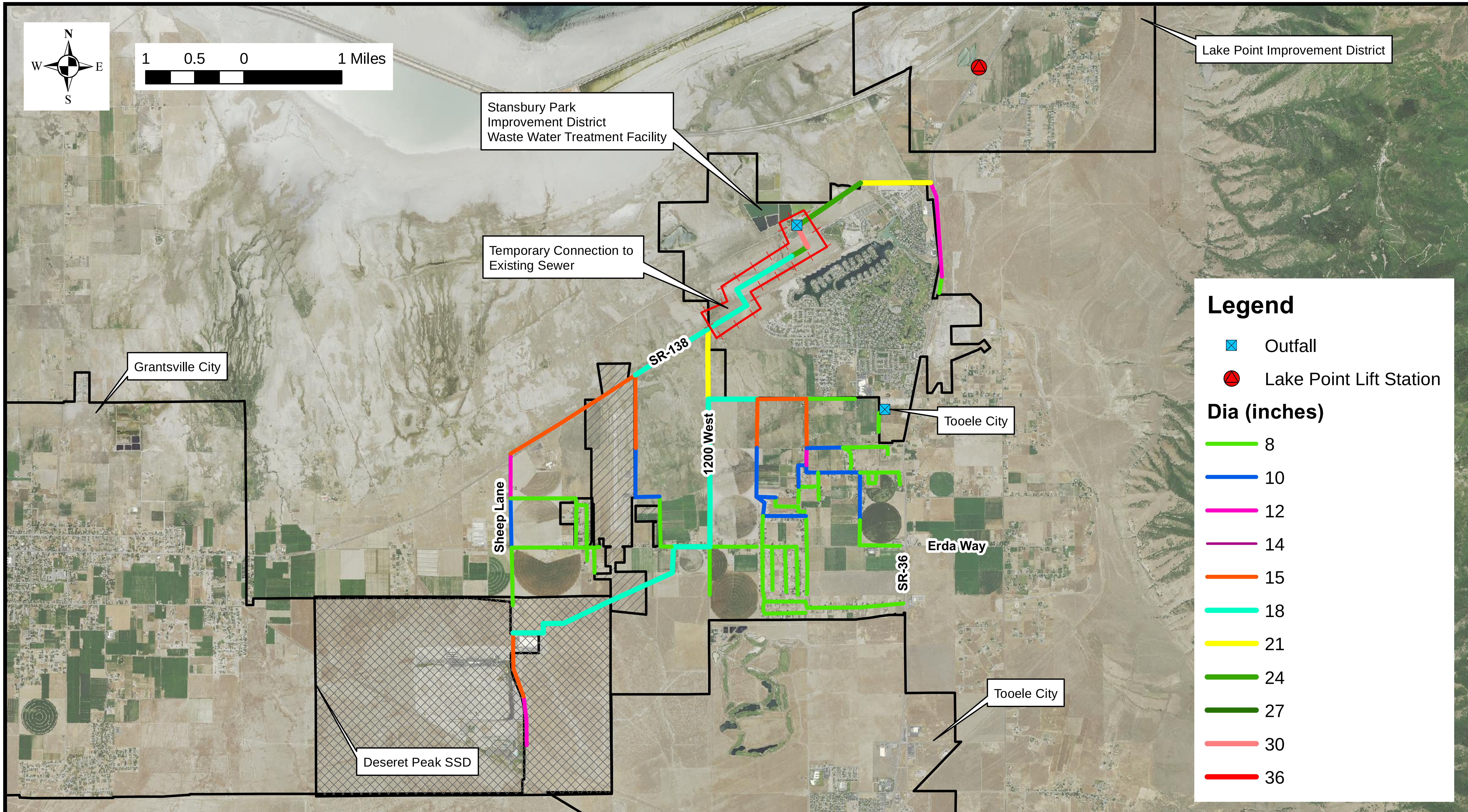


HANSEN ALLEN & LUCE INC ENGINEERS

TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN

CONCEPTUAL COLLECTION AND CONVEYANCE PLAN
50 YEAR ALTERNATIVE

FIGURE 6-3

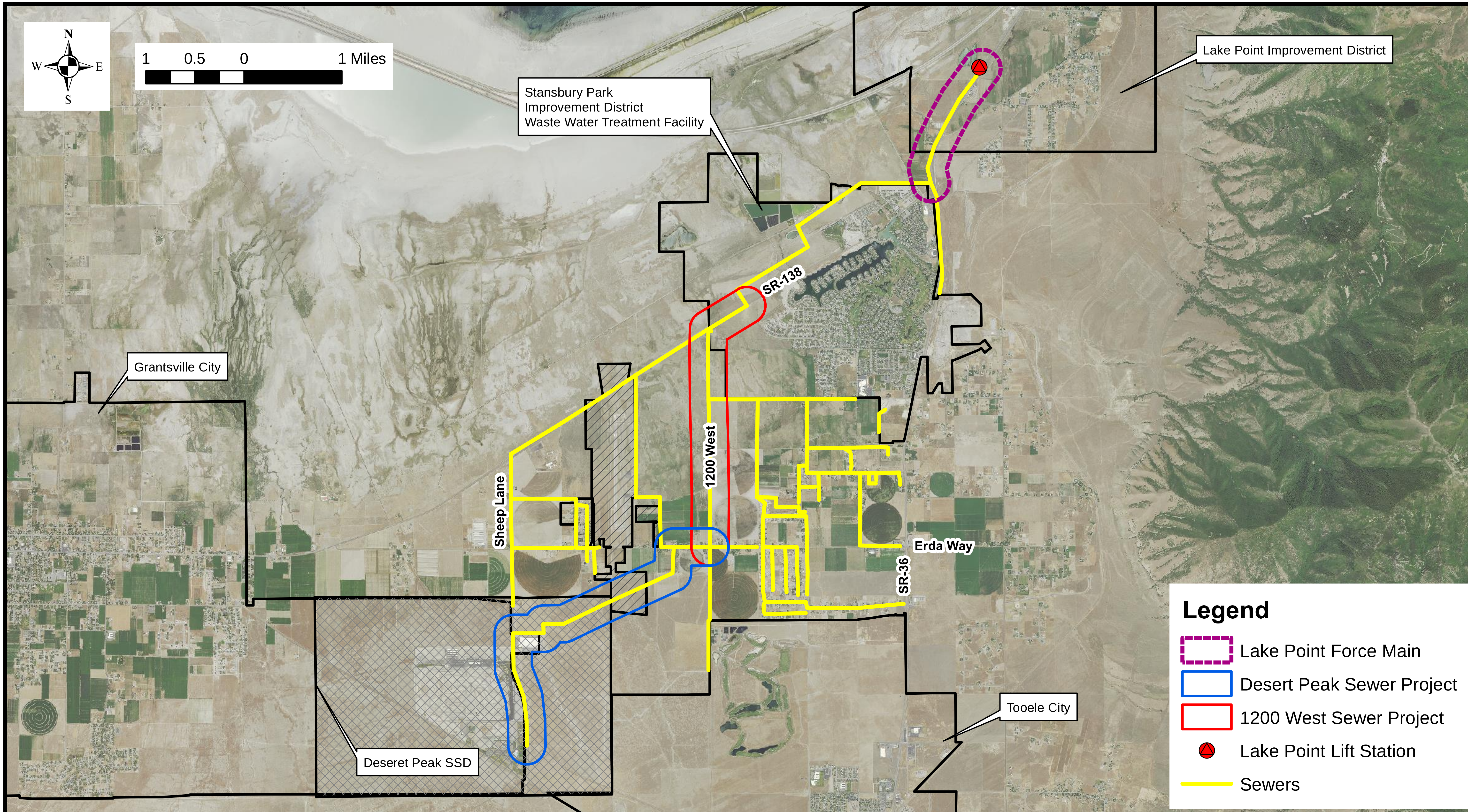


HANSEN ALLEN & LUCE inc ENGINEERS

TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN

CONCEPTUAL COLLECTION AND CONVEYANCE PLAN
50 YEAR ALTERNATIVE
(TEMPORARY CONNECTION TO EXISTING LINE)

FIGURE 6-4



HANSEN ALLEN & LUCE INC ENGINEERS

TOOELE COUNTY
NORTHERN TOOELE VALLEY
WASTE WATER REGIONALIZATION PLAN

PROJECTS MAP

FIGURE 6-5

systems. The system modeling demonstrated that waste water can be conveyed by gravity in most instances. It is also may be possible to eliminate a number of existing lift stations that are currently operating in the Deseret Peak area.

There are at least two instances that pumping may be required. All flow entering the waste water treatment facility will be pumped several feet at the headworks. The flow enters the headworks at an elevation below the lagoons and must be conveyed and lifted to the required elevation by pumping.

Flows also may need to be pumped from the Lake Point ID, if its current lagoon system is to be phased out and treatment provided by Stansbury Park ID. However, once the connection is being designed and once additional topographic survey data are available, further study should be conducted to determine if a gravity route is available.

HYDROGEN SULFIDE PRODUCTION

Hydrogen sulfide (H_2S) is a chemical byproduct of wastewater, under certain conditions, that can be dangerous to human health and can be corrosive to wastewater conveyance and storage systems. H_2S typically occurs as a gas which can occupy wastewater manholes, vaults, wet wells and pipes, and can cause corrosion. Facilities made of concrete are often damaged in H_2S environments through the formation of sulfuric acid.

While the science of H_2S is complex and the occurrence can be difficult to predict, it is most likely to occur in pipes with very mild slopes and flow velocities less than about 2 feet/second. Since gravity pipes in the northern Tooele Valley must conform to the existing mild slopes, the velocities are expected to be low, particularly when the collection system is new and growth has not yet occurred. As a result, there is concern that H_2S generation may occur. In order to assess whether H_2S is likely to occur, modeling results from several typical pipes were examined according to a methodology described in *Gravity Sanitary Sewer Design and Construction, ASCE Manual No. 60*. The assessment confirmed that there is a marginal chance of H_2S generation.

Given that the generation of H_2S has a marginal chance of occurring in the planned conveyance system, it is recommended that waste water operators enact safety measures to protect themselves during times they access the facilities. Air monitoring of sewers should be performed before entry. Personal protective safety equipment should also be used. Additionally, periodic testing the manholes should be performed to determine which areas, if any, are susceptible to H_2S production.

Pipes, manholes, wet wells and other equipment should be constructed of materials that are H_2S resistant. If concrete manholes are used, these should either be lined or constructed with concrete additives to mitigate the corrosive effects.

LOW SLOPE SEWERS AND MAINTENANCE

All of the sewers are planned with slopes that meet the minimum state standards. When flowing full, the flow velocity is expected to be high enough to maintain a clean pipe. However, before the full development occurs, flow velocities will be relatively low and maintenance levels will likely be higher than for typical sewers. This is particularly true for sewers generally oriented in an east-west direction since these sewers are expected to have relatively lower flow velocities. Sewers sloping to the north have steeper slopes and should have normal levels of maintenance.

Sewers with mild slopes area expected to have higher levels of H_2S build-up, as indicated previously, and higher levels of sediment build-up. Sewer videos should be performed on a regular basis to identify the locations and levels of sediment build-up. Sewers should be cleaned as needed.

CHAPTER 7 – WASTE WATER TREATMENT EVALUATION

INTRODUCTION OF TREATMENT ALTERNATIVES

Once waste water is collected and conveyed, it needs to be routed to a waste water treatment facility. An evaluation of water treatment options was considered as part of this study. Options for wastewater treatment are listed in Table 7-1.

Table 7-1. Treatment Alternatives

Item	Alternative
1	No Treatment Alternative
2	Treatment at Stansbury Park Improvement District Lagoons
3	Treatment at Lake Point Improvement District Lagoons
4	Treatment at Grantsville Lagoons
5	Treatment at Tooele City Waste Water Treatment Plant
6	Treatment at New Lagoons
7	Regional Treatment Plant Serving Northern Tooele County

DISCUSSION OF TREATMENT ALTERNATIVE LOCATIONS

A description and discussion of each alternative is provided.

No Treatment Alternative

The method of waste water treatment for existing development is on-site waste water disposal (i.e. septic tanks). As indicated in the septic tank density study, the on-site waste water disposal approach is reaching a limit due to the density of development and the ground water formations' ability to absorb the waste. Therefore, if land development growth is going to continue, it will be necessary to treat the waste. For this reason, the "no treatment" alternative is not identified as the preferred alternative.

Treatment at the Stansbury ID Lagoons

In the initial phases of the study, the Stansbury Park ID agreed to expand its service area and receive flows from the unincorporated portions of northern Tooele Valley. In additional to Stansbury Park ID's willingness to accept flows, the facilities are in a favorable location since they are downstream of much of northern Tooele Valley. This makes conveyance more efficient with gravity flow possible for most of the area. Treatment at the Stansbury Park ID Lagoons is the preferred alternative for treatment.

Treatment at the Lake Point ID Lagoons

The Lake Point ID lagoons were considered as a possible location for treatment. However, the lagoons would require additional piping, as well as pumping in order to convey waste water to the treatment site. Additionally, the lagoons are smaller than other options, with less room for expansion. The Lake Point ID lagoons were not selected as a feasible location for treatment expansion for the purpose of regionalized treatment.

Treatment at the Grantsville Lagoons

Treatment at the Grantsville Lagoons was considered and is feasible. However, the distance to the Grantsville Lagoons is greater for much of the service area and would require additional piping and possibly pump stations. This would lead to greater cost. Treatment at the Grantsville City lagoons was not selected as the preferred option for land within the planned growth areas.

Treatment at the Tooele City Waste Treatment Plant

The Tooele City waste water treatment plant was considered as an alternative to provide treatment of the northern Tooele Valley waste water. However, the Tooele City WWTP is higher in elevation than most of the service area and would require significant pumping, resulting in the related energy expense. Tooele City also expressed concern about using capacity of the City treatment plant. For these reasons, the Tooele City WWTP has not been identified as the preferred alternative for treatment.

Treatment at New Waste Water Lagoons

The construction of new waste water lagoons was considered and is possible, but less feasible than connecting with the Stansbury Park ID WWTP. In the short term, existing capacity can be used from the Stansbury Park ID lagoons, avoiding the expense and permitting effort required to construct a new facility. As actual growth occurs, fees can be collected and improvements can be made as the need arises.

Regional Treatment Plant Serving Northern Tooele County

The possibility of establishing a single mechanized treatment plant for the entire valley was considered. The assumption with this alternative is that existing treatment plants would cease operations, with all flows being routed to a common location. A specific location wasn't selected, but based on topography; the regional treatment plant would likely be located between Stansbury Park and Grantville and would be located 1 or 2 miles north of State Route 138. A regional treatment plant would require pumping to convey flows from outlying areas.

One factor that limits the feasibility of a single regional treatment plant is that Tooele City and Grantsville City have recently completed major improvements at their respective facilities. These improvements provide capacity for substantial future growth and have required significant capital investment. Both Tooele City and Grantsville City indicated that they are unwilling to dispose of the current facilities in order to incur additional expense at a new facility.

While a single regional treatment plant for all waste flows in the northern Tooele Valley remains an option in the long term, it likely won't be feasible for a couple decades.

DISCUSSION OF TREATMENT TECHNOLOGIES

In addition to reviewing the possible locations for waste water treatment, several treatment types were investigated. The type of treatment is relevant because of the costs, land requirements, and discharge characteristics of different treatment technologies. For example, waste water lagoons are a common choice among small and rural communities, including the communities in Tooele County, since they are relatively low cost and low maintenance. The lagoons are also popular in small and rural communities because the large land area required for the lagoons is usually available. However, as the amount of flow increases and as stricter discharge limits are applied by regulators, more sophisticated technologies are often required.

Water Works Engineers (WWE) evaluated the advantages and limits of various waste water treatment technologies. WWE reviewed the proposed population estimates, existing technologies being used within Tooele County and technologies used at other locations in Utah. Based on this information, WWE provided technology recommendations. A copy of the WWE study is included as Appendix B.

Summary of WWE Recommendations

WWE found that lagoons remain a feasible treatment technology as long as new more restrictive discharge limits for nitrogen, phosphorus or other constituents are not enacted. If needed, new nitrogen limits could likely be met by additional aeration or fixed film processes. Chemical addition would likely be needed to meet phosphorus limits. However, chemical addition would likely result in the need for more mechanical processes to handle new increases in solids production.

CHAPTER 8 – COST ESTIMATION

INTRODUCTION

Cost estimates have been prepared for the key alternatives. The purpose of the cost estimates is to provide guidance for funding planning and to allow cost comparison of different alternatives. Administrative and engineering costs are estimated as percentages. Cost estimates for treatment technologies are included within the Water Works Engineers Memorandum in Appendix B.

ACCURACY OF COST ESTIMATES

When considering cost estimates, there are several levels or degrees of accuracy, depending on the purpose of the estimate and the percentage of detailed design that has been completed. The following levels of are typical goals:

Type of Estimate	Precision
Master Plan	-50% to +100%
Preliminary Design	-30% to +50%
Final Design or Bid	-20% to +20%

For example, at the master plan level (or conceptual or feasibility design level), if a project is estimated to cost $1,000,000, then the precision or reliability of the cost estimate would typically be expected to range between approximately $500,000 and $2,000,000. While this may not seem very accurate, the purpose of master planning is to develop general sizing, location, cost and scheduling information on a number of individual projects that may be designed and constructed over a period of many years. Master planning also typically includes the selection of common design criteria to help ensure uniformity and compatibility among future individual projects. Details such as the exact capacity of individual projects, the level of redundancy, the location of facilities, the alignment and depth of pipelines, the extent of utility conflicts, the cost of land and easements, the construction methodology, the types of equipment and material to be used, the time of construction, interest and inflation rates, permitting requirements, etc., are typically developed during the more detailed levels of design.

At the preliminary design level, some of the aforementioned information will have been developed. Major design decisions such as the size of facilities, selection of facility sites, pipeline alignments and depths, and the selection of the types of equipment and material to be used during construction, will typically have been made. At this level of design the precision of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $700,000 and $1,500,000.

After the project has been completely designed, and is ready to bid, all design plans and technical specifications will have been completed and nearly all of the significant details about the project should be known. At this level of design, the precision of the cost estimate for the same $1,000,000 project would typically be expected to range between approximately $800,000 and $1,200,000.

At times, the cost estimating accuracy goals are not achievable. Factors such as availability of labor and materials, contractor perceived levels of competition, contractor assumptions, unidentifiable sub-surface conditions and other factors are not apparent until bidding. However, the costs provided are based upon actual construction costs and bids for similar work and represent the best currently available estimate.

COST ESTIMATES

Construction Cost Estimate

Construction cost estimate summaries are provided in Table 8-1. A detailed breakdown is included in Appendix C.

Table 8-1 Construction Cost Estimate Summary

Item	Build-Out Alternative	50-Year Alternative	50-Year Alternative (With SPID Line)
1200 West Sewer Project	$3,400,000	$3,000,000	$3,300,000 (See Note)
Deseret Peak Sewer Project	$2,600,000	$2,400,000	$2,400,000
Lake Point Lift Station	$1,100,000	$1,100,000	$1,100,000
Lake Point Force Main	$800,000	$800,000	$800,000
Other Sewers	$17,400,000	$16,900,000	$16,900,000
Sub-Total	$25,300,000	$24,200,000	$24,500,000
Engineering (@15%)	$3,795,000	$3,630,000	$3,675,000
Administration (@10%)	$2,530,000	$2,420,000	$2,4505,000
TOTAL	**$31,625,000**	**$30,250,000**	**$30,625,000**

Note: This 1200 West sewer project cost includes pipe along 1200 West, the 50-year permanent connection north of SR-138 to the lagoons and the temporary connection to the existing Basin 7 trunk sewer. The 1200 West project cost to the existing Basin 7 sewer trunk line (not including future sewers north of SR-138) is $2,400,000.

In Table 8-1, it may be observed that constructing the 50-Year Alternative is expected to cost between about $1 million and 1.5 million less than constructing the Build-out Alternative. The 50-Year Alternative with the SPID line is higher because it requires an additional temporary line to tie in with the existing Basin 7 Trunk Line.

It is notable that the cost difference between the build-out alternative and the 50-year alternative are predicted to only be about 4%. This is due to few factors. First, many of the smaller sewers (8-inches diameter) are the same for all alternatives since this is the state minimum size). Also, the cost of the pipe represents a small portion of the total cost of trench construction and so an increase in pipe size has a substantial increase in flow capacity, but a relatively small increase in cost.

Operations and Maintenance Cost Estimate

An estimation of annual operations and maintenance (O&M) costs has been prepared to assist with cost planning for the expansion. The costs include treatment and equipment maintenance costs, but not capital costs. The annual waste water budget for operations and maintenance was obtained for Stansbury Park ID and was divided by the number of ERUs to determine the O&M cost per ERU. The waste water cost per ERU for O&M is as follows:

Estimated Annual O&M Cost Per ERU = $120

This value was compared with other Utah Cities which were within the $120 to $150 range. Therefore, the estimated cost provided above appears to be reasonable.

Comparison of Costs

All of the preferred alternatives convey flows by gravity except for the lift station at Lake Point. The lift station is needed in all of the key alternatives. Therefore, O&M costs are not expected to change significantly between the alternatives and the cost comparison of alternatives can be based on construction costs.

CHAPTER 9 – MASTER PLAN

MASTER PLAN

A master plan has been developed for waste water collection, conveyance and treatment for the northern Tooele Valley. This plan has been developed based on the technical analyses and evaluations by Hansen, Allen & Luce, Inc., discussions with stakeholders and consultation with the Tooele County Board of Commissioners, the Tooele County Health Department and Tooele County staff. Key components of the plan are as follows:

Collection and Conveyance

It is recommended that either the Build-out Alternative provided in Figure 6-2 or the 50-Year Alternative provided on Figure 6-3 be selected by Tooele County as the preferred alternative. Currently {R317-3-2.2 U.A.C} requires that sewers be designed for the “ultimate tributary population or the 50-year planning period, whichever requires a larger capacity.” This rule appears to require that the build-out plan be selected unless a waiver is approved by the Director of the Utah Division of Water Quality.

For local (smaller) pipes, the Build-out Alternative and the 50-year Alternatives are identical so with either alternative, effectively the Build-Out Alternative will be selected. However, for the collector and outfall (larger) lines, Tooele County should consider seeking approval of the 50-year Alternative for the following reasons:

1. Given that the interceptors and outfalls are expected to be located within streets or easement corridors, the capacities of the lines should be readily expandable in the future.

2. If additional capacity is needed in the future beyond 50-years, it will be easier to fund additional capacity at that time since a larger user base will exist and greater impact fees are anticipated. This will reduce costs to current users and will more equitably distribute costs to the future users.

3. Conservative peaking factors have been applied to pipe sizing. This includes a peaking factor of 2.5 which has been applied to collectors and outfall lines in accordance with state rules. In actuality, data from other communities suggests that the peaking factor will likely be less than 2. Additionally, the pipelines with diameters of 15-inches or less have been master planned with a depth/diameter of generally about 0.5 or less, with larger interceptor lines at 0.75 or less. This is in accordance with ASCE Manual No. 60 recommendations. Based on these two conservative assumptions, it is predicted that the pipelines have significant reserve capacity in comparison with full pipe flow.

Waste Water Treatment

The preferred alternative is that waste water treatment be provided by Stansbury Park Improvement District. The District has agreed to accept the waste water as long as the funding can be arrange such that the existing customers will not be required to pay the cost of improvements or treatment for new development.

Operations and Maintenance

The preferred option is for the Stansbury Park ID to provide operations and maintenance. The District will expand its service area to include the area identified in the study and will provide O&M. It would also be possible to provide O&M service through a separate new special district that has not yet been established, if needed.

Connection of Existing Septic Tanks to New Collection Areas

It is anticipated that Tooele County will require sewer service connections for existing buildings when a sewer line passes within 300-feet of the building. At the time of connection, the existing septic tank will be abandoned. It is anticipated that the building owner will pay the costs associated with the septic tank abandonment and connection. However, it is recommended that alternative funding methods and grants be sought to reduce the burden on the property owners if possible.

Schedule of Implementation

It is anticipated that the construction of the 1200 West sewer and the Deseret Peak sewer will proceed first. These projects will be the beginning of the system. Other pipelines will be added later. It is anticipated that the construction schedule of specific pipelines will depend on the rate of development. As developments are planned at densities higher than 5 acres/lot, the developers will need to connect to the waste water collection system. It is anticipated that developers will construct local sewers as needed for the development and will connect the local sewers to the system for conveyance to the Stansbury Park ID lagoons. The interceptors and collectors shown in the master plan should be constructed at the indicated size by development. Additionally, Tooele County and the Stansbury Park ID may choose to construct sewers to help establish the system and to facilitate improvements to groundwater quality. In any case, development densities will be limited to 5 acres/residential septic system unless a connection can be made to an existing sewer that conveys flow to the waste water treatment facility.

OTHER RECOMMENDATIONS

Distance for Connection to Existing Sewers by New Subdivisions

Tooele County and the Tooele County Health Department are coordinating on interim policies for connection of new subdivisions to the collection system. One criterion for new development is to check whether there is an existing sewer nearby and if there is, the development must connect. For this criterion, the subdivision is considered to be nearby if a sewer is located within a distance equal to the 150-feet multiplied by the number of lots.

New Developments to Provide Dry Stubs

Given that the waste water collection system will develop over time and may not be available during the construction of new developments, it is recommended that Tooele County consider how to implement the connection of new developments with future sewers. One option would be to require all new buildings within the service areas to provide building piping to the front of the lot (and possibly to the property line) so that a connection can be easily constructed once sewers become available.

REFERENCES

1. American Society of Civil Engineers/Water Pollution Control Federation. (1982). Gravity Sanitary Sewer Design and Construction. Manuals and Reports on Engineering Practice No. 60.

2. Hansen, Allen & Luce, Inc. (May 2016). Tooele County - Septic System Density Study.

3. RSMeans. (2016). Heavy Construction Cost Data. Construction Publishers and Consultants.

4. State of Utah Administrative Code. (2016). {R317-3 Design Requirements for Wastewater Collection, Treatment and Disposal Systems}.

5. Janae Wallace & Mike Lowe. The Potential Impact of Septic Tank Soil-Absorption Systems on Water Quality in the Principal Valley-Fill Aquifer, Tooele Valley, Tooele County, Utah - Assessment and Guidelines. Report of Investigation 235. Utah Geological Survey. March 1998.

APPENDIX A
Population and ERU Estimates

Tooele County
Waste Water Master Plan
283.02.100
January 18, 2017

EQUIVALENT RESIDENTIAL CONNECTION AND POPULATION PROJECTIONS

Area	Existing	5 years	15 years	20 years	30 years	50 years	Build-Out ERUS	Build-Out Population	Notes
Unincorporated Erda Area (Study Area, Not SPID)	518	711	1,328	1,760	2,836	4,926	12,874	41,197	Assumes growth from Jones and Demille 2015 Regional Water Study[1]
Unincorporated Sheep Lane Area (West of Airport	58	80	149	197	318	552	1,602	5,126	Assumes growth from Jones and Demille 2015 Regional Water Study[1]
Stansbury Park ID	3,545	4,253	5,903	6,841	9,331	9,611	9,611	30,755	Build-out date is projected to be 2047. Growth rates from the Stanbury Park 2013 Waste Water Master Plan was used.[2]
Lake Point ID	550	638	857	993	1,335	2,411	7,570	24,224	Assumes 3% growth, for comparison
Deseret Peak SSD	549	636	855	992	1,333	2,407	3,449	11,037	Assumes 3% growth, for comparison
Total	**5,220**	**6,318**	**9,092**	**10,783**	**15,152**	**19,907**	**35,106**	**112,339**	

1. The specific growth rates were 6.5% through 2024, 6.4% through 2034, 4.9% through 2046, and 2.8 through 2066. These rates were applied to the Erda and Sheep Lane Area
2. The Stansbury Park growth rate was projected to be 3% in 2016. It was projected to climb to 4% by 2020 and then drop back to 3% by 2030 and stay at 3% untill reaching buildi-out in 2047.

Tooele County
Waste Water Master Plan
283.02.100
March 2017

Summary of Existing and Future ERUs and Demands
BUILD-OUT SCENARIO

SubZone	Existing ERUs	Future ERUs	Loading/ERU (Gal/ERU)	Existing Average Daily Loading (Gallon/day)	Future Average Daily Loading (Gallon/day)	MH	Existing Average Daily Loading (MGD)	Future Average Daily Loading (MGD)
1	12.0	23.7	320	3,840.00	7,575.20	Jun-40	0.00384	0.00758
2	16.0	16.0	320	5,120.00	5,120.00	Jun-41	0.00512	0.00512
3	20.0	20.0	320	6,400.00	6,400.00	Jun-37	0.00640	0.00640
4	17.0	17.0	320	5,440.00	5,440.00	Jun-39	0.00544	0.00544
5	27.0	27.0	320	8,640.00	8,640.00	Jun-14	0.00864	0.00864
6	17.0	17.0	320	5,440.00	5,440.00	Jun-34	0.00544	0.00544
7	35.0	35.0	320	11,200.00	11,200.00	Jun-35	0.01120	0.01120
8	31.0	31.0	320	9,920.00	9,920.00	Jun-36	0.00992	0.00992
9	2.0	2.0	320	640.00	640.00	Jun-27	0.00064	0.00064
10	4.0	42.0	320	1,280.00	13,424.00	Jun-32	0.00128	0.01342
11	9.0	219.7	320	2,880.00	70,312.00	Jun-28	0.00288	0.07031
12	19.0	19.0	320	6,080.00	6,080.00	Jun-43	0.00608	0.00608
13	27.0	27.0	320	8,640.00	8,640.00	Jun-60	0.00864	0.00864
14	26.0	73.5	320	8,320.00	23,520.00	Jun-15	0.00832	0.02352
15	26.0	26.0	320	8,320.00	8,320.00	Jun-44	0.00832	0.00832
16	6.0	243.3	320	1,920.00	77,864.00	Jun-74	0.00192	0.07786
17	0.0	454.2	320	-	145,336.44	Jun-96	0.00000	0.14534
19	4.0	4.0	320	1,280.00	1,280.00	Jun-70	0.00128	0.00128
20	14.0	103.9	320	4,480.00	33,232.00	Jun-66	0.00448	0.03323
21	22.0	414.7	320	7,040.00	132,711.99	Jun-48	0.00704	0.13271
22	12.0	69.0	320	3,840.00	22,084.00	Jun-78	0.00384	0.02208
23	3.0	95.1	320	960.00	30,416.00	Jun-77	0.00096	0.03042
24	2.0	463.4	320	640.00	148,282.88	Jun-105/Jun-118	0.00064	0.14828
25	15.0	383.3	320	4,800.00	122,656.00	Jun-81	0.00480	0.12266
26	0.0	200.7	320	-	64,232.00	Jun-97	0.00000	0.06423
27	0.0	329.6	320	-	105,456.00	Jun-103	0.00000	0.10546
28	29.0	421.1	320	9,280.00	134,755.84	Jun-119	0.00928	0.13476
29	3.0	270.6	320	960.00	86,584.00	Jun-59	0.00096	0.08658
30	0.0	390.0	320	-	124,800.00	Jun-100	0.00000	0.12480
31	0.0	400.0	320	-	128,000.00	Jun-101	0.00000	0.12800
32	4.0	409.5	320	1,280.00	131,048.00	Jun-18	0.00128	0.13105
33	0.0	1260.0	320	-	403,200.00	Jun-11	0.00000	0.40320
34	0.0	193.4	320	-	61,873.92	Jun-102	0.00000	0.06187
35	0.0	799.9	320	-	255,962.88	Jun-80	0.00000	0.25596
36	0.0	584.8	320	-	187,120.00	Jun-99	0.00000	0.18712
37	0.0	600.0	320	-	192,000.00	Jun-84	0.00000	0.19200
38	4.0	158.2	320	1,280.00	50,611.20	Jun-82	0.00128	0.05061
39	3.0	135.9	320	960.00	43,496.00	Jun-71	0.00096	0.04350
40	9.0	109.8	320	2,880.00	35,142.40	Jun-50	0.00288	0.03514
41	19.0	268.0	320	6,080.00	85,761.60	Jun-17	0.00608	0.08576
42	5.0	59.2	320	1,600.00	18,936.00	Jun-55	0.00160	0.01894
43	18.0	18.0	320	5,760.00	5,760.00	Jun-57	0.00576	0.00576
44	15.0	17.0	320	4,800.00	5,440.00	Jun-61	0.00480	0.00544

SubZone	Existing ERUs	Future ERUs	Loading/ERU (Gal/ERU)	Existing Average Daily Loading (Gallon/day)	Future Average Daily Loading (Gallon/day)	MH	Existing Average Daily Loading (MGD)	Future Average Daily Loading (MGD)
45	0.0	104.0	320	-	33,280.00	Jun-63	0.00000	0.03328
46	27.0	70.7	320	8,640.00	22,632.00	Jun-53	0.00864	0.02263
47	3.0	373.1	320	960.00	119,400.00	Jun-52	0.00096	0.11940
48	2.0	172.9	320	640.00	55,320.00	Jun-104	0.00064	0.05532
49	0.0	381.4	320	-	122,044.80	Jun-07	0.00000	0.12204
50	0.0	290.8	320	-	93,068.80	Jun-08	0.00000	0.09307
51	0.0	305.9	320	-	97,894.40	Jun-06	0.00000	0.09789
52	0.0	435.8	320	-	139,468.80	Jun-04	0.00000	0.13947
53	57.0	75.9	320	18,240.00	24,288.00	Jun-88	0.01824	0.02429
54	1.0	111.8	320	320.00	35,779.20	Jun-93	0.00032	0.03578
Deseret Peak SSD (55)	549.0	3449.0	320	175,680.00	1,103,680.00	Jun-113 & Jun-114	0.17568	1.10368
Gravel Pit Commercial (56 & 57)	0.0	1000.0	320	-	320,000.00	Jun-107	0.00000	0.32000
	0.0	1630.0	320	-	521,600.00	Jun-109	0.00000	0.52160
						TOTAL =	0.36	5.71

APPENDIX B
Water Works Engineers
Treatment Evaluation and Technical Memo

Tooele County
Wastewater Master Plan
Treatment Evaluation Technical Memo

Date: October 18, 2016
Prepared by: Scott Teeters
Checked by: Cory Christiansen, P.E.
Michelle Barry, P.E., PhD

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Introduction

Tooele County includes both incorporated and unincorporated communities located in the area South of Interstate 80 between the Oquirrh and Stansbury mountain ranges. The County currently houses a population of close to 69,000 people but is expected to grow significantly in the coming years. Specifically, the Northern portion of Tooele County, including Stansbury Park, which currently includes an estimated 5,220 equivalent residential units (ERUs), is projected to grow to approximately 31,610 ERUs in the next thirty years (Hansen, Allen & Luce, Inc). Infrastructure improvements will be necessary to accommodate the needs of this growing population, including construction of a wastewater collection system and the development of additional wastewater treatment capacity. Currently, the Stansbury Park Improvement District (SPID) owns and operates a system of facultative lagoons to treat the wastewater collected within its collection system. Many of the residences and businesses in the unincorporated portion of the County utilize septic systems for wastewater treatment and disposal. It is assumed that these septic systems will be eliminated in the future and the unincorporated portion of the County will be included in the SPID service area. The purpose of this technical memorandum (TM) is to provide an evaluation of the treatment capacity of the existing treatment lagoons and evaluate future treatment alternatives to provide both increased capacity and treatment to meet State discharge limits.

Lagoon Treatment

The SPID currently uses facultative discharging lagoons to treat municipal wastewater. This is a low-cost, low-operation treatment option that has been historically used in many communities to meet municipal wastewater treatment needs. In general, these types of lagoons consist of excavated basins that are lined to prevent leaching into the surrounding soils. One of the existing lagoons is equipped with aeration equipment. The other lagoons are left open to the atmosphere (open-air lagoons) and do not contain aeration or mixing equipment. This arrangement allows the environment's natural processes to treat the wastewater as aerobic, anaerobic, and anoxic layers form within the lagoons. This type of lagoon system is capable of providing five-day biochemical oxygen demand (BOD_5) removal up to 95%, significant nitrogen removal, and approximately 50% phosphorus removal[1]. However, the treatment capacity and capabilities of these lagoons is dependent on several factors. Winter time residence times must be longer than summertime residence times to provide sufficient time for treatment to occur at colder temperatures. Sludge accumulation at the bottom of lagoons can reduce the available volume, resulting in lower residence times and associated treatment capacity. For this reason, lagoons typically require periodic dredging and disposal of accumulated solids. Total Suspended Solids (TSS) concentrations from lagoon effluent can range from ≤ 30 mg/L to more than 100 mg/L depending on the algal concentration and design of discharge structures[1]. Typically, overflow cells are included to prevent the discharge of insufficiently treated wastewater during high flows associated with wet weather events.

[1] EPA Wastewater Technology Fact Sheet – Facultative Lagoons

Discharge Requirements

Discharge quality requirements are governed by the Utah Division of Water Quality. This department protects drinking and surface water bodies by regulating the quality of water entering these bodies. The Stansbury Park NPDES limits and pending nutrient limits on phosphorus and nitrogen as discussed below.

Current UPDES Permit

The lagoons are currently permitted to treat a design flow of 1 MGD with an operational flow of 0.75 MGD. The lagoons currently discharge to an unnamed ditch that flows to the North through a gravity flow pipeline beneath I-80. The discharge location is controlled by a manual gate that is operated to direct the effluent to either a wetland or a rapid infiltration basin. The water from the wetland eventually enters a playa that is separated from the Great Salt Lake by railroad tracks. The lagoons currently have a weekly maximum effluent limit of 65 mg/L BOD and 65 mg/L TSS.

Pending Nutrient Regulations

Phosphorus

In January 2015, the Technology-Based Phosphorus Effluent Limits (TBPEL) Rule, R317-1-3.3 went into effect for municipal wastewater treatment facilities in Utah. This rule establishes a maximum phosphorus discharge limit of 1.0 mg/L. The purpose of this rule is to reduce nutrient loading and subsequent algal blooms in waters of the State. The rule includes guidelines and requirements for lagoon-based treatment systems. Lagoons will be monitored to determine the annual load of phosphorus discharged from the facility. The rule indicates that the maximum annual amount of phosphorus that a lagoon will be allowed to discharge will be 125 percent of the current annual total phosphorus loading to the lagoon's receiving stream. Once this phosphorus cap is reached, the owner will have five years to construct treatment processes or implement treatment alternatives to prevent the lagoon from exceeding this phosphorus cap. It is assumed from the review of this rule that if a lagoon facility is replaced by a mechanical facility, the new facility will be required to meet the 1.0 mg/L total phosphorus discharge limit. It should be noted that the TBPEL Rule includes language indicating that the phosphorus limit may be reduced below 1.0 mg/L for a facility based on the assessment of the facility's receiving waters.

TBPEL and Phosphorus Loading Cap Exceptions

Variances regarding the implementation of the TBPEL rule were also specified by the Utah Division of Water Quality (UDWQ). Three exceptions that may apply to the SPID facility are summarized briefly below:

- The rule can be delayed if sewer costs that, as a result of implementing the TBPEL rule, result in a value greater than 1.4% of the median adjusted gross household income of the service area based on data from the Utah State Tax Commission after inclusion of grants, loans, and other funding.
- If the owner of a discharging treatment works can demonstrate that the TBPEL rule and associated phosphorus cap are unnecessary to protect water bodies downstream of the point of discharge, no limit will be applied. Wastewater effluent discharge to the wetlands and playa may reduce the need for phosphorus reduction in the effluent if it can be demonstrated to the State's satisfaction that higher phosphorus inputs to these areas will have minimal impact. Currently a consortium of wastewater treatment facilities and water districts is conducting a study to show that reducing phosphorus loading to

the Great Salt Lake will provide no environmental benefit. The results of this study may be useful in showing that the phosphorus cap for the SPID lagoons is not necessary, but the study results are several years from being finalized and it is not clear how the State will react to the study findings.

- The phosphorus cap can be avoided if the owner of a treatment works can demonstrate that phosphorus reduction can also be achieved using approaches such as water quality trading, seasonal offsets, effluent reuse, or land application.

These variances may be possible to avoid the phosphorus load cap established in the TBPEL, however, it must be noted that these variances must be revisited periodically to verify that the conditions for the variance remain applicable.

Nitrogen

The State of Utah is working towards implementing a similar effluent limit for nitrogen. Currently, the State is considering the establishment of an effluent nitrogen limit of 10 mg/L total inorganic nitrogen (TIN). As of 2016, no exact criteria or variances have been developed, but nitrogen removal capabilities must be considered for the North Tooele County wastewater treatment system since it is highly probable that a nitrogen limit will be imposed in the next five years. It is expected that the limit will be imposed on treatment lagoons similar to the phosphorus limit, with the establishment of the cap on nitrogen loading.

One possibility for nitrogen removal includes retrofitting the lagoons currently in place. Lagoons can be equipped with aeration equipment or integrated fixed film to allow for a higher removal of Total Kjeldahl Nitrogen (TKN) than facultative lagoons without nutrient removal upgrades. Aerated lagoons have been shown to remove an average of 74% of influent TKN through nitrification and denitrification[2]. In addition, integrated fixed film processes can be incorporated to naturally increase nitrogen removal. This process includes plastic media, which provides additional surface area for attachment of nitrifying and denitrifying bacteria. As a result, more TKN removal occurs without increasing the mixed liquor suspended solids concentration of the lagoon.

Both retrofit solutions could enable the SPID to remove enough nitrogen from the municipal wastewater to meet future regulations. However, simply retrofitting the lagoons will provide little capability for phosphorus removal. Based on the TBPEL limits, it is likely the SPID WWTP will need to be converted to a mechanical treatment plant at some point in the future to meet the lower phosphorous limits and capacity requirements of a growing population.

Service Area

Figure 1 shows North Tooele County and the anticipated development within this area. It is expected that a new collection system will be created to service the newly developed areas as the development occurs. It is also expected that the existing treatment lagoons will be expanded as needed to increase their treatment capacity.

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[2] Middlebrooks, Joe, et al. "Nitrogen Removal in Wastewater Stabilization Lagoons." 6th National Drinking Water and Wastewater Treatment Technology Transfer Workshop. 1999

As noted above, expansion of the lagoon system will be limited by their ability to address nutrient limits established by new State regulations.

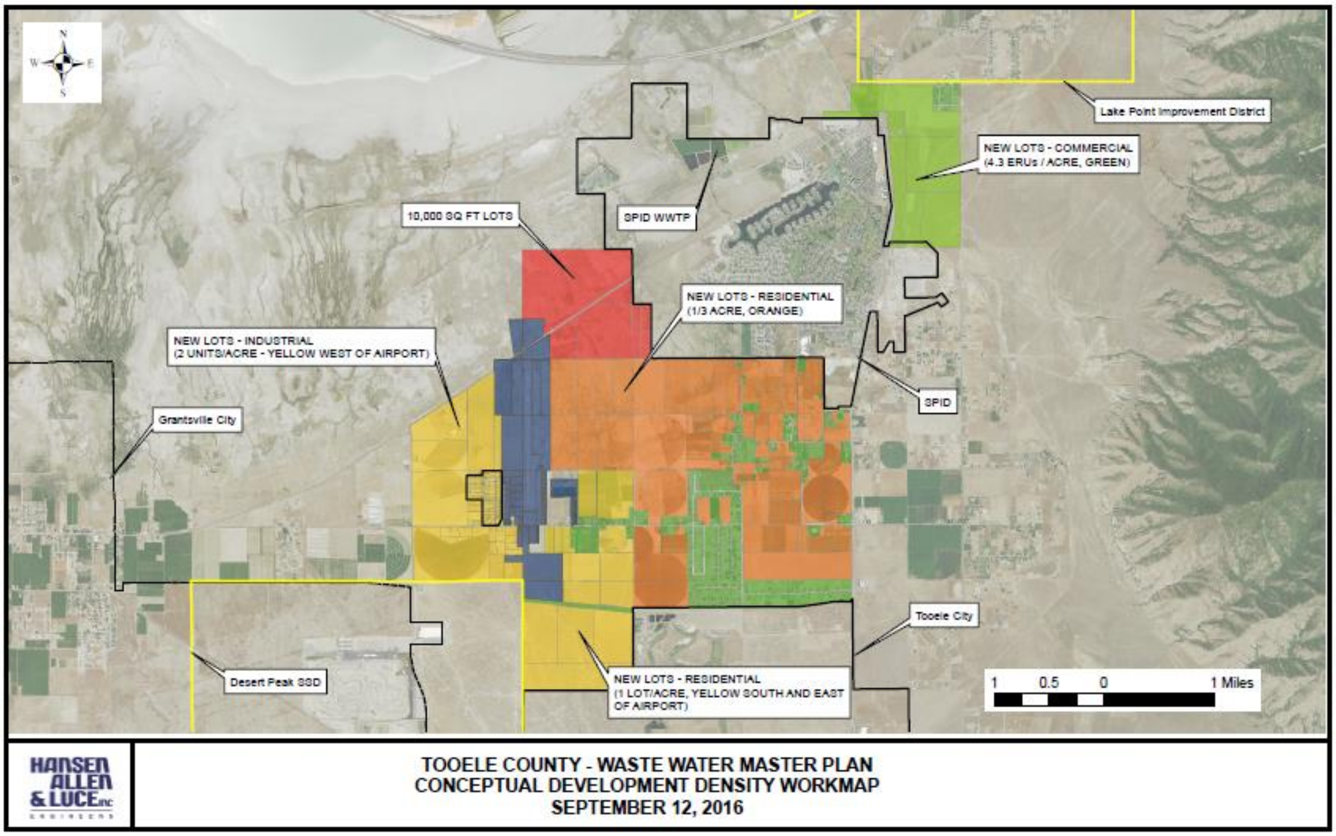

Figure 1. Stansbury Park Development Plan

Flows and Loads

Hansen, Allen & Luce provided the current and future flow estimates from each area of the County. Table 1 summarizes the estimated current and projected ERUs and associated wastewater flows for the service area. Estimated and projected BOD_5 and TSS loads were calculated based on guidelines of 0.22 lbs/capita-day and 0.25 lbs/capita-day respectively, and are also summarized in Table 1.[3] Utah Administrative Code R317-3-10 specifies a maximum loading rate for lagoons of 35 lb BOD/acre/day for treatment. This loading rate was used to calculate the minimum acres of lagoons required for each service. This information is also summarized in the table below.

[3] Utah Administrative Code R317-3-4

Table 1. Wastewater Flows and Loads Estimates and Lagoon Area Requirements

Area of SPID	ERUs[(2)]	Avg. Day Flows[(2)] (MGD)	BOD Load[(1)] (lbs/day)	TSS Load[(1)] (lbs/day)	P Load (lbs/day) [(4)]	N Load (lbs/day) [(4)]	Minimum Lagoon Area[(3)] (acres)
Estimated 2016 Values							
Unincorporated Erda Area	518	0.17	374	425	10	60	10.5
Unincorporated Sheep Lane Area	58	0.02	44	50	1.2	7	1.3
Stansbury Park	3545	1.13	2,486	2,825	68	400	71.0
Lake Point	550	0.18	396	450	11	63	11.3
Deseret Peak	549	0.18	396	450	11	63	11.3
TOTAL	**5,220**	**1.68**	**3,700**	**4,200**	**102**	**590**	**106**
Projected 2046 Values							
Unincorporated Erda Area	12,827	4.1	9,020	10,250	249	1450	258
Unincorporated Sheep Lane Area	1,602	0.51	1,122	1,275	31	180	32
Stansbury Park	9,611	3.08	6,776	7,700	187	1086	193
Lake Point	900	0.29	638	725	18	102	18
Deseret Peak	6,670	2.13	4,690	5,325	129	751	134
TOTAL	**31,610**	**10.1**	**22,240**	**25,280**	**613**	**3570**	**635**

(1) Utah Administrative Code R317-3-4 recommends use of 0.22 lbs/capita-day BOD5 and 0.25 lbs/capita-day TSS and 100 gal/capita-day
(2) Data provided by Hansen, Allen, and Luce (2016)
(3) Utah Administrative Code R317-3-10 recommends maximum loading rate of 35 lb BOD/acre/day for non-aerated lagoons
(4) Sedlak, Richard. Phosphorus and Nitrogen Removal From Municipal Wastewater Principles and Practice, 2nd edition. Lewis Publishers, 1991. Values of 16 g N/capita-day and 1 kg P/capita-year taken to estimate nitrogen and phosphorus load.

The current SPID lagoons are 121 acres, sufficient area to treat flows up to 1.92 MGD (approx. 5,900 ERUs). If lagoon treatment is continued at the SPID WWTP, more than five times the current acreage of lagoons will be needed by 2046. Additionally, State regulations may prevent expansion of the lagoons. Utah State Code R317-3-10 requires a minimum buffer of 0.25 miles between lagoons and areas developed for residential, commercial, or institutional purposes. This regulation will likely limit the expansion of the SPID treatment lagoons to the east or the south. Additional land appears to be available to the west and north of the existing plant, however pending nutrient removal limits may also restrict expansion of the lagoon system.

It is also reasonable to consider the construction of a new lagoon treatment system located in the County. The lagoon system will require approximately 106 acres for the near term and 635 acres at build-out. The development of a new lagoon system will also require the 0.25-mile buffer area discussed above. This option may be viable if the expansion of the SPID facility proves to be undesirable, or if a location is available that can create enough cost savings for conveyance and operations to cover the cost of the development of a new site.

Mechanical Treatment Alternatives

Based on the phosphorus cap rules included in the TBPEL for lagoon systems, a mechanical treatment plant upgrade will likely be required in the future for the SPID WWTP. The timing of this upgrade is impacted by both the potential rule exemptions discussed previously, and the growth rate of the service area. There are several treatment alternatives available for future upgrade of the SPID WWTP to meet pending nutrient limits, including conventional activated sludge, extended aeration (oxidation ditches), sequencing batch reactors (SBRs) and membrane biological reactors (MBRs).

Conventional Activated Sludge

Conventional activated sludge treatment consists of a biological reactor where microorganisms responsible for treatment are aerated and kept in suspension, a liquid/solids separation process (e.g., sedimentation), and a recycle system for returning a portion of the separated solids (i.e., return activated sludge, RAS) back to the reactor. Various configurations can be utilized to achieve biological nutrient removal (BNR) sufficient to meet pending nutrient limits. A common configuration is the Modified Ludzack-Ettinger (MLE) process, which consists of an anoxic zone located ahead of aeration basins (Figure 2).

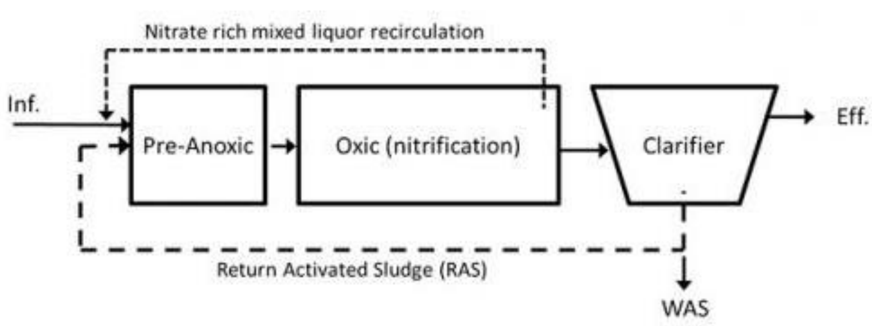

Figure 2. Modified Ludzack-Ettinger Process

The anoxic zone receives influent wastewater, RAS, and recycled mixed liquor from the end of the aerobic zone. Using this configuration, nitrates produced in the aeration basins through nitrification are denitrified in the anoxic zone. Additionally, MLE allows for swing zones that can be used to meet nitrogen limits as wastewater characteristics vary. There are various adaptations and configurations of the MLE process that can be employed to meet the treatment requirements of the facility. The configuration utilized is typically selected based on the evaluation and modeling of the wastewater characteristics.

Extended Aeration

Extended aeration processes include similar treatment strategies as the activated sludge process, but utilize larger tankage to achieve much higher residence times in the system. Larger aeration tanks (e.g., oxidation ditches) with longer (> 20 days) solids retention times (SRTs) are used. This process is best employed where space is not limited and less complex operation is preferred. Large aeration tank volumes provide good equalization for flow and load variations and produce a high-quality effluent. The systems can be configured to promote both nitrogen and phosphorus removal through the use of anoxic and anaerobic zones. Mixed liquor recycle is often achieved using a flow control gate located in the aeration zone, eliminating the need for mixed liquor recycle pumps. Similar to the activated sludge process, solids are separated from the liquid stream using final clarifiers. A portion of the solids are returned to the reactor using RAS pumps. The solids not recycled are wasted and must be dewatered and hauled away for disposal.

Sequencing Batch Reactors

Sequencing batch reactors operate as fill-and-draw reactors with non-aerated mixing, aeration, and clarification occurring in the same tank. The operational sequence includes the following steps: (1) fill, (2) react (aeration), (3) settle (sedimentation/clarification), (4) decant, and (5) idle. Normal cycle time is approximately 5 hours. For continuous flow applications, a minimum of two SBR tanks must be used. Sludge wasting is not included as one of the five steps, but is a vital step in the SBR process. SBRs are typically used for smaller (<10 MGD) capacity plants due to the equipment and tank requirements inherent in the fill/draw operation. There is no need for RAS pumping because aeration and settling occur in the same chamber. SBR systems can be difficult to operate during periods of rapid changes in flow such as significant wet weather events. This difficulty in operation can be addressed through the inclusion of more units, or the use of flow equalization basins if flow variations are expected to be significant and common.

Membrane Biological Reactors

Membrane biological reactor processes are activated sludge processes that utilize membranes rather than clarifiers for solids separation. MBR treatment processes consist of suspended growth biological reactors with solids separation via microfiltration membranes (nominal pore size ranging from 0.1-0.4 µm). Membranes are typically submerged in the biological reactor, but can be a separate unit process similar to secondary clarifiers in a conventional activated sludge process as well. MBRs produce an effluent quality similar to a combination of secondary clarification and effluent microfiltration, and can therefore be used to produce reuse quality effluent. Similar to conventional activated sludge, MBRs can be operated in an MLE configuration. MBR systems allow operation at much higher mixed liquor suspended solids (MLSS) concentrations, which reduces the necessary volume of the aeration basins. MBR systems do not respond well to rapid changes in flow, thus equalization basins are often included onsite for MBR systems to provide equalization of wet weather flows.

Biological Nutrient Removal and Chemical Phosphorus Removal

BNR is accomplished in a similar manner for each of the technologies described above. This includes an anaerobic zone/cycle to condition the biology for phosphorous uptake, and anoxic and aerobic zones/cycles to facilitate phosphorus uptake, nitrification and denitrification. Due to the pending nutrient regulations for phosphorus and nitrogen in the State of Utah, each of the above processes was considered to require BNR processes, as well as the ability to feed chemical for phosphorus removal if necessary. It is important to note that while BNR can be utilized to bring phosphorus to below 1 mg/L as required in the TBPEL, reliably reaching a lower concentration of 0.1 - 0.6 mg/L of phosphorus will require chemical addition followed by tertiary filtration for conventional activated sludge, extended aeration, and SBR systems. MBRs have been shown to be capable of meeting a lower phosphorus limit (<0.1 mg/L) with chemical addition[4].

Alternative Selection

Cost Comparison of Technologies

A comparison of capital and operating costs ($ 2016) for each treatment technology is shown in Table 2, which also describes the assumptions made for each estimate. Cost comparisons were included for facilities designed to meet a 1 mg/L phosphorus effluent limit and potential future lower phosphorus effluent limit. All capital costs were estimated assuming a design flowrate of 5 MGD, as this is the design flowrate of the referenced studies. While the SPID WWTP currently requires less capacity than 5 MGD, estimates by Hansen, Allen & Luce, Inc. projected a wastewater flowrate of 10.1 MGD by 2046. Additional costs include solids handling and disposal costs, which are estimated at $53 per wet ton. Assuming that a 5 MGD treatment plant creates an average of 4 tons of sludge per day, an estimate of $78,000 per year for solids handling and disposal has been included for each treatment option.[5] These costs are anticipated to be similar for the four treatment alternatives discussed herein (approximately $3M capital and $128k/yr annual operating for 5 mgd treatment capacity).[6]

[4] Young, Thor, et al. "When does building an MBR make sense? How variations of local construction and operating cost parameters impact overall project economics." GE Water and Process Technologies, 2013.
[5] EPA. "Handbook Estimating Sludge Management Costs." National Service Center for Environmental Publications. 1985.
[6] Based on cost comparisons between cited sources, capital costs for anaerobic digestion are estimated at roughly $3 million for a 5 MGD plant, with an estimated associated annual operating cost of $128,000 per year. California Environmental Protection Agency. "Current Anaerobic Digestion Technologies Used for Treatment of Municipal Organic Solid Waste". 2008.

Table 2. Comparative Costs for Treatment Alternatives (based on 5 MGD average flow/treatment capacity)

Treatment Technology	Units Included	Design Phosphorus Limit	Estimated, Comparative Capital Costs ($ 2016)	Estimated, Comparative Capital Costs with Solids Handling ($ 2016)	Estimated Annual O&M Costs ($ 2016)	Estimated Annual O&M Costs with Solids Handling ($ 2016)
Conventional Activated Sludge	Screening Grit Removal Primary Clarifiers Reactor Secondary Clarifiers Disinfection	1 mg/L Phosphorus Effluent Limit	$36M - $44M[1]	$39M - $47M[1]	$1.1M - $1.3M[1]	$1.2M - $1.4M[1]
		0.1 mg/L Phosphorus Effluent Limit (Filtration Included)	$41M - $50M[1]	$44M - $53M[1]	$1.2M - $1.4M[1]	$1.3M - $1.5M[1]
Extended Aeration	Screening Grit Removal Bioreactors Secondary Clarifiers Disinfection	1 mg/L Phosphorus Effluent Limit	$37M - $45M[1][2]	$40M - $48M[1][2]	$1.0M - $1.2M[1][2]	$1.1M - $1.3M[1][2]
		0.1 mg/L Phosphorus Effluent Limit (Filtration Included)	$42 - $51M[1][2]	$45 - $54M[1][2]	$1.1M - $1.3M[1][2]	$1.2M - $1.4M[1][2]
Sequencing Batch Reactor	Screening Equalization Basin Reactors Filtration Disinfection	1 mg/L Phosphorus Effluent Limit	$40M - $48M[1][2]	$43M - $51M[1][2]	$1.0M - $1.3M [1][2]	$1.1M - $1.4M [1][2]
		0.1 mg/L Phosphorus Effluent Limit (Filtration Included)	$45M - $54M[1][2]	$48M - $57M[1][2]	$1.2M - $1.4M[1][2]	$1.3M - $1.5M[1][2]
Membrane Bioreactor	Screening Grit Removal Reactor Primary and Secondary Clarifiers Disinfection	1 mg/L Phosphorus Effluent Limit	$34M - $41M[1]	$37M - $44M[1]	$1.3M - $1.5M[1]	$1.4M - $1.6M[1]
		0.1 mg/L Phosphorus Effluent Limit	$34M - $41M[1]	$37M - $44M[1]	$1.4M - $1.6M [1]	$1.5M - $1.7M [1]
Lagoons[3]	Screening Lagoons Chem Addition[4] Solids Separation[4]	1 mg/L Phosphorus Effluent Limit[4]	$15M - $16m	$17M - $18M	$0.8M - $1.0M	$0.9M - $1.1M

[1] Young, Thor, et al. "When does building an MBR make sense? How variations of local construction and operating cost parameters impact overall project economics." GE Water and Process Technologies, 2013. This includes costs of conventional activated sludge with and MBR, both with and without meeting a 0.1 mg/L effluent phosphorus limit. This same price difference for conventional activated sludge (i.e., difference with and without tertiary filtration) was used to estimate the cost of tertiary filtration for SBR and extended aeration units as well.

[(2)]Jafarinejad, Shahryar. "Cost estimation and economical evaluation of three configurations of activated sludge process for a wastewater treatment plant (WWTP) using simulation." Appl. Water Sci. 2016

[(3)] As discussed previously in this report, a lagoon system is not expected to be capable of meeting the anticipated Nitrogen and Phosphorus limits using biological processes only. This may be addressed for Phosphorus removal with the use of chemical addition and solids separation. Nitrogen removal will require a process that includes sequential anoxic and aeration zones. Although it is possible to create these zones in lagoons, it is difficult to control the system and the volumes required for Nitrogen removal result in the need for very large lagoons that are not viable. The information for lagoons is provided for comparison purposes and does not represent a system that is capable of meeting anticipated Nitrogen limits.

[(4)] A lagoon system will not be capable of meeting the proposed 1.0 mg/L Phosphorus limit without chemical addition. The addition of chemicals (metal salts) for Phosphorus removal will result in the creation of significant solids that will need to be removed. Dosing of chemicals to the lagoons will result in the accumulation of significant chemical solids in the lagoons, which will reduce the residence time and decrease the lagoons' ability to treat the wastewater. It is assumed that chemical will be added to the lagoon effluent and a solids separation (clarifiers) step will be required to remove the solids formed. The lagoon system does not provide a viable option for meeting a lower Phosphorus limit (0.1 mg/L) since this limit will require filtration in addition to chemical addition and sedimentation, and the costs and operational requirements of the system will be significantly higher than the cost of a mechanical system.

Triple-Bottom Line Comparison of Treatment Technologies

Triple-bottom line analysis consists of comparing alternatives on the basis of their social, environmental, and economic considerations. Table 3 summarizes the triple-bottom line analysis for each of the treatment technologies evaluated for use at the SPID WWTP. A score is shown for each treatment train based on the financial, social, and environmental factors considered. The scoring utilizes the following scale: 1 = Fair, 2 = Good, and 3 = Superior. The scores are shown in the green boxes and summed in the bottom row of the table. This primarily qualitative analysis is intended to provide a sense of the relative preference of each strategy in comparison to one another.

Table 3. Treatment Technology Comparison

Selection Criteria	Description	Treatment Technology			
		Conventional Activated Sludge	**Extended Aeration**	**SBR**	**MBR**
Financial					
Capital Costs	Fixed costs incurred for the initial purchase of land, buildings, construction, and equipment (1)	**3**	**2**	**1**	**3**
		Variable, based on nutrient removal needs. Would require aerobic, anaerobic, and anoxic zones, and secondary clarifiers. Tertiary filtration would be required to meet a lower P limit.	Relatively high capital costs for tankage (e.g., oxidation ditches, secondary clarifiers). Less equipment intensive than other alternatives (i.e., does not require a blower system for aeration). Tertiary filtration required to meet a lower P limit.	Large batch reactors must be constructed. However, no secondary clarifiers and RAS pumping required. Requires equalization basins based on the nature of batch processing – continuous feed alternatives are available typically for lower capacity plants (i.e., less than 4 MGD). Tertiary filtration required to meet a lower P limit.	Does not require secondary clarifiers or tertiary filtration. Filtration system is sized based on hydraulic capacity of the membrane system, thus, peak wet weather flow equalization is typically used.
O&M Costs	Costs associated with the operation and maintenance of facilities including electrical, chemicals, and solids disposal costs	**2**	**3**	**2**	**1**
		Operation intensive due to high number of processes involved, but not maintenance intensive.(1)	Low operational costs due to simple design. Low maintenance. Facility does not require a blower system for aeration.	Sequencing operation requires more operational controls and operator oversight. Requires more blower capacity due to the lack of organic removal in primaries.	Membrane cleaning and replacement costs significant. Membrane fouling can lead to higher O&M costs and high energy demand.

Selection Criteria	Description	Treatment Technology			
		Conventional Activated Sludge	Extended Aeration	SBR	MBR
Social					
Reliability	Consistency of effluent quality independent of variations in influent characteristics	**2**	**3**	**3**	**2**
		Process is well understood and predictable due to the longstanding use of this technology. However, more susceptible to bioreactor upsets than other alternatives.	Very stable process due to high retention times in bioreactors	Batch process provides very good control resulting in reliable effluent quality.	Produces high quality effluent. Performance is not dependent on sludge stability[3]. Without sufficient equalization storage, process is susceptible to overflowing in event of solids overload/plugging of membrane filtration system.
Safety	Amount of dangerous or hazardous processes or chemicals involved	**3**	**3**	**3**	**2**
		Metal salts (ferric or alum) typically onsite for phosphorus removal.	Metal salts (ferric or alum) typically onsite for phosphorus removal.	Metal salts (ferric or alum) typically onsite for phosphorus removal.	Metal salts (ferric or alum) typically onsite for phosphorus removal. Little hands-on operator maintenance required. Additional chemicals required for membrane cleaning.
Implementation (Future Phasing Options)	Ease of constructing additional phases to meet future flows	**2**	**2**	**3**	**2**
		System design is flexible for future upgrades.	Size of ditches make plant expansion more land intensive.	Small footprint and unit based system facilitate expansion.	Small footprint facilitates expansion. Heavy dependence on equipment in the membrane system requires coordination and planning for expansion

Selection Criteria	Description	Treatment Technology			
		Conventional Activated Sludge	**Extended Aeration**	**SBR**	**MBR**
Public Perception	Associated odor, noise, vehicular traffic	**2**	**2**	**3**	**3**
		Odors can be controlled using covered primaries. Blowers require sound enclosures	Use of mechanical aerators rather than blowers reduces noise. Aerators require sound enclosures.	Elimination of primary clarifiers reduces potential for odors. Blowers require sound enclosures	Odors can be controlled using covered primaries. Blowers require sound enclosures
Environmental					
Nutrient Removal	Ease and efficiency of implementing BNR processes with technology	**2**	**2**	**2**	**3**
		Effective in achieving nutrient removal with appropriate design features.	Effective in achieving nutrient removal with appropriate design features.	Effective in achieving nutrient removal with appropriate design features.	Effective in achieving nutrient removal with appropriate design features. Can achieve very low P discharge with chemical addition.
Solids Handling Requirements	Consideration of the amount, biodegradability and/or stability of solids generated	**2**	**3**	**3**	**2**
		Secondary clarifier required. Well stabilized sludge produced. However, lighter, fluffy sludge flocs require larger clarifiers.	Secondary clarifier required. High effluent suspended solids. Well stabilized sludge.	Well-stabilized sludge produced, less biosolids production. No RAS stream needed.	Low amounts of solids released in effluent. Mixed liquor is much more concentrated than activated sludge.

Selection Criteria	Description	Treatment Technology			
		Conventional Activated Sludge	Extended Aeration	SBR	MBR
Sustainability	Technology lends itself to opportunities to recover resources including reuse water, composting, phosphorus recovery, co-gen facilities	**2**	**2**	**2**	**3**
		Phosphorus and nitrogen recovery possible, along with co-gen facilities if anaerobic digestion is used. Additional treatment requirement to meet reuse requirements.	Phosphorus and nitrogen recovery possible, along with co-gen facilities if anaerobic digestion is used. Additional treatment requirement to meet reuse requirements.	Phosphorus and nitrogen recovery possible, along with co-gen facilities if anaerobic digestion is used. Additional treatment requirement to meet reuse requirements.	Effluent quality sufficient for water reuse with proper disinfection. Processes can be added upstream to accommodate co-gen facilities and phosphorus recovery with primaries and anaerobic digesters.(3)
Emissions	Generation of pollutant air emissions	**3**	**3**	**2**	**2**
		Low aeration and cogeneration capabilities make for lower emissions. (2)	Mechanical aeration. Improved flow equalization and well stabilized sludge help limit emissions.(2)	High aeration energy, but well-settled solids allow for more efficient solids removal, causing less emissions.(2)	High aeration energy, more energy intensive method for removing solids.(2)
Energy Consumption	Energy requirements for operation	**2**	**3**	**2**	**1**
		Estimate: 1250-4250 kW-Hr/million gallons(1)	Average amount of energy required for aeration. Lowest mechanical equipment and associated energy consumption of alternatives.	Estimate: 1250-4250 kW-Hr/million gallons(1)	Estimate: 2000-7000 kW-Hr/million gallons(1)

Selection Criteria	Description	Treatment Technology			
		Conventional Activated Sludge	**Extended Aeration**	**SBR**	**MBR**
Chemical Usage	Chemical requirements for operation	**3**	**3**	**3**	**1**
		Chemical addition may be used for phosphorus removal or to improve BNR. Carbon addition may be required for denitrification.	Chemical addition may be used for phosphorus removal or to improve BNR. Carbon addition may be required for denitrification.	Chemical addition may be used for phosphorus removal or to improve BNR. Carbon addition may be required for denitrification.	Chemical addition may be used for phosphorus removal or to improve BNR. Carbon addition may be required for denitrification. Additional chemicals required for membrane cleaning processes including a variety of acids, sodium hypochlorite and hydrogen peroxide depending on the type of fouling contaminant.(1)
TOTAL SCORE		**28**	**31**	**29**	**25**

(1) Hazen and Sawyer. "Wastewater Treatment Capacity and Effluent Disposal Study." Technical Memorandum 3 – Evaluation of Treatment Technologies. 2011.
(2) Metcalf and Eddy. Wastewater Engineering Treatment and Resource Recovery. McGraw-Hill. 2014.
(3) California Environmental Protection Agency. "Current Anaerobic Digestion Technologies Used for Treatment of Municipal Organic Solid Waste". 2008.

Recommendations and Conclusions

Projected growth and development in Northern Tooele County and pending nutrient limits have led to an investigation into future upgrades and expansion needed at the SPID WWTP. The existing lagoon system could be expanded to meet projected capacity requirements, however, pending nitrogen and phosphorus limits will require modifications to improve nutrient removal as flows increase. The lagoons can be aerated or retrofitted with integrated fixed film processes to meet possible future nitrogen limits. Chemical addition may be utilized to meet phosphorus limits, but this will result in a significant increase in solids production, which will limit the viability of continued lagoon treatment. While variances to the phosphorus effluent limits may be possible, it is not currently clear whether the State will eliminate the phosphorus discharge cap for lagoons that discharge to the Great Salt Lake. Planning for construction of a new mechanical treatment plant would offer the SPID the ability to meet nutrient regulations. Triple-bottom line analysis based on financial, social, and environmental factors, indicate that extended aeration, conventional activated sludge, and MBRs are the most favorable alternatives considered. In terms of ease of operation and lowest O&M costs, extended aeration is most favorable. Should the SPID be interested in water reuse, or if lower phosphorus limits are likely in the future, MBR technologies may offer some benefits in cost and operation.

APPENDIX C
Cost Estimates

Tooele County - Waste Water Regionalization Plan
283.02.100
January 18, 2017

Build-out Construction Cost Estimate Calculation
Id and node labels refer to SSA model FUT_ALT_6hiDP (included in Appendix D)

ID	DESCRIPT	UP_NODE	DN_NODE	LENGTH	DIA_INCH	IN_STREET	Unit Cost/FT	Total Cost		1200 West Project	Desert Peak Sewer
Link-03		Jun-04	Jun-06	3102.3400	8.0000	N	$ 93.00	$ 288,517.62			
Link-04		Jun-07	Jun-05	2326.3800	15.0000	N	$ 120.00	$ 279,165.60			
Link-05		Jun-06	Jun-07	2642.2400	12.0000	N	$ 110.00	$ 290,646.40			
Link-06		Jun-05	Jun-08	3088.8400	18.0000	N	$ 131.00	$ 404,638.04			
Link-07		Jun-08	Jun-09	2895.6200	18.0000	N	$ 131.00	$ 379,326.22			
Link-09		Jun-10	Out-02	88.0600	36.0000	N	$ 202.00	$ 17,788.12		$ 17,788.12	
Link-100		Jun-91	Jun-92	290.1500	8.0000	Y	$ 126.00	$ 36,558.90			
Link-101		Jun-92	Jun-88	382.5600	8.0000	Y	$ 126.00	$ 48,202.56			
Link-103		Jun-94	Jun-88	711.4700	8.0000	Y	$ 126.00	$ 89,645.22			
Link-104		Jun-95	Out-05	1388.9600	8.0000	N	$ 93.00	$ 129,173.28			
Link-106		Jun-27	Jun-96	1240.4300	8.0000	Y	$ 126.00	$ 156,294.18			
Link-107		Jun-96	Jun-28	1338.3000	8.0000	Y	$ 126.00	$ 168,625.80			
Link-108		Jun-81	Jun-98	2534.8400	8.0000	Y	$ 126.00	$ 319,389.84			
Link-11		J-12	Jun-10	1629.9400	36.0000	N	$ 202.00	$ 329,247.88		$ 329,247.88	
Link-110		Jun-97	Jun-98	2582.5400	8.0000	N	$ 93.00	$ 240,176.22			
Link-111		Jun-84	Jun-99	2626.9800	10.0000	N	$ 104.00	$ 273,205.92			
Link-112		Jun-99	Jun-80	3931.8300	15.0000	N	$ 120.00	$ 471,819.60			
Link-113		Jun-103	Jun-100	2226.9900	21.0000	N	$ 145.00	$ 322,913.55		$ 322,913.55	
Link-114		Jun-100	Jun-101	2658.4600	21.0000	N	$ 145.00	$ 385,476.70		$ 385,476.70	
Link-115		Jun-101	Jun-102	2630.8900	21.0000	N	$ 145.00	$ 381,479.05		$ 381,479.05	
Link-116		Jun-102	Jun-20	2687.0800	24.0000	N	$ 159.00	$ 427,245.72		$ 427,245.72	
Link-117		Jun-104	Jun-29	2612.3500	10.0000	N	$ 104.00	$ 271,684.40			
Link-119		Jun-106	Jun-06	3292.8600	8.0000	N	$ 93.00	$ 306,235.98			
Link-120		Jun-107	Jun-108	895.2900	12.0000	N	$ 110.00	$ 98,481.90			
Link-121		Jun-108	Jun-109	5210.5200	12.0000	N	$ 110.00	$ 573,157.20			
Link-122		Jun-109	Jun-110	3385.5000	21.0000	N	$ 145.00	$ 490,897.50			
Link-123		Jun-110	Jun-10	4349.3300	27.0000	N	$ 167.00	$ 726,338.11			
Link-124		Jun-112	Jun-109	6911.7600	14.0000	N	$ 110.00	$ 760,293.60			
Link-125		Jun-113	Jun-21	1262.8600	12.0000	N	$ 110.00	$ 138,914.60			$ 138,914.60
Link-126		Jun-03	Jun-114	814.6100	18.0000	N	$ 131.00	$ 106,713.91			$ 106,713.91
Link-127		Jun-114	Jun-115	1597.3900	21.0000	N	$ 145.00	$ 231,621.55			$ 231,621.55
Link-128		Jun-115	Jun-116	501.8000	21.0000	N	$ 145.00	$ 72,761.00			$ 72,761.00
Link-129		Jun-116	Jun-117	1103.3100	21.0000	N	$ 145.00	$ 159,979.95			$ 159,979.95
Link-13		Jun-13	Jun-14	652.4400	8.0000	Y	$ 126.00	$ 82,207.44			
Link-130		Jun-117	Jun-118	2642.7600	21.0000	N	$ 145.00	$ 383,200.20			$ 383,200.20
Link-131		Jun-118	Jun-119	3807.0600	21.0000	N	$ 145.00	$ 552,023.70			$ 552,023.70
Link-132		Jun-119	Jun-120	1395.7000	21.0000	N	$ 145.00	$ 202,376.50			$ 202,376.50
Link-133		Jun-120	Jun-98	1946.9400	21.0000	N	$ 145.00	$ 282,306.30			$ 282,306.30
Link-134		Jun-98	Jun-103	420.2800	21.0000	N	$ 145.00	$ 60,940.60		$ 60,940.60	
Link-135		Jun-121	Jun-82	592.7600	8.0000	N	$ 93.00	$ 55,126.68			
Link-136		Jun-30	Jun-102	2648.5400	21.0000	N	$ 145.00	$ 384,038.30			
Link-14		Jun-14	Jun-15	2322.0800	8.0000	Y	$ 126.00	$ 292,582.08			
Link-141		Jun-18	Jun-30	2619.6200	18.0000	N	$ 131.00	$ 343,170.22			
Link-142		Jun-52b	Jun-29	2643.5400	15.0000	N	$ 120.00	$ 317,224.80			
Link-143		Jun-11	Jun-124	2823.3200	30.0000	N	$ 175.00	$ 494,081.00		$ 494,081.00	
Link-144		Jun-124	J-12	3825.5700	36.0000	N	$ 202.00	$ 772,765.14		$ 772,765.14	
Link-17		Jun-16	Jun-17	535.2400	12.0000	Y	$144.00	$ 77,074.56			
Link-18		Jun-17	Jun-18	2626.9600	12.0000	N	$ 110.00	$ 288,965.60			
Link-22		Jun-20	Jun-11	1231.7000	30.0000	N	$ 175.00	$ 215,547.50		$ 215,547.50	
Link-23		Jun-21	Jun-22	1271.0300	12.0000	N	$ 110.00	$ 139,813.30			$ 139,813.30
Link-24		Jun-22	Jun-03	2693.7300	12.0000	N	$ 110.00	$ 296,310.30			$ 296,310.30
Link-31		Jun-29	Jun-30	2630.4300	18.0000	N	$ 131.00	$ 344,586.33			
Link-32		Jun-33	Jun-32	619.4500	8.0000	Y	$ 126.00	$ 78,050.70			
Link-33		Jun-32	Jun-31	696.9800	8.0000	Y	$ 126.00	$ 87,819.48			
Link-34		Jun-31	Jun-15	516.8400	8.0000	Y	$ 126.00	$ 65,121.84			
Link-35		Jun-34	Jun-31	2308.3300	8.0000	Y	$ 126.00	$ 290,849.58			
Link-36		Jun-35	Jun-32	2431.4900	8.0000	Y	$ 126.00	$ 306,367.74			
Link-37		Jun-36	Jun-33	2573.8300	8.0000	Y	$ 126.00	$ 324,302.58			
Link-38		Jun-37	Jun-13	2197.4400	8.0000	Y	$ 126.00	$ 276,877.44			
Link-40		Jun-38	Jun-13	668.6900	8.0000	Y	$ 126.00	$ 84,254.94			
Link-41		Jun-39	Jun-38	2203.5900	8.0000	Y	$ 126.00	$ 277,652.34			
Link-42		Jun-42	Jun-37	348.3200	8.0000	Y	$ 126.00	$ 43,888.32			
Link-43		Jun-41	Jun-42	2800.0700	8.0000	Y	$ 126.00	$ 352,808.82			
Link-44		Jun-40	Jun-41	2386.4000	8.0000	Y	$ 126.00	$ 300,686.40			
Link-45		Jun-28	Jun-43	1614.5200	8.0000	Y	$ 126.00	$ 203,429.52			
Link-46		Jun-43	Jun-44	2313.4300	10.0000	Y	$ 137.00	$ 316,939.91			
Link-47		Jun-44	Jun-16	732.6800	12.0000	Y	$144.00	$ 105,505.92			
Link-48		Jun-15	Jun-44	1634.5100	8.0000	Y	$ 126.00	$ 205,948.26			
Link-49		Jun-45	Jun-46	1233.7000	8.0000	N	$ 93.00	$ 114,734.10			
Link-50		Jun-46	Jun-47	488.9700	8.0000	N	$ 93.00	$ 45,474.21			
Link-51		Jun-47	Jun-17	1029.7500	10.0000	N	$ 104.00	$ 107,094.00			
Link-52		Jun-55	Jun-56	828.7200	8.0000	Y	$ 126.00	$ 104,418.72			
Link-54		Jun-57	Jun-56	882.4900	8.0000	Y	$ 126.00	$ 111,193.74			
Link-55		Jun-56	Jun-54	1154.7000	10.0000	Y	$ 137.00	$ 158,193.90			
Link-56		Jun-54	Jun-58	434.8900	10.0000	Y	$ 137.00	$ 59,579.93			

Link-57		Jun-53	Jun-58	387.2000	10.0000	Y	$ 137.00	$ 53,046.40			
Link-58		Jun-58	Jun-52b	916.4300	12.0000	N	$ 110.00	$ 100,807.30			
Link-60		Jun-59	Jun-60	347.3300	8.0000	N	$ 93.00	$ 32,301.69			
Link-61		Jun-60	Jun-45	252.1800	8.0000	Y	$ 126.00	$ 31,774.68			
Link-63		Jun-49	Jun-50	543.3500	10.0000	N	$ 104.00	$ 56,508.40			
Link-64		Jun-48	Jun-49	2553.1100	10.0000	N	$ 104.00	$ 265,523.44			
Link-65		Jun-61	Jun-62	950.8300	8.0000	Y	$ 126.00	$ 119,804.58			
Link-66		Jun-62	Jun-63	411.2500	8.0000	Y	$ 126.00	$ 51,817.50			
Link-67		Jun-63	Jun-52b	1961.2000	12.0000	N	$ 110.00	$ 215,732.00			
Link-68		Jun-70	Jun-69	649.9700	8.0000	Y	$ 126.00	$ 81,896.22			
Link-69		Jun-64	Jun-49	440.4800	8.0000	N	$ 93.00	$ 40,964.64			
Link-70		Jun-69	Jun-68	1233.1200	8.0000	N	$ 93.00	$ 114,680.16			
Link-71		Jun-64	Jun-68	412.7200	8.0000	N	$ 93.00	$ 38,382.96			
Link-72		Jun-67	Jun-68	377.0700	8.0000	Y	$ 126.00	$ 47,510.82			
Link-73		Jun-65	Jun-64	571.2300	8.0000	Y	$ 126.00	$ 71,974.98			
Link-74		Jun-66	Jun-65	361.7600	8.0000	Y	$ 126.00	$ 45,581.76			
Link-75		Jun-50	Jun-72	1709.8700	10.0000	N	$ 104.00	$ 177,826.48			
Link-76		Jun-72	Jun-53	629.8000	10.0000	Y	$ 137.00	$ 86,282.60			
Link-77		Jun-71	Jun-72	1457.7100	8.0000	Y	$ 126.00	$ 183,671.46			
Link-78		Jun-74	Jun-73	2164.6000	8.0000	Y	$ 126.00	$ 272,739.60			
Link-79		Jun-73	Jun-48	1349.8400	8.0000	N	$ 93.00	$ 125,535.12			
Link-82		Jun-78	Jun-79	385.2200	8.0000	N	$ 93.00	$ 35,825.46			
Link-83		Jun-79	Jun-77	426.3100	8.0000	N	$ 93.00	$ 39,646.83			
Link-84		Jun-77	Jun-63	1962.3500	8.0000	N	$ 93.00	$ 182,498.55			
Link-85		Jun-09	Jun-80	2027.2300	18.0000	N	$ 131.00	$ 265,567.13			
Link-86		Jun-80	Jun-11	4717.1500	24.0000	N	$ 159.00	$ 750,026.85			
Link-89		Jun-82	Jun-83	2671.4100	8.0000	N	$ 93.00	$ 248,441.13			
Link-90		Jun-83	Jun-84	1297.0300	10.0000	N	$ 104.00	$ 134,891.12			
Link-92		Jun-89	Jun-07	3506.9900	8.0000	N	$ 93.00	$ 326,150.07			
Link-93		Jun-90	Jun-85	447.0500	8.0000	Y	$ 126.00	$ 56,328.30			
Link-94		Jun-85	Jun-86	2281.5700	8.0000	Y	$ 126.00	$ 287,477.82			
Link-95		Jun-86	Jun-89	359.8400	8.0000	Y	$ 126.00	$ 45,339.84			
Link-96		Jun-88	Jun-87	2261.4100	8.0000	Y	$ 126.00	$ 284,937.66			
Link-97		Jun-87	Jun-86	549.0600	8.0000	Y	$ 126.00	$ 69,181.56			
Link-99		Jun-93	Jun-92	1354.3900	8.0000	Y	$ 126.00	$ 170,653.14			
						SR-138 Temp Line					
						Construction Cost		$ 24,093,477.31		$ 3,407,485.26	$ 2,566,021.31
						Sub-Total				$ 3,407,485.26	$ 2,566,021.31

Tooele County - Waste Water Regionalization Plan
283.02.100
January 5, 2017

50 yr Construction Cost Estimate Calculation
Id and node labels refer to SSA model FUT_ALT_9 included in Appendix D

ID	UP_NODE	DN_NODE	LENGTH	DIA_INCH	IN_STREET	Cost/ft	Cost		1200 West	Desert Peak	1200 West without north of SR-138
Link-03	Jun-04	Jun-06	3102.3400	8.0000	N	$93.00	$288,517.62				
Link-04	Jun-07	Jun-05	2326.3800	12.0000	N	$110.00	$255,901.80				
Link-05	Jun-06	Jun-07	2642.2400	10.0000	N	$104.00	$274,792.96				
Link-06	Jun-05	Jun-08	3088.8400	15.0000	N	$120.00	$370,660.80				
Link-07	Jun-08	Jun-09	2895.6200	15.0000	N	$120.00	$347,474.40				
Link-100	Jun-91	Jun-92	290.1500	8.0000	Y	$126.00	$36,558.90				
Link-101	Jun-92	Jun-88	382.5600	8.0000	Y	$126.00	$48,202.56				
Link-103	Jun-94	Jun-88	711.4700	8.0000	Y	$126.00	$89,645.22				
Link-104	Jun-95	Out-05	1388.9600	8.0000	N	$93.00	$129,173.28				
Link-106	Jun-27	Jun-96	1240.4300	8.0000	Y	$126.00	$156,294.18				
Link-107	Jun-96	Jun-28	1338.3000	8.0000	Y	$126.00	$168,625.80				
Link-108	Jun-81	Jun-98	2534.8400	8.0000	Y	$126.00	$319,389.84				
Link-110	Jun-97	Jun-98	2582.5400	8.0000	N	$93.00	$240,176.22				
Link-111	Jun-84	Jun-99	2626.9800	10.0000	N	$104.00	$273,205.92				
Link-112	Jun-99	Jun-80	3931.8300	15.0000	N	$120.00	$471,819.60				
Link-113	Jun-103	Jun-100	2349.0700	18.0000	N	$131.00	$307,728.17		$307,728.17		$307,728.17
Link-114	Jun-100	Jun-101	2715.0500	18.0000	N	$131.00	$355,671.55		$355,671.55		$355,671.55
Link-115	Jun-101	Jun-102	2574.5200	18.0000	N	$131.00	$337,262.12		$337,262.12		$337,262.12
Link-116	Jun-102	Jun-20	2687.0800	21.0000	N	$145.00	$389,626.60		$389,626.60		$389,626.60
Link-117	Jun-104	Jun-29	2612.3500	8.0000	N	$93.00	$242,948.55				
Link-119	Jun-106	Jun-06	3292.8600	8.0000	N	$93.00	$306,235.98				
Link-120	Jun-107	Jun-108	895.2900	8.0000	N	$93.00	$83,261.97				
Link-121	Jun-108	Jun-109	5135.0900	12.0000	N	$110.00	$564,859.90				
Link-122	Jun-109	Jun-110	3766.7900	21.0000	N	$145.00	$546,184.55				
Link-123	Jun-110	Jun-10	4117.2600	24.0000	N	$159.00	$654,644.34				
Link-124	Jun-112	Jun-109	6961.9800	14.0000	N	110.0000	$765,817.80				
Link-125	Jun-113	Jun-21	1353.2900	12.0000	N	$110.00	$148,861.90			$148,861.90	
Link-126	Jun-03	Jun-114	823.9700	15.0000	N	$120.00	$98,876.40			$98,876.40	
Link-127	Jun-114	Jun-115	1639.5300	18.0000	N	$131.00	$214,778.43			$214,778.43	
Link-128	Jun-115	Jun-116	501.8000	18.0000	N	$131.00	$65,735.80			$65,735.80	
Link-129	Jun-116	Jun-117	1103.3100	18.0000	N	$131.00	$144,533.61			$144,533.61	
Link-13	Jun-13	Jun-14	652.4400	8.0000	Y	$126.00	$82,207.44				
Link-130	Jun-117	Jun-118	2585.9300	18.0000	N	$131.00	$338,756.83			$338,756.83	
Link-131	Jun-118	Jun-119	3861.6900	18.0000	N	$131.00	$505,881.39			$505,881.39	
Link-132	Jun-119	Jun-120	1395.7000	18.0000	N	$131.00	$182,836.70			$182,836.70	
Link-133	Jun-120	Jun-98	1946.9400	18.0000	N	$131.00	$255,049.14			$255,049.14	
Link-134	Jun-98	Jun-103	297.6200	18.0000	N	$131.00	$38,988.22		$38,988.22		$38,988.22
Link-135	Jun-121	Jun-82	592.7600	8.0000	N	$93.00	$55,126.68				
Link-136	Jun-30	Jun-102	2648.5400	18.0000	N	$131.00	$346,958.74				
Link-14	Jun-14	Jun-15	2322.0800	8.0000	Y	$126.00	$292,582.08				
Link-141	Jun-18	Jun-30	2619.6200	15.0000	N	$120.00	$314,354.40				
Link-142	Jun-52b	Jun-29	2643.5400	15.0000	N	$120.00	$317,224.80				
Link-165	Jun-10	Out-02	31.2500	30.0000	N	$175.00	$5,468.75		$5,468.75		
Link-17	Jun-16	Jun-17	535.2400	10.0000	Y	$137.00	$73,327.88				
Link-172	Jun-11	Jun-148	3034.1200	24.0000	N	$159.00	$482,425.08		$482,425.08		
Link-173	Jun-148	Jun-12	3779.0300	24.0000	N	$159.00	$600,865.77		$600,865.77		
Link-174	Jun-12	Jun-10	1625.6300	24.0000	N	$159.00	$258,475.17		$258,475.17		
Link-18	Jun-17	Jun-18	2626.9600	10.0000	N	$104.00	$273,203.84				
Link-22	Jun-20	Jun-11	1253.6600	21.0000	N	$145.00	$181,780.70		$181,780.70		$181,780.70
Link-23	Jun-21	Jun-22	1271.0300	12.0000	N	$110.00	$139,813.30			$139,813.30	
Link-24	Jun-22	Jun-03	2693.7300	15.0000	N	$120.00	$323,247.60			$323,247.60	
Link-31	Jun-29	Jun-30	2630.4300	15.0000	N	$120.00	$315,651.60				
Link-32	Jun-33	Jun-32	619.4500	8.0000	Y	$126.00	$78,050.70				
Link-33	Jun-32	Jun-31	696.9800	8.0000	Y	$126.00	$87,819.48				
Link-34	Jun-31	Jun-15	516.8400	8.0000	Y	$126.00	$65,121.84				
Link-35	Jun-34	Jun-31	2308.3300	8.0000	Y	$126.00	$290,849.58				
Link-36	Jun-35	Jun-32	2431.4900	8.0000	Y	$126.00	$306,367.74				
Link-37	Jun-36	Jun-33	2573.8300	8.0000	Y	$126.00	$324,302.58				
Link-38	Jun-37	Jun-13	2197.4400	8.0000	Y	$126.00	$276,877.44				
Link-40	Jun-38	Jun-13	668.6900	8.0000	Y	$126.00	$84,254.94				
Link-41	Jun-39	Jun-38	2203.5900	8.0000	Y	$126.00	$277,652.34				
Link-42	Jun-42	Jun-37	348.3200	8.0000	Y	$126.00	$43,888.32				
Link-43	Jun-41	Jun-42	2800.0700	8.0000	Y	$126.00	$352,808.82				
Link-44	Jun-40	Jun-41	2386.4000	8.0000	Y	$126.00	$300,686.40				
Link-45	Jun-28	Jun-43	1614.5200	8.0000	Y	$126.00	$203,429.52				

Link-46	Jun-43	Jun-44	2313.4300	10.0000	Y	$137.00	$316,939.91				
Link-47	Jun-44	Jun-16	732.6800	10.0000	Y	$137.00	$100,377.16				
Link-48	Jun-15	Jun-44	1634.5100	8.0000	Y	$126.00	$205,948.26				
Link-49	Jun-45	Jun-46	1233.7000	8.0000	N	$93.00	$114,734.10				
Link-50	Jun-46	Jun-47	488.9700	8.0000	N	$93.00	$45,474.21				
Link-51	Jun-47	Jun-17	1029.7500	10.0000	N	$104.00	$107,094.00				
Link-52	Jun-55	Jun-56	828.7200	8.0000	Y	$126.00	$104,418.72				
Link-54	Jun-57	Jun-56	882.4900	8.0000	Y	$126.00	$111,193.74				
Link-55	Jun-56	Jun-54	1154.7000	10.0000	Y	$137.00	$158,193.90				
Link-56	Jun-54	Jun-58	434.8900	10.0000	Y	$137.00	$59,579.93				
Link-57	Jun-53	Jun-58	387.2000	10.0000	Y	$137.00	$53,046.40				
Link-58	Jun-58	Jun-52b	916.4300	12.0000	N	$110.00	$100,807.30				
Link-60	Jun-59	Jun-60	347.3300	8.0000	N	$93.00	$32,301.69				
Link-61	Jun-60	Jun-45	252.1800	8.0000	Y	$126.00	$31,774.68				
Link-63	Jun-49	Jun-50	543.3500	10.0000	N	$104.00	$56,508.40				
Link-64	Jun-48	Jun-49	2553.1100	10.0000	N	$104.00	$265,523.44				
Link-65	Jun-61	Jun-62	950.8300	8.0000	Y	$126.00	$119,804.58				
Link-66	Jun-62	Jun-63	411.2500	8.0000	Y	$126.00	$51,817.50				
Link-67	Jun-63	Jun-52b	1961.2000	10.0000	N	$104.00	$203,964.80				
Link-68	Jun-70	Jun-69	649.9700	8.0000	Y	$126.00	$81,896.22				
Link-69	Jun-64	Jun-49	440.4800	8.0000	N	$93.00	$40,964.64				
Link-70	Jun-69	Jun-68	1233.1200	8.0000	N	$93.00	$114,680.16				
Link-71	Jun-64	Jun-68	412.7200	8.0000	N	$93.00	$38,382.96				
Link-72	Jun-67	Jun-68	377.0700	8.0000	Y	$126.00	$47,510.82				
Link-73	Jun-65	Jun-64	571.2300	8.0000	Y	$126.00	$71,974.98				
Link-74	Jun-66	Jun-65	361.7600	8.0000	Y	$126.00	$45,581.76				
Link-75	Jun-50	Jun-72	1709.8700	10.0000	N	$104.00	$177,826.48				
Link-76	Jun-72	Jun-53	629.8000	10.0000	Y	$137.00	$86,282.60				
Link-77	Jun-71	Jun-72	1457.7100	8.0000	Y	$126.00	$183,671.46				
Link-78	Jun-74	Jun-73	2164.6000	8.0000	Y	$126.00	$272,739.60				
Link-79	Jun-73	Jun-48	1349.8400	8.0000	N	$93.00	$125,535.12				
Link-82	Jun-78	Jun-79	385.2200	8.0000	N	$93.00	$35,825.46				
Link-83	Jun-79	Jun-77	426.3100	8.0000	N	$93.00	$39,646.83				
Link-84	Jun-77	Jun-63	1962.3500	8.0000	N	$93.00	$182,498.55				
Link-85	Jun-09	Jun-80	2027.2300	15.0000	N	$120.00	$243,267.60				
Link-86	Jun-80	Jun-11	4726.1400	18.0000	N	$131.00	$619,124.34				
Link-89	Jun-82	Jun-83	2671.4100	8.0000	N	$93.00	$248,441.13				
Link-90	Jun-83	Jun-84	1297.0300	10.0000	N	$104.00	$134,891.12				
Link-92	Jun-89	Jun-07	3506.9900	8.0000	N	$93.00	$326,150.07				
Link-93	Jun-90	Jun-85	447.0500	8.0000	Y	$126.00	$56,328.30				
Link-94	Jun-85	Jun-86	2281.5700	8.0000	Y	$126.00	$287,477.82				
Link-95	Jun-86	Jun-89	359.8400	8.0000	Y	$126.00	$45,339.84				
Link-96	Jun-88	Jun-87	2261.4100	8.0000	Y	$126.00	$284,937.66				
Link-97	Jun-87	Jun-86	549.0600	8.0000	Y	$126.00	$69,181.56				
Link-99	Jun-93	Jun-92	1354.3900	8.0000	Y	$126.00	$170,653.14				
							$23,044,115.52		$ 2,958,292.13	$ 2,418,371.10	$ 1,611,057.36

APPENDIX D
Data Disk