Springdale Wastewater Master Plan

May, 2021

SUNRISE ENGINEERING

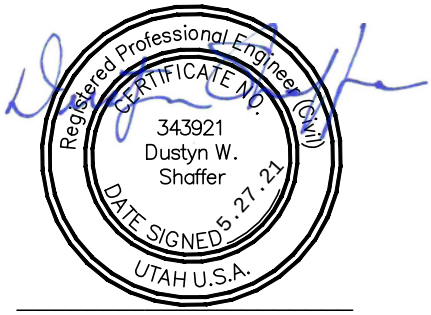
WASTEWATER MASTER PLAN

MAY 2021

MAYOR.....Stanley J. Smith
COUNCIL MEMBER.....Randy Aton
COUNCIL MEMBER.....Suzanne Elger
COUNCIL MEMBER.....Adrian Player
COUNCIL MEMBER.....Lisa Zumpft
TOWN MANAGER.....Rick Wixom
TOWN CLERK.....Darci Carlson
PUBLIC WORKS SUPERINTENDENT.....Rob Totten
TREASURER.....Dawn Brecke

PREPARED BY:

11 North 300 West
Washington, UT 84780
TEL: 435-652-8450
FAX: 435-652-8416



Dustyn W. Shaffer, P.E.
Principal Engineer
State of Utah No. 343921

TABLE OF CONTENTS

EXHIBITS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

I. EXECUTIVE SUMMARY

The following section is for summary purposes only. Detailed information regarding the numbers and figures presented herein are provided in the body of this Springdale Town Wastewater Master Plan.

A. INTRODUCTION

Springdale is located in eastern Washington County, Utah on Highway 9 next to Zion National Park. The Town's wastewater system is used by the neighboring community of Rockville as well as Zion National Park. Springdale's collection system flows to treatment lagoons to the west of Rockville.

The communities connected to the Town's wastewater system are small but located in an area with a high volume of tourism and seasonal visitors. Due to the high number of visitors, the flow for the system is significantly impacted by commercial use.

B. SYSTEM USERS ANALYSIS

Springdale has historically experienced moderate growth but is limited in overall growth by the boundaries of Zion National Park and the Town of Rockville. This Plan analyzes the historical population growths and predicts a growth rate for the planning period. It is anticipated that Springdale will experience more commercial growth than residential as visitation to Zion and surrounding areas increases.

Rockville has set forth ordinances limiting the amount of growth the Town can have each year. While this limited growth is in place now, the governing ordinance for this may be removed in the future. This Plan analyzes the historical growth of the Town and predicts the calculated rate for the future.

Several assumptions were made regarding the growth of wastewater contribution from Zion National Park. The busy season at Zion is assumed to be nearing capacity and the already high flows from the park are assumed to decline rather than maintain the historical growth seen.

C. SEWER SYSTEM CAPACITY

Springdale's sewer system can be separated into two categories, the collection system, and the treatment system. This Plan analyzes each category based on existing flows as well as future projected flows. From these, the areas of concern or deficit within the system can be addressed to satisfy future demands.

This Plan identified several areas of concern with the collection system in regard to pipe sizing and condition. The age of the Town's system is a main contributor to the concerns found within this Plan and several recommendations have been made to correct the issues.

The treatment lagoons have been in violation of the Town's wastewater permit for several years and therefore is the biggest concern for the Town. A third-party engineering firm, H&S Environmental LLC, performed a study on the treatment system to determine what the cause of the issues were and how the Town could bring their discharge requirements back into compliance with their permit. The results from H&S Environmental are discussed in this Plan, however, the full report can be found in Appendix D.

D. RECOMMENDATIONS

Several recommendations have been made for the Town's wastewater system. Some of these recommendations should be taken care of immediately by the Town while others may be taken care of as part of future projects or by regular ongoing maintenance.

The recommendations, both for the collection system and the treatment lagoons, are provided in Section V of this report.

II. INTRODUCTION

This Section reviews the purpose and scope of this wastewater master plan and analysis, provides background information, identifies the plan's area or limits, and considers connections with adjacent entities related to wastewater facilities in the Town of Springdale.

A. PURPOSE AND SCOPE

The Town of Springdale (Town) contracted with Sunrise Engineering, Inc. to provide an update to their Wastewater Master Plan (Plan) that would address the needs of the wastewater system for anticipated Town buildout. Needed collection and treatment system upgrades for anticipated buildout are of particular interest to the Town at this time so that any improvements made today will have the ability to service the Town through the anticipated buildout.

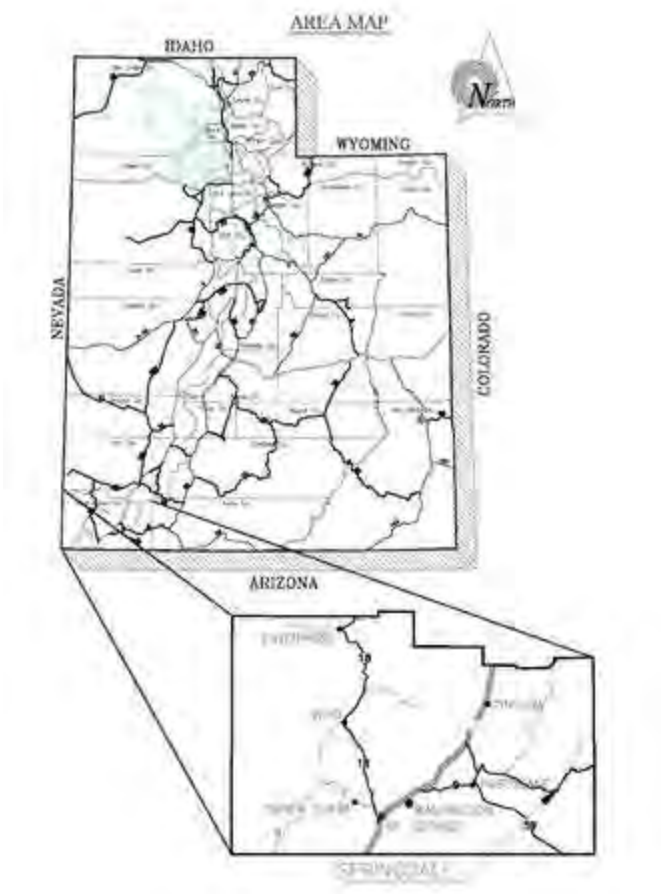


Figure II-1. Area map of Springdale

A glance at the Springdale Wastewater System (System) shows an effective collection system throughout the Town, and a main transmission line carrying wastewater to the treatment facility. Wastewater is currently being treated by a lagoon system before being discharged to the Virgin River.

The existing treatment and collection systems have been in place for some time and are in need of various improvements to bring the service up to current State standards. Some of the needed improvements have been recognized by the Town and are verified by this Plan. Those recognized improvements include inspecting the collection lines to find any damaged pipes or areas of infiltration, upsizing collection lines for future flows, and modifications to the treatment lagoons and treatment procedures.

B. BACKGROUND INFORMATION

This Wastewater Master Plan has been prepared for the Town of Springdale, located in Eastern Washington County, Utah, along Highway 9 and adjacent to Zion National Park. The Town of Springdale has experienced moderate to high growth rates for a small town over the past 50 years. As in other communities, the wastewater system must be improved and enlarged to support growth and development within the Town and to comply with current State of Utah Water Quality Standards. Unlike many small towns of similar size, Springdale has experienced much of its recent growth in commercial use such as hotels and restaurants. This growth, along with the associated residential growth experienced, presents a challenge for the planning of infrastructure to accommodate existing and future growth.

The System has been analyzed under the State of Utah Department of Water Quality regulations to determine existing system conditions and needs and to determine projected system needs as the community grows to anticipated buildout.

III. SYSTEM USERS ANALYSIS

An important element in any community plan is a user analysis or a projection of the Town's population growth rate. This projection gives the planner an idea of the future demands the Town should plan for throughout the planning period. This section summarizes how the growth rate, planning period, population projections and capacity were calculated or obtained.

A. LENGTH OF PLANNING PERIOD

The Utah Administrative Code states that new sewers should be designed for the estimated ultimate tributary population or the 50-year planning period, whichever requires a larger capacity. Therefore, this Plan will use the most conservative values for each community during the planning period for analysis and recommended improvements. This Plan will also help to anticipate which recommended improvements should be addressed immediately and which improvements will be required as the Town grows. Ultimately, this Plan will make recommendations based on the buildout scenario and all necessary improvements that need to be made before the Town is fully developed according to current zoning. Revenue sources should be carefully evaluated each year as the Town Council sets budgets and anticipates these future system improvements.

B. POPULATION GROWTH RATE

An important element in the development of a wastewater master plan is the projection of the community's population growth rate. This projection gives the planner an idea of the future demands on the wastewater system for the length of the planning period. Appendix A contains detailed growth projections which are summarized in this section of the report.

Springdale's system incorporates flows from Springdale as well as Rockville and Zion National Park (Zion). Population estimates and projections for these communities were obtained from Census data and the Wasatch Front Regional Council (WFRC) data portal.

i. Springdale

Table III-1 summarizes the historical population data for Springdale between 1970 and 2020. A graphical representation of the same values is provided in Figure III.1.

Table III-1 Springdale historic population

Year	Population	Annual Growth Rate	
1970	182	-	-
1980	258	1970-1980	3.6%
1990	275	1980-1990	0.6%
2000	457	1990-2000	5.2%
2010	529	2000-2010	1.5%
2020	674	2010-2020	2.5%

Springdale has experienced a 2.7% average growth rate between 1970 and 2020. While population growth is essential to anticipating system capacity needs over a specific time period, development in the Town will eventually reach the boundaries currently defined by Zion National Park on the north, east, and west, and by

Rockville to the south. Therefore, a slightly adjusted rate of 2.5% will be used to project the future growth of Springdale.

ii. Rockville

Since the collection and treatment systems include wastewater from the Town of Rockville, it is necessary to include the population growth from this neighboring community as well. Table III.2 summarizes the historical population data for Rockville between 1980 and 2020. Figure III.1 provides a graphical representation of these same values.

Table III-2. Rockville historic population

Year	Population	Annual Growth Rate	
1980	156	-	-
1990	182	1980-1990	1.6%
2000	247	1990-2000	3.1%
2010	245	2000-2010	-0.1%
2020	302	2010-2020	2.1%

Between 1980 and 2020, Rockville has experienced a 1.7% average growth rate. The Town of Rockville's General Plan encourages a limited growth policy and states an optimal community size of up to 500 people. Based on the desires of the Rockville community, a modest 1.5% growth rate will be used. The estimated time for Rockville to reach 500 residents is 34 years, occurring in 2054.

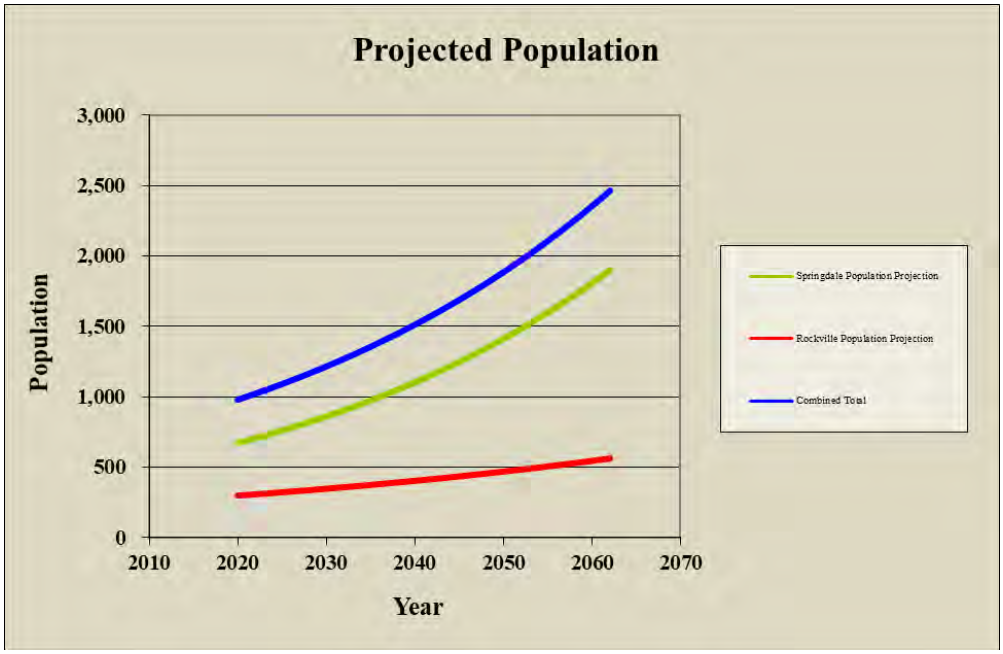


Figure III-1. Projected population for Springdale and Rockville

iii. Zion National Park

Due to the transient nature of Zion, a different approach must be taken to calculate the historical and projected future contribution to Springdale's wastewater system. This approach will be discussed later in this section.

C. WASTEWATER CONNECTIONS

In this Plan, reference will be made to Equivalent Residential Units (ERU). One ERU is defined as the amount of wastewater produced by an average residential connection. Because an ERC relates to the amount of water required for the average residential connection, use of this term allows commercial or other types of connections to be equated to a residential connection. For the purposes of this report, Town owned connections are considered "other" connections.

i. Existing Wastewater Connections & ERU

According to the data provided by the Town of Springdale, there are currently (as of April 2020) 426 connections in Springdale and 60 connections in Rockville. Table III.3 shows the current number of connections to the System.

Table III-3. Current 2020 System Connections

Connection Category	Connections		
	Springdale	Rockville	Combined
Residential	307	54	361
Commercial	113	4	117
Other	6	3	9
Total	**426**	**61**	**487**

A review of the culinary water usage from the previous 12 months was performed to determine the ERU value to assign to each connection category. Residential water usage was an average of 291 gallons per day for both Springdale and Rockville and was set as the baseline for 1 ERU. Commercial usage was different between the two communities with Springdale commercial equating to 4.70 ERUs and Rockville commercial equating to 2.00 ERUs. Other usage was less than the average daily usage for residential connections for both communities, resulting in 0.75 ERUs. Table III-4 shows the current number of ERUs based on the culinary water system. These figures will be used later in this Plan to develop present densities in relation to zoning in order to provide a better estimation of flow accumulation in the existing collection system.

Table III-4. Current 2020 System ERUs

Connection Category	ERUs		
	Springdale	Rockville	Combined
Residential	307	54	361
Commercial	531	8	539
Other	4	2	6
Total	**842**	**64**	**906**

One additional connection to the system serves Zion National Park. During 2019, the average daily flow into Springdale's system was 104,711 gallons. Based on the average residential daily flow of 291 gallons, the Zion connection yields 360 ERUs.

ii. Projected Wastewater ERUs

This Plan will use the buildout figures for each community connected to the wastewater system.

Springdale

The Town of Springdale has performed their own calculations and determined their estimated buildout connections. The buildout data from the Town was used to estimate the Town's buildout ERUs. The estimated buildout ERUs are shown below in Table III-5.

Table III-5. Estimated buildout ERUs From Town Calculations

Residential	1,053	ERUs
Commercial	1,084	ERUs
Other	8	ERUs
Total	**2,145**	**ERUs**

The total number of Springdale wastewater ERUs projected at buildout is 2,297.

However, we need to determine the most conservative value for design by calculating the number of ERUs at the end of the 50-year planning period. This is calculated using the compound interest formula as follows:

$$F = current\ ERUs \times (1 + rate)^{50\ years}$$

Where F is the projected number of future ERUs, and the rate of growth is 2.50% per year. This formula yields the following total residential ERUs:

$$F = 307 \times (1 + 0.025)^{50} = 1{,}055\ ERUs$$

Commercial and other ERUs were calculated with the same equation with different growth rates. Commercial ERUs were based on a growth rate of 2.5% for the first 10 years and 1.7% from 11 years to the end of the planning period. The other connections were assumed to double in the 50-year planning period. This results in a total estimated ERU of 2,352. The estimated number of ERUs at buildout are summarized in Table III-6.

Table III-6. Estimated ERUs at end of 50 – year planning window.

Residential	1,055	ERUs
Commercial	1,289	ERUs
Other	8	ERUs
Total	**2,352**	**ERUs**

For the purposes of this Plan, the higher number of ERUs calculated using growth rates over the 50-year planning window will be used.

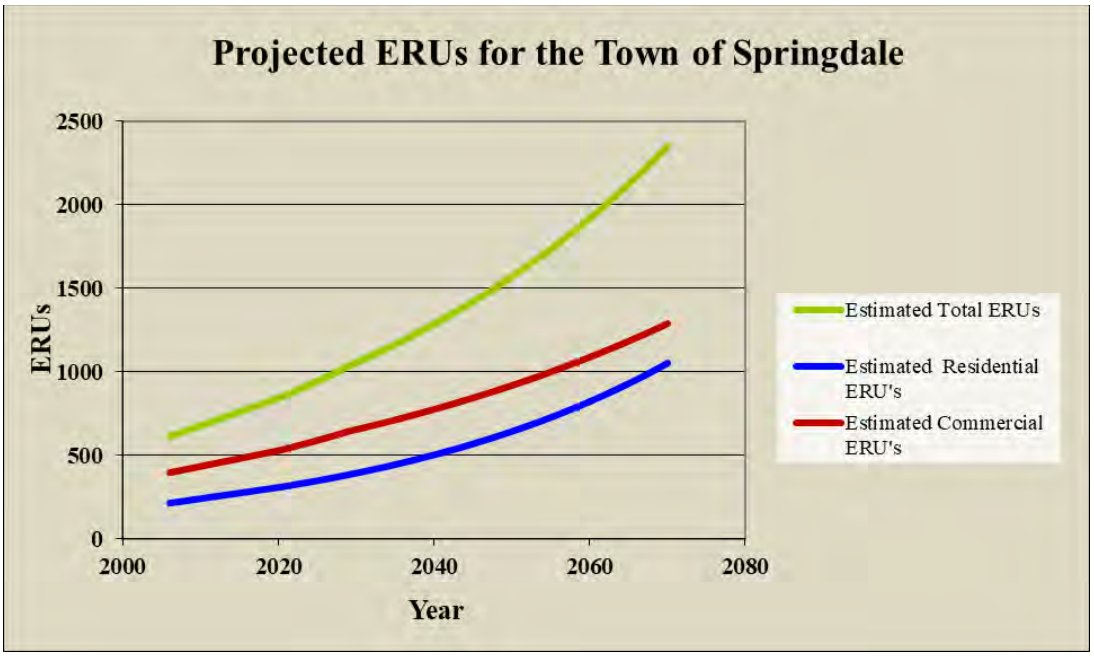


Figure III-2. Projected ERUs for Springdale

Rockville

As mentioned previously in this Plan, Rockville encourages limited growth and is planning for an ideal population of 500 people. Dividing the population in 2020 by the number of residential ERUs in 2020 will provide us with an estimated 5.60 people per residential ERU as demonstrated by the following calculation:

$$302\ people\ /\ 54\ ERUs = 5.64\ people/ERU$$

If the population at buildout is divided by the number of people per ERU we can find the number of ERUs at buildout, which is 88 residential ERUs.

Again, the most conservative number was needed to be used for design. The same method to calculate the future number of ERUs for Springdale was used to calculate an estimated number of ERU for Rockville at the end of the 50-year planning window. Using the growth rate of 1.50% per year, the formula yields the following total residential ERUs:

$$F = 54 \times (1 + 0.015)^{50} = 114\ ERUs$$

For Rockville, we can see the 50-year planning period is the more conservative value for planning and will be used in this Plan to satisfy the Utah Administrative Code. Figure III.3 is a graphical representation of the projected ERU growth.

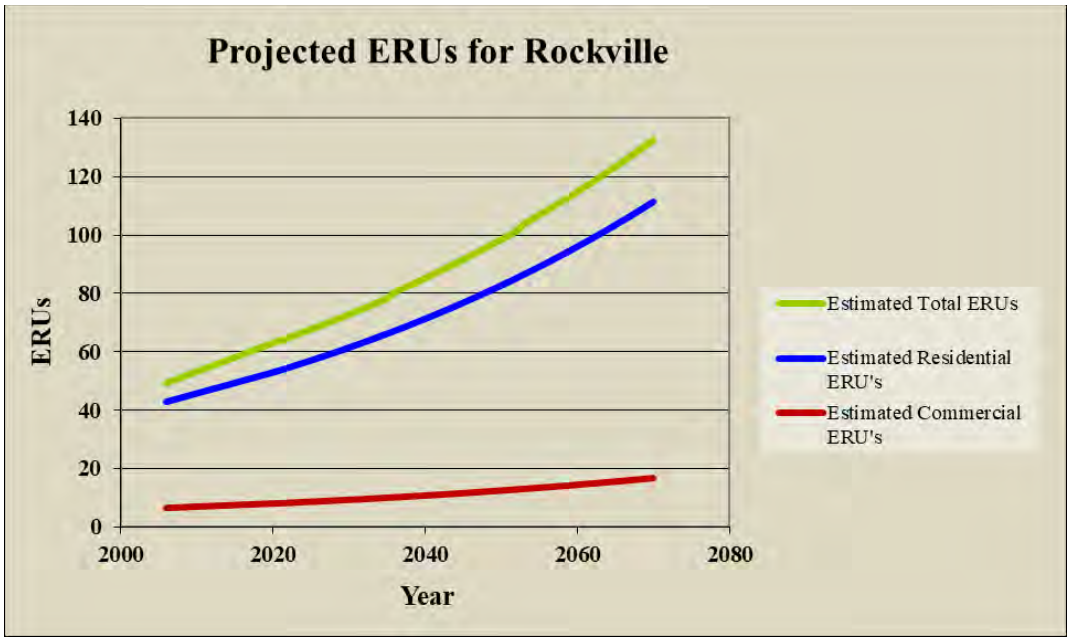


Figure III-3. Projected ERUs for Rockville

Table III.6 provides the projected future ERUs to be used in the analysis of Springdale's wastewater System.

Table III-7. Projected Future System ERUs

Connection Category	ERUs		
	Springdale	Rockville	Combined
Residential	1,055	114	1,169
Commercial	1,289	17	1,306
Other	8	4	12
Total	**2,352**	**135**	**2,487**

Zion National Park

Visitation to Zion National Park has doubled since the previous Master Plan in 2007, with wastewater flows increasing by approximately 65%. Assuming the maximum daily visitation to the Park is nearing capacity, a conservative wastewater flow increase of 100% in the next 50 years will be used for planning purposes. It will be important for the Town to track the actual increase in flows coming from Zion National Park and make the necessary planning corrections in updates to this Plan.

Current annual average daily flows from Zion National Park are nearly 105,000 gallons per day. With the estimated average daily flow increase of 100%, future flows will be about 210,000 gallons per day.

An estimated population can be determined for Zion using the total future flows per day and the State guideline of wastewater per person of 100 gallons per capita per day. This calculation yields a theoretical population of 2,100 people.

D. THEORETICAL POPULATION

A total theoretical population for the System can now be found by combining all the figures from each contributing community. The total theoretical population is summarized in Table III-8. Note, this is not the actual population, but an equivalent population where all commercial ERUs and anticipated flows are converted into population figures and added to the projected actual population figures.

Table III-8. Theoretical Population Figures

Town of Springdale	**5,175 People**
Town of Rockville	**759 People**
Zion National Park	**2,098 People**
Total	**8,032 People**

IV. SEWER SYSTEM CAPACITY

This section seeks to analyze the capacity of the existing sewer system within Springdale Town, including both the collection system trunk lines and the wastewater treatment facility, in order to identify problem areas and potential issues which could arise as the Town grows.

A. COLLECTION SYSTEM

i. Utah Administrative Code

According to the design requirements for wastewater collection, treatment and disposal systems given in R317-3 of the Utah Administrative Code, new sewer systems shall be designed on the basis of an annual average daily rate of flow. The State guideline for annual average daily rate is 100 gallons per capita per day (gpcd). Laterals and collector pipelines shall be designed by applying a peaking factor of 4.0, and interceptors and outfall pipelines shall apply a peaking factor of 2.5.

The Utah Administrative Code also requires that no gravity sewer shall be less than eight (8) inches in diameter, while a six (6) inch diameter pipe may be permitted when the sewer is serving only one connection. Exhibit 2 shows the existing collection system piping.

The Utah Administrative Code also requires that the pipe diameter and slope shall be selected to obtain velocities that minimize settling problems. All sewers shall be designed and constructed to obtain mean velocities of not less than 2 feet per second, when flowing full, and based on Manning's formula using an "n" value of 0.013. Table IV-1 provides the minimum slope required per pipe diameter to acquire the minimum velocity of 2 feet per second.

Table IV-1. Minimum Pipe Slope

D (in)	Slope (ft/ft)	V (fps)
8	0.00332	2.00
10	0.00247	2.00
12	0.00194	2.00
15	0.00144	2.00
18	0.00113	2.00
21	0.00092	2.00
24	0.00077	2.00

ii. Zoning and Land Use

The design of any wastewater pipe system requires that the amount of wastewater flows entering the system are known. Wastewater flow quantities can usually be derived based on existing or predicted population densities within the wastewater collection area. Standard design practices and calculations are applied to the population numbers to predict average and peak wastewater flows that will be generated in the area and introduced into the wastewater system. This section seeks to summarize how design wastewater flows were calculated for the Town of Springdale study area.

The Town of Springdale has identified the different types of land use and zoning within the Town boundaries as follows: Foothill Residential, Valley Residential, Village Commercial, Central Commercial, Public Use, and Agricultural.

Once the different zones have been identified, an ERU based density can be calculated by taking the total ERUs associated with each zone and dividing by the total number of acres in that zone. The following equation illustrates the densities assigned to both residential and commercial zones under existing conditions. For the following calculations, the commercial and other connections have been combined.

Existing Residential Density

307 Res. ERUs / 1,283 Res. Acres = 0.24 ERUs/Acre

Existing Commercial and Other Density

535 Comm. ERUs / 211 Comm. Acres = 2.54 ERUs/Acre*

*This figure includes both "Commercial" and "Other" ERUs

The same is done for densities at buildout.

Buildout Residential Density

1,055 Res. ERUs / 1,283 Res. Acres = 0.82 ERUs/Acre

Buildout Commercial and Other Density

1,297 Comm. ERUs / 211 Comm. Acres = 5.90 ERUs/Acre*

*This figure includes both "Commercial" and "Other" ERUs

Applying these calculated densities to each zone results in an average total number of ERUs produced by a given area.

From this we can also deduce the resulting corresponding population density. This is accomplished by determining the average number of people per ERU. In the Town of Springdale, the total number of people per ERU is calculated by taking the entire current residential population and dividing that by the total number of residential ERUs. The following equation illustrates this calculation.

674 people / 307 ERUs = 2.20 people/ERU

*Based on 2020 population and ERU estimates

Using each of these figures we can now divide the Town up into any number of regions and be able to quantify the total equivalent population of that region and the resulting wastewater flow it will generate. The next section will refer to these areas within the Town as collection basins.

iii. Collection Basins

Each collection basin is an area defined by topographic or other features that govern or influence how wastewater is most efficiently routed away from an area. The collection basins used in this Plan are the same basins used in the previous Master Plan, which were determined using surface contours, aerial photographs, and a program developed at Brigham Young University called WMS. There is a total of 13 collection basins, which are illustrated in Exhibit 1.

The total flow generated by each of the wastewater collection basins is simply calculated by multiplying the appropriate ERU density, the average population per ERU, and the acreage of the given collection basin. By assigning an average peak flow per capita, the total flow from that basin can be determined. The same process is done for all 13 collection basins within the Town of Springdale under both existing and future conditions.

This method is important in determining the required capacity of the wastewater main trunk line as it accumulates flow from each collection basin down to the treatment facility.

Table IV-2 illustrates the described process for Drainage Basin 4 during existing conditions. Note that this table is provided as an example of how the total flow is calculated for any of the collection basins and the full process will not be provided for each basin under existing and buildout conditions.

Appendix B contains the spreadsheet printouts showing the acreage of each basin, the resulting equivalent population of each basin, and the total flow resulting from each basin, under both existing and buildout conditions. Also shown in Appendix B is the analysis of the main trunk line as it collects the total flows from the 13 collection basins.

Table IV-2. Sample flow calculations from Drainage Basin 4

Total Area (acre)	91.54
Total Area of Zone "Residential" (Acre)	82.35
Total Area of Zone "Commercial" (Acre)	9.19
Residential ERU Density (ERU/Acre)	0.24
Commercial ERU Density (ERU/Acre)	2.54
Total ERU in Drainage Basin 4	43.01
Total ERU from Residential Zone	19.71
Total ERU from Commercial Zone	23.30
Number of People per ERU	2.20
Total Equivalent Population in Drainage Basin 4	94.61
Flow per Person with Peaking Factor of 2.5 (Gal/Person/Day)	250
Total Flow Produced by Drainage Basin 4 (Gal/Day)	**23,653.18**

The sum of all the existing flows from Springdale's 13 collection basins results in a total peak flow from Springdale of 541,230 gal/day.

The same process was done for buildout in Springdale, which resulted in a total peak flow of 1,482,460 gal/day.

iv. Rockville and Zion National Park

The flows produced by Rockville and Zion National Park were analyzed using a different method since finite flows along the main trunk line produced from these locations are not within the scope of this Plan.

The existing and future flows produced by Rockville were configured in the following manner.

Currently, there are approximately 53 residential connections, 4 commercial connections, and 3 other connections in Rockville. Based on the connection fee rates and gallons used, each commercial connection is equivalent to 2.04 ERUs and each other connection is equivalent to 0.8 ERU, resulting in a total of 63 combined ERUs for the Town of Rockville. Applying Rockville's people per ERU amount of 5.70, there is a theoretical population of 356 people on the current system.

It was assumed in Section III above that the Town of Rockville would reach a population of 636 at the end of the planning period.

The theoretical peak flow for the Town of Rockville, for both existing and future conditions, can be calculated using the average daily flow rate and a peaking factor of 2.5. The future theoretical peak daily flow from Rockville is estimated as 89,870 gal/day.

$$636 \text{ people} * 100 \text{ gal/person/day} * 2.5 \text{ PF} = 159{,}000 \text{ gal/day}$$

It was also assumed that Zion National Park contributes an annual daily average of 105,000 gallons per day to the current system. The future flow will be based on a 100% increase from today's figures resulting in 210,000 gallons per day. Applying the same peaking factor of 2.5 yields a buildout peak daily flow from Zion of 525,000 gal/day.

$$210{,}000 \text{ gal/day} * 2.5 \text{ PF} = 525{,}000 \text{ gal/day}$$

The flows from Zion National Park will enter into the collection system at the most upstream node in the current collection system, while Rockville's flows will enter the collection system closer to the treatment facility.

v. Collection Pipe Sizing

The total theoretical flow generated by the Town of Springdale, Rockville, and Zion National Park according to the assumptions described in the previous subsections was used to determine the required pipe sizes in the collection system.

Design criteria entered in the pipe design spreadsheet assume the pipe system will flow at full capacity, a Manning's roughness coefficient of 0.013, a minimum flow velocity of 2.0 fps, and maximum flow velocity of 15.0 fps. The manhole elevations and pipeline segment lengths were taken from the Town's GIS information, from which the pipe inverts were estimated to be on average 8 feet below manhole elevation but were adjusted at several nodes to ensure minimum velocities and slopes were maintained.

The results of the spreadsheet are provided in Appendix B. It should be noted that the design of the conceptual wastewater system was completed at a master planning level only; detailed design completed during an improvements project may require an adjustment in installed pipe sizes.

vi. Conclusions

It was determined that the existing capacity of the main trunk line in the collection system is sufficient for peak flows produced by the Town of Springdale, Rockville, and Zion National Park under existing conditions. It has been concluded that pipe slopes, capacities and velocities are all in compliance with current State standards.

Conversely, the projected buildout peak flows produced by the Town of Springdale, Rockville and Zion National Park will exceed the present capacity of certain segments of the main trunk. These segments and recommended improvements will be addressed in Section V and shown in Exhibit 3.

B. TREATMENT FACILITY

Springdale operates a wastewater lagoon treatment facility which periodically discharges effluent water into the Virgin River. The facility has two large ponds (3 cells) used for treating the influent wastewater. The first pond is separated into two parts, or cells, by a baffle wall and are used to provide aeration for BOD_5 and Ammonia removal. The second pond, or cell, is used for sedimentation and clarification. The facility is currently equipped with three 20 HP blowers and oxygen diffusers. The facility also contains a UV building and re-aeration structure. The UV equipment is used to disinfect effluent that is released from the facility. Effluent then passes through a re-aeration structure, which entrains the effluent with dissolved oxygen by physical means before being discharged into the Virgin River.

The capacity of the aerated lagoon system was designed based on effluent standards of BOD or total suspended solids (TSS). The treatment facility was **NOT** designed for phosphorus removal. However, due to

new regulations of R317-1-3, and according to the Town's permit found in Appendix E, the Town has a maximum phosphorus loading cap of 3,490 lbs/year and will need to monitor effluent phosphorus concentrations to determine when they will exceed their loading cap. Currently the lagoons are operating with a loading cap of between 2,600 and 3,250 lbs/year.

i. Hydraulic Capacity

A minimum detention time is required to achieve effluent standards for aerated lagoons and is used to determine if the existing lagoons are adequately sized. According to R317-3 of the Utah Administrative Code for aerated lagoons, the minimum detention time is the greater of 30 days or the value determined using the following equation:

$$E = \left(\frac{1}{1 + (2.3 * K_1 * t)}\right)$$

where:
t = detention time (days)
E = desired remaining BOD_5
K_1 = reaction coefficient (day^{-1})

Since 85% removal of BOD_5 is required, E = 15% or 0.15. The reaction coefficient, K_1, may be conservatively assumed to be .06 (at one degree Centigrade). Solving for "t" we obtain 25 days which is less than the minimum required 30 days. Therefore, the required detention time is 30 days. Table IV-3 provides the storage capacity of the treatment lagoons.

Table IV-3. Storage capacity of treatment lagoons

	Aerated Cell	Storage Cell	Combined
Bottom Surface Area (ft2)	476,546	388,991	865,537
High Water Surface Area (ft2)	564,102	461,300	1,025,402
Side Slope (H:V)	3	3	3
Max Depth (ft)	9	9	9
Sludge Depth (ft)	2.10	0.55	1.28
Max Capacity (gal)	35,030,553	28,622,708	63,653,261
Current Capacity (gal)	27,544,962	27,022,400	54,567,362

According to the design requirements for treatment and disposal systems given in R317-3 of the Utah Administrative Code, new sewer systems shall be designed on the basis of an annual average daily rate of flow of 100 gallons per day per person (gpcd). This number includes an allowance for infiltration / inflow from ground water.

Using the estimated theoretical population at buildout of 8,032 people and a per capita flowrate of 100 gallons per day, the total volume of wastewater flowing into the treatment system each day is 803,200 gallons. The required volume of the aeration cell is obtained by multiplying the total daily wastewater flowrate by the detention time of 30 days, which results in a volume of 24.1 million gallons. Since the current capacity of the aerated cell is 27.5 million gallons, the hydraulic capacity of the wastewater facility is sufficient through buildout. See Appendix B for calculations regarding lagoon hydraulics. These calculations are summarized in Table IV-4.

Table IV-4. Hydraulic Capacity of Lagoons

Buildout Population	8,032
Treatment Plant Influent (gal)	803,200
Required Volume (million gal)	24.1
Existing Volume (million gal)	27.5
Existing Volume Surplus (million gal)	**3.45**

ii. Biological Oxygen Demand (BOD)

In addition to the detention time requirements, the State regulates the required oxygen input per pound of BOD_5 applied to the treatment facility and the BOD removal efficiency. The requirement for oxygen input is 2 lbs of oxygen per pound of BOD_5. Our understanding is that each 20 HP blower and aeration diffuser are capable of injecting 1,150 lbs to 1,350 lbs of oxygen per day (based on typical oxygen transfer efficiencies for a fine bubble diffuser system). At an average influent BOD_5 concentration of 200.07 mg/l and average influent flow of 0.15 MGD, the loading of BOD_5 is 250.4 lbs/day. The calculated loading of BOD_5 requires 500.9 lbs of oxygen, suggesting that the aeration system has sufficient capacity. Using the projected population growth over the next 50 years, the required oxygen input will be approximately 1,725 lbs. The treatment facility's three blowers and diffusers are capable of producing the oxygen requirements at buildout. The calculations for the required oxygen demands can be found Below in Figure IV-1.

Unit Conversion of BOD_5 =	$\frac{200.07\ mg}{l}$	X	$\frac{2.2x10^{-6}\ lb}{mg}$	X	$\frac{l}{0.26\ gl}$	X	$\frac{0.15\ MG}{day}$	=	$\frac{250.4\ lbs}{day}$
Current Required Oxygen =	250.4 lbs	X	$\frac{2\ lb\ Oxygen}{1\ lb\ BOD_5}$	X	500.9 lbs				
Future Required Oxygen = Using same projected Springdale growth rate	500.9 lbs	X	$(1 + 2.5\%)^{50}$	=	1721.6 lbs				

Figure IV-1: Required Oxygen Calculations

The BOD removal efficiency required is 85% removal for Springdale's wastewater permit. A study performed by H&S Environmental, LLC determined the overall average BOD_5 removal efficiency is compliant with the Town's permit with a removal efficiency of 87.8%.

iii. Total Suspended Solids (TSS)

The same study by H&S Environmental, LLC reports that the Town has violated its permit 15 times for effluent TSS and 18 times for TSS percent removal. The Town has been aware of this issue and tried various approaches over the past several years to address TSS issues. During the course of 4.6 years (from 2015 to 2019), the monthly average concentration of TSS was 50.53 mg/l, which is over their permit limit of 45 mg/l.

Suspended solids are predominately organic matter, and in an aerated lagoon treatment process the solids are removed by special bacteria (a.k.a. bugs) which feed on the organic matter. After the bugs have consumed the solids, they reduce and die, falling to the bottom of the lagoons forming a blanket of sludge.

A substantial amount of sludge has accumulated in the aeration cell of the treatment lagoons (an average of 2.10 feet) which could be contributing to the TSS removal issues. Sludge is a collection of dead bacteria and

algae cells, which store and release nutrients, which can stimulate algae growth and cause problems for TSS. However, a buildup of sludge is not the only cause of suspended solids issues.

The study performed by H&S Environmental concluded that algae growth also contributed to the TSS problems. A water quality spot check made on Jan 23, 2020 yielded effluent levels of BOD_5, $CBOD_5$, and $SCBOD_5$, and TSS indicating that algae is a likely source for the BOD and TSS problems. According to H&S, reducing the algae population in the ponds would solve these issues.

iv. Phosphorus Capacity

The Department of Water Quality amended a new rule in 2016 to help reduce phosphorus discharges into State waters. The new rule affected Springdale's wastewater permit (see Appendix E) by placing an annual loading cap on phosphorus that can be discharged into the Virgin River. The allowable load for the Town's permit is 3,490 lbs/yr, effective July 1, 2018.

The annual loading cap is the highest allowable phosphorus loading discharged over a calendar year, calculated as the sum of all the average monthly loading discharges measured during a calendar year. The reported monthly loading is calculated as:

$$\textit{Monthly Loading (lbs/Month)} = \textit{Avg Flow} * \textit{Avg Concentration} * 8.34\ \textit{(lbs/Gal)} * \textit{Days (/Month)}$$

The annual total phosphorus loading is calculated as:

$$\textit{Annual Loading (lbs/Year)} = \sum \textit{Monthly Loading (lbs/Month)}$$

Records of the treatment facility's effluent phosphorus concentration for the past 12 months indicate an annual loading of 2,955 lbs/yr.

Although there are many variables when considering the rate of phosphorus loading increase, it is reasonably estimated based on current discharge rates and average annual phosphorus loadings that the Town will exceed their loading cap in the next 5 to 10 years. The Town should begin thinking about how to comply with their phosphorus permit loading cap. Some recommendations will be made in Section V of this Plan.

V. RECOMMENDATIONS

This section offers recommendations for the existing and future capacity of the wastewater treatment facility as well as the sewer collection system.

A. COLLECTION SYSTEM IMPROVEMENTS

In general, the Town's wastewater collection system is satisfactory, and there are no major issues preventing the wastewater system from functioning as it was intended. However, there are a few recommended improvements, both immediate and future, that would help maintain compliance with the Town's permit and allow the Town to measure their system flows more accurately.

i. Immediate Improvements

It is recommended that the collection system be video inspected, which the Town has already started. This may be phased over the next three years; inspecting 1/3 of the collection system each year. Some of the treatment facility compliance issues, such as insufficient BOD_5 and TSS percent removal, are potentially resulting from diluted influent. Dilution could come from groundwater infiltration, draining swimming pools, or other clean water sources. Additionally, some pipeline segments have bellies in the line that result in ponding and possible unpleasant odors. Inspecting the existing lines by camera will help locate any instances where infiltration may be happening and identify pipes needing replacement.

ii. Future Improvements

The majority of the current collection system was installed in the late 70's. The pipe installed was truss pipe which has a lifespan ranging anywhere from 40 to 100 years, depending on proper installation and other various factors. It is anticipated that the collection system installed during the late 70's will need to begin being replaced in the next 10 to 20 years. A number of manholes are either buried or their whereabouts are unknown. This should also be addressed as the old collection system is replaced.

Since it is difficult to know when and where the pipe will ultimately have failures the Town may take either of two approaches. One would be to replace pipes when failures are noticed. This will likely result in unexpected shutdowns and potentially require temporary bypass pumping while pipeline segments are replaced. This approach can be costly in the long run and hard to plan for. Another approach would be to plan and budget for replacing certain segments on annual basis. This recommended approach will allow for strategic replacement and minimize urgent costs.

The master planning analysis of the current collection system also showed that the lower portion of the main trunk line (pipe segments 41 to 127 on the pipe segment map in Appendix B) will need to be replaced with a 15" diameter section. Flows in this portion are likely to exceed capacity when the Town has a total of more than 1,450 ERU's, which is anticipated to occur in 25 to 30 years. Since the current collection system might be replaced (see paragraph above) within that period, it is recommended that the 15" portion be upgraded as the rest of the system is replaced.

An alternative to upsizing the sewer main is to install an additional parallel main, which may reduce the cost of the project. However, since the existing pipe is aging and will need to be replaced regardless, the opinion of probable cost for these improvements assumes the upsizing to a single 15-inch pipe.

B. TREATMENT FACILITY IMPROVEMENTS

The current overall performance of the treatment lagoons is fair, but the system has violated several permit standards over the last 5 years. This section outlines some recommended improvements to bring the treatment facility back into compliance with the Town's wastewater permit requirements, as well as improve efficiency of the treatment facility so the life of lagoons can be maximized.

i. Immediate Improvements

The performance evaluation report provided by H&S Environmental, LLC offers several recommendations based on the results of their evaluation. The full report with detailed descriptions of the recommendations is provided in Appendix D, but a brief outline is given below.

1) <u>Remove sludge from cells 1 & 2</u>

Removing the sludge from the bottom of the lagoons will provide several benefits for the treatment capacity. Sludge exerts a measurable oxygen demand (aiding in BOD violations), reduces the volume and treatment originally designed into the system, and re-releases nutrients, ammonia, phosphorous, CO_2, and organic acids that stimulate algae growth.

Removal of the existing sludge should assist the Town in correcting the treatment capacity and permit violation issues they have been facing for several years.

Springdale has already hired Environmental Techniques International (ETI) to assist in removing the lagoon sludge with multiple applications of chemical products such as CBX ProOxidizer and CBX Sniper. The first application of these chemicals was applied in August 2020 and four other applications have been done since. The sixth and final application is scheduled for July 2021. ETI will then evaluate the efficiency of this method for sludge removal. If this method does not provide satisfactory removal of sludge, the Town will need to look into alternative methods such as dredging the lagoons.

2) <u>Investigate possible additions to the influent flow</u>

The recommendation was made for the collection system to be inspected by camera to identify bellies or areas needing rehabilitation. This method, along with smoking the pipes, can help to discover sources of low influent TSS and BOD_5 concentrations. Excess clean flows from snowmelt, springs, cleaning of the National Park, draining of private swimming pools, or other sources cause dilute TSS and BOD to enter the treatment lagoons. These diluted flows could be a contributor to the poor treatment and permit violations.

Often the best upgrade to a lagoon system can be made in the collection system. Tightening up pipe connections will help prevent percent removal exceedances and increase retention time for higher rates of ammonia removal.

3) Install a headworks structure

A headworks structure will keep the bulk of the trash from entering the lagoons and subsequently the Cell #1 sludge blanket to lower influent BOD after the influent sampling point. Removing large trash will also extend the service life of the diffusers and the pond system as a whole.

It is recommended that the headworks structure be a powered screen. This piece of equipment has a cylindrical screening basket to capture debris where it is moved by a screw conveyor to a waste bin for dewatering and removal. This type of headworks structure is recommended due to its simple design that minimizes maintenance (compared to other screens), head loss, and plugging/binding. Several local wastewater treatment facilities in Southern Utah have upgraded their system to include a powered screen. The downside to this additional piece of equipment is the added operational duties, expenses, and maintenance. Appendix F contains information on a Raptor Fine Screen by Lakeside which is one of the possible options for a powered screen.

4) Perform diagnostic BOD, TSS, and ammonia tests on each cell in the system

Since algae is likely the primary source of TSS in the lagoons the Town should sample and try to determine the exact type of algae that is present. This will help in evaluating possible solutions.

By performing intra-pond tests the Town can identify specific areas of the treatment system where ongoing problems are occurring. By locating where the problem areas are and when they are occurring, the Town can save time, money, and simplify the job of lagoon optimization and permit compliance.

The most telling process control tests for determining when influent loading is becoming a problem are Cell #1 effluent BOD_5, and BOD and ammonia removal efficiencies. These should be analyzed monthly.

Treatment should be focused on Cell #1 as much as possible. This will allow for better TSS, BOD, and ammonia and nitrate removal in Cell #2. Each cell has specific functions to perform (see H&S report for more information on these functions), which are more easily accomplished by getting the most productivity out of Cell #1. Removing the sludge in Cell #1 is the first step in this process.

5) Sample at the beginning of the month

Sampling at the beginning of the month will allow the Town to make corrections before pulling a second sample at the end of the month. The dissolved oxygen in the lagoons should be at or slightly above 2 mg/l for best ammonia removal and to keep odors down. Dissolved oxygen is best measured before sunrise since algae consumes oxygen under dark conditions and release it during sunlight.

Always be sure to check reported values by the State and USEPA; THEY CAN MAKE MISTAKES.

6) Multiple level effluent draw-off structure and transfer structure between cells

Since water chemistry changes with depth, a functioning multiple level draw-off structure can allow the operator to select the quality of water being discharged from the plant. Algae grows in the upper three feet of the treatment cell and can inflate BOD and TSS numbers. Higher levels of BOD and TSS can be found in samples taken from the top due to algae. The effluent structure was designed to draw from multiple levels and the lower level should be used.

It is recommended that the transfer structure be reconstructed to allow for an option to draw from lower levels in the second aeration cell. Currently the draw is from the top of the second aeration cell. This will help reduce the amount of BOD and TSS that is transferred from the second aeration cell into the storage cell.

7) Install a filtration system

In the case that the previous recommended improvements do not satisfy the discharge permit requirements, the Town could install a filtration system on the effluent side of the treatment lagoons. There are two main kinds of filtration systems that could be used, a continuous backwash sand filter or a disc filter. Each kind of filter can be used to polish wastewater effluent levels of TSS and BOD at a relatively low cost. Water quality from these types of filters may be similar to water treated by a packaged activated sludge system. The latest USEPA manual on wastewater pond systems discusses the benefits of using sand and disc filters. This addition to Springdale's wastewater treatment facility may be beneficial for ensuring the Town stays within its permitted limits and prolonging the lifespan of the existing wastewater treatment system.

Either of these systems would be installed on the effluent side of the existing treatment plant but before the UV disinfection. These filters are modular, allowing for any size filter area and expansion when needed. The sand filter provides a continuous backwash of the media for reduced energy, maintenance, equipment, or controls, but does require compressed air equipment. The largest downside to the sand filtration is the pressure head required to operate the system and may require pumping based on the existing lagoon site configuration. The disc filter would be smaller than the sand filter and require less head to operate. For Springdale's site, there may not be enough room to insert the filtration between the lagoon discharge and UV building, without additional piping or relocating the UV building. Maintenance for each type of filter would be comparable. See Appendix F for additional information about sand and disk filter options.

If the other methods of addressing TSS do not result in improvement, adding filtration is likely to be the most effective step the Town could take. If the Town is interested in pursuing a filtration system, an additional feasibility study will be required to determine which, if any, filtration system is most appropriate with the Town's treatment lagoon site.

8) Erosion protection of the discharge to the river

The discharge to the Virgin River is to the southwest of the final storage cell. The meander of the river continues to evolve from year to year and may be a threat to move closer to the point of discharge or even the southwest corner of the lagoons. It is recommended to implement a design and construction of erosion protection measures to mitigate encroachment by the river.

ii. Future Improvements

Future improvements to the lagoons include the following recommended items. These items include both design improvements as well as the life expectancies of several components of the system.

First, the intake structure located in the aeration lagoon collects water from the surface. This is not a preferred practice since unwanted floating material can pass from the aeration lagoon directly into the storage cell. It is preferred that the intake structure receives water below the surface, therefore preventing floating material from passing on to the next cell.

Next, phosphorus concentrations in the lagoons could exceed the permitted capacity in the next 5 to 10 years. When the Town has reached their loading cap, they will have five years to come back into compliance. There are several actions that can be taken to reduce the phosphorus levels in the Springdale wastewater treatment system.

1) **Discharge to agricultural land**

Since the State's concern for discharging phosphorus is the contamination to the Virgin River and since the Town's discharge permit defines the phosphorus annual loading cap as the highest allowable phosphorus loading discharged over a calendar year, the Town can reduce their loading discharged to the Virgin River by discharging to agricultural lands or other approved reuse scenarios, depending on the level of treatment.

For areas owned by the Town that are fenced and contained, the current effluent may be land applied if the current permit limits are met. The Town owns a four-acre fenced parcel that is immediately south of Cell 1. The area would likely require a berm around the perimeter to contain the water from entering the Virgin River, but it could be planted, and flood irrigated. There is another area of approximately one acre to the west of the final storage cell and UV building that could be fenced and planted.

The State allows outside land application of wastewater effluent if certain treatment standards are met prior to application of the effluent. There are multiple types of land application and certain allowable uses for each type of wastewater treatment.

• TYPE 1 – Use of Treated Domestic Wastewater Effluent Where Human Contact is Likely. Uses include residential irrigation, non-residential irrigation, toilet flushing, fire protection, irrigation of food crops where the applied re-use water is likely to have direct contact with the edible part, irrigation of pasture for milking animals, impoundments of water where direct human contact is likely to occur.

• TYPE 2 – Use of Treated Domestic Wastewater Effluent Where Human Exposure is Unlikely. Uses include irrigation of sod farms, silviculture, limited access highway rights-of-way, and other areas where human access is restricted or unlikely to occur, irrigation of food crops where the applied reuse water is not likely to have direct contact with the edible part, irrigation of animal feed crops other than pasture used for milking animals, impoundments of water where direct

human contact is not allowed or unlikely to occur, cooling water and soil compaction or dust control in construction areas.

If land application outside of the Town's fenced site is to be implemented, the effluent would require Type 2 treatment. Type 2 reuse is described above and in Rule R317-3-11.5 of the Utah Administrative Code. Among other limits the effluent would have to have an average TSS of 25 mg/L or less, which the current effluent does not meet additional or improved treatment would be required. There is a nearby private landowner to the west of the lagoon site that the Town may approach to discuss land application of the treated effluent.

Exhibit 4 shows the potential land application areas in relation to the lagoons.

2) **Construct a mechanical treatment facility**

A mechanical treatment facility is a completely different type of treatment facility than the lagoons currently in use. These facilities are often a packaged design and can have several advantages and disadvantages.

Some advantages of these mechanical treatment facilities are high efficiency, elimination of organics, and biological nitrification without chemicals. A properly designed mechanical plant should solve other permit issues such as TSS and BOD.

However, there are disadvantages to these facilities as well. The main disadvantage is the cost. Mechanical treatment facilities cost more to build and also more to operate and maintain. These facilities are also more cumbersome to operate.

The aeration blowers, the blower motors, the baffle wall separating the aeration cells, and the ultraviolet radiation disinfection system were installed during the Wastewater Facilities Expansion Project in 1996 but have been replaced periodically as needed since their first installation. These components should continue to be replaced as part of the Town's ongoing maintenance of the treatment lagoons. The life expectancy for each item is provided below.

1) **Blower Units**

The blower units are expected to last an estimated 5-7 years assuming the units are serviced as spelled out in the operation manual and run for 24 hours a day. This assumption gives them a total life expectancy of 43,800 to 61,320 hours. However, for Springdale's system, the blowers are currently cycled between three units and run for approximately 15 hours a day, making a total lifespan of no more than 10 years from the time of installation.

2) **Blower Motors**

The motors powering the blowers run the same 15 hours per day as the blowers. The average life expectancy for an AC motor ranging from 5-20 HP, operating the given number of hours each day, is around 16-20 years. It was recommended by the manufacturer that the motors should be expected to last 18 years given proper maintenance and operational conditions.

3) Baffle Wall

The baffle wall has a life expectancy of about 20 years. However, the Town has expressed concerns regarding the effectiveness of the baffle wall, stating that water can be seen flowing around the edges of the wall. This may be an indication that the 5x4 foot flow through window located on the southern end of the baffle wall may not be operating as effectively as it should. These flows may also be an indication that the baffle wall has reached the end of its life expectancy and that regular maintenance on the lagoons would require the replacement of the baffle wall.

4) UV Disinfection System

The UV disinfection system has several components, and each has a considerably different life expectancy. The bulbs themselves last for approximately 13,000 hours, the ballasts usually last between 5-9 years depending on the temperature and usage, and the rest of the setup can last 20 years or more depending on the amount of use.

According to these figures and suggestions from Coombs Hopkins, the supplier, the Town can expect to periodically replace the ballasts every few years. Running the lights for 25 days, three months out of the year, the Town can expect them to last about 7-8 years and should expect to replace those as they die out.

The UV disinfection system has the capability of treating 500,000 gallons a day, although the discharge permit states a maximum monthly average of 290,000 gallons. The number of days required for discharging takes into account monthly precipitation, evaporation, and seepage rates along with peaking during the summer months. By installing a second unit, the Town would be able to discharge for a fewer number of days, or not require the UV disinfection systems to run at maximum capacity.

C. SUMMARY OF RECOMMENDATIONS

Section V.B recommended improvements for the collection system and the treatment facility. These recommendations consisted of capital improvement projects as well as increased testing and observation procedures. The recommended capital improvement projects are summarized in the table below along with their estimated cost (in today's dollars) and if they are recommended as immediate or future improvements.

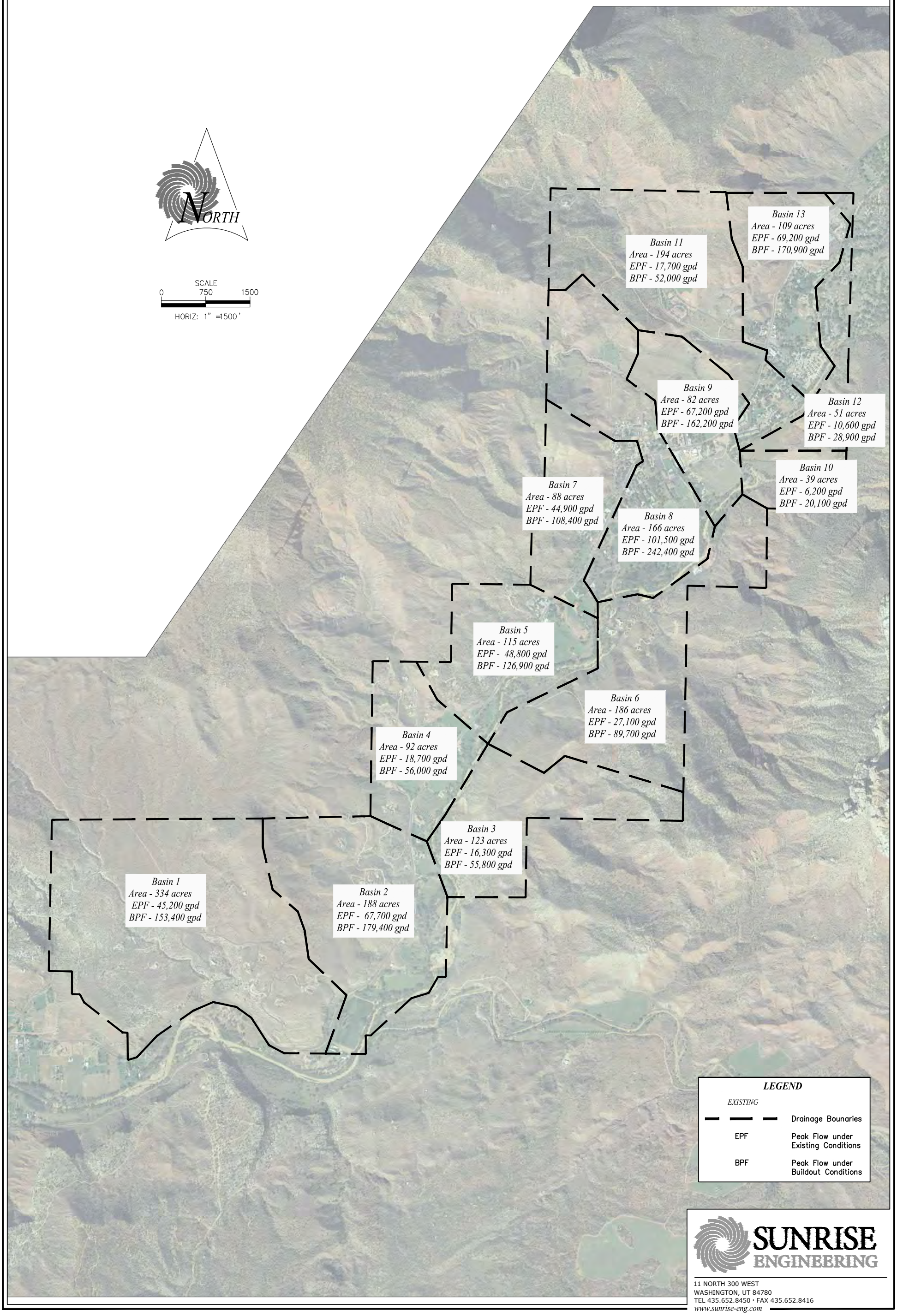
Table V-1: Summary of Recommended Improvements

Improvement	Timeframe	Estimated Cost
Camera Inspection of Collection System	Immediate	$ 116,200.00
Plant Headworks Replacement	Immediate	$ 750,500.00
Transfer Structure	Immediate	$ 173,900.00
Disk Sand Filter	Immediate	$ 1,617,300.00
Erosion Control	Immediate	$ 265,900.00
Upsize Sewer Main	Future	$ 2,969,660.00

Detailed cost estimates for each project can be found in Appendix C.

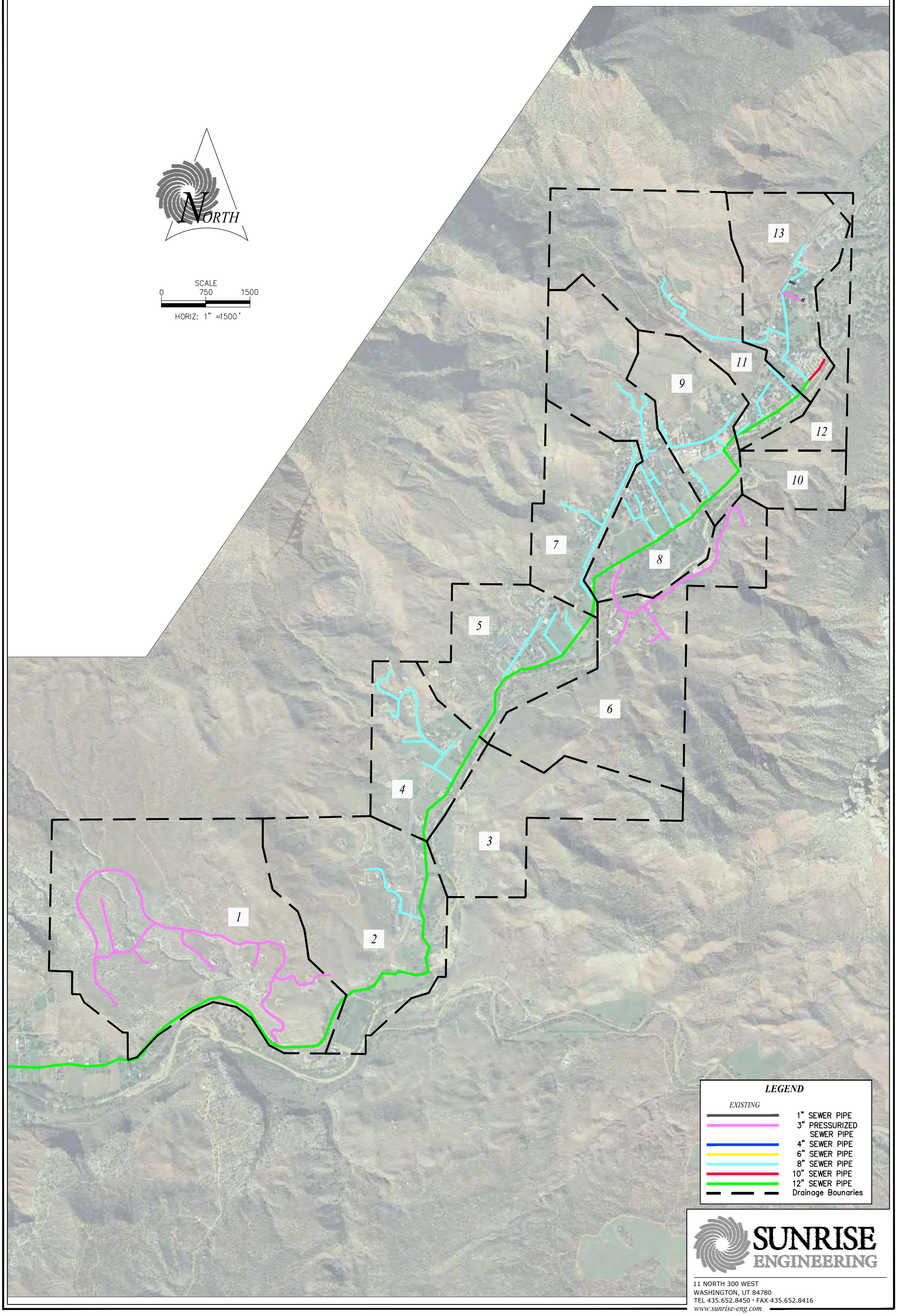
EXHIBITS

TOWN OF SPRINGDALE
SEWER DRAINAGE BASIN BOUNDARIES & BASIN CHARACTERISTICS
EXHIBIT 1



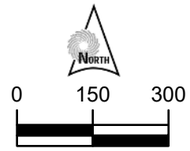
SUNRISE ENGINEERING
11 NORTH 300 WEST
WASHINGTON, UT 84780
TEL 435.652.8450 • FAX 435.652.8416
www.sunrise-eng.com

TOWN OF SPRINGDALE
DRAINAGE BASINS &
EXISTING COLLECTION SYSTEM
EXHIBIT 2



SUNRISE ENGINEERING
11 NORTH 300 WEST
WASHINGTON, UT 84780
TEL 435.652.8450 · FAX 435.652.8416
www.sunrise-eng.com

MAP LEGEND



1 In = 300 Feet

- Inlet Structure
- Baffle Wall
- Transfer Structure
- Effluent Discharge
- SS Gravity Main
- Blower Building
- U.V. Building

LandOwnership

- Private
- Springdale Town
- Parcel Boundary

Label Format:
Owner Name (Potential Crop Acres)

SPRINGDALE Utah ESTD 1862

SUNRISE ENGINEERING

11 NORTH 300 WEST
WASHINGTON, UTAH 84780
TEL 435.652.8450 - FAX 435.652.8416
www.sunrise-eng.com

SPRINGDALE TOWN

TREATMENT PLANT EFFLUENT LAND APPLICATION

				SHEET NO.	EX

APPENDIX A

GROWTH & USER ANALYSIS

	May-19		Jun-19		Jul-19		Aug-19		Sep-19		Oct-19	
Connection Type	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**
Residential	290	$5,873	291	$ 9,485	290	$ 4,310	292	$ 7,488	298	$ 7,121	303	$ 6,529
Outside	54	$1,143	53	$ 1,143	53	$ 1,143	54	$ 1,143	54	$ 1,143	53	$ 1,143
Unconnected	9	$126	9	$ (154)	7	$ 98	7	$ 98	7	$ 98	6	$ 84
Unconn. Outside	3	$42	3	$ 42	3	$ 42	3	$ 42	3	$ 42	3	$ 42
Commercial	118	$17,321	114	$ 48,839	114	$ (4,735)	115	$ 22,668	115	$ 20,580	114	$ 19,759
Rockville Commercial	4	$216	4	$ 216	4	$ 216	4	$ 216	4	$ 216	4	$ 216

Connection Type	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn
Residential	8,625	$ 20.25	11,847	$ 32.59	7,217	$ 14.86	10,032	$ 25.64	9,576	$ 23.90	8,963	$ 21.55
Outside	8,862	$ 21.16	8,966	$ 21.56	8,966	$ 21.56	8,865	$ 21.17	8,862	$ 21.16	8,966	$ 21.56
Unconnected	7,000	$ 14.03	(1,140)	$ (17.15)	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03
Unconn. Outside	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03
Commercial	41,663	$ 146.79	115,194	$ 428.41	(7,509)	$ (41.54)	54,802	$ 197.11	50,062	$ 178.96	48,592	$ 173.33
Rockville Commercial	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91

	Nov-19		Dec-19		Jan-20		Feb-20		Mar-20		Apr-20	
Connection Type	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**	**Conn**	**Rev**
Residential	307	$ 5,991	312	$ 4,979	310	$ 4,859	312	$ 5,021	310	$ 5,142	307	$ 5,453
Outside	53	$ 1,143	53	$ 1,143	56	$ 1,143	53	$ 1,143	53	$ 1,143	53	$ 1,143
Unconnected	6	$ 84	6	$ 84	6	$ 84	6	$ 84	6	$ 84	6	$ 84
Unconn. Outside	3	$ 42	3	$ 42	3	$ 42	3	$ 42	3	$ 42	3	$ 42
Commercial	114	$ 15,908	113	$ 8,019	113	$ 8,577	114	$ 8,778	112	$ 10,114	113	$ 4,261
Rockville Commercial	4	$ 216	4	$ 216	4	$ 216	4	$ 216	4	$ 216	4	$ 216

Connection Type	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn	Gallons	$/Conn
Residential	8,432	$ 19.51	7,503	$ 15.96	7,429	$ 15.67	7,539	$ 16.09	7,667	$ 16.59	7,975	$ 17.76
Outside	8,966	$ 21.56	8,966	$ 21.56	8,664	$ 20.41	8,966	$ 21.56	8,966	$ 21.56	8,966	$ 21.56
Unconnected	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03
Unconn. Outside	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03	7,000	$ 14.03
Commercial	39,771	$ 139.54	21,866	$ 70.97	23,154	$ 75.90	23,440	$ 77.00	26,915	$ 90.30	13,182	$ 37.71
Rockville Commercial	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91	17,413	$ 53.91

Table 1
Average (May 19 - Apr 20)

	Conn	Rev	$/Conn	Gallons	ERU
Residential	302	$ 6,021	$ 19.95	8,545	1.00
Outside Residential (Rockville)	54	$ 1,143	$ 21.36	8,914	1.04
Unconnected	7	$ 71	$ 10.57	6,096	0.71
Outside Unconnected (Rockville)	3	$ 42	$ 14.03	7,000	0.82
Commercial	114	$ 15,984	$ 139.99	39,888	4.67
Rockville Commercial	4	$ 216	$ 53.91	17,413	2.04

Table 2
Latest (Apr 20)

	Conn	ERU	ERUs
Residential	307	1.00	307
Outside (Rockville Res.)	54	1.00	54
Unconnected	6	0.70	4
Unconn. Outside	3	0.80	2
Commercial	113	4.70	531
Rockville Commercial	4	2.00	8
Total	**487**		**906**

Monthly Commercial ERUs

	ERU/ Connection		Commercial ERUs	
	Springdale	Rockville	Springdale	Rockville
May	4.83	2.02	570	8
June	9.72	1.47	1,109	6
July	-1.04	2.41	(119)	10
Aug	5.46	1.74	628	7
Sep	5.23	1.82	601	7
Oct	5.42	1.94	618	8
Nov	4.72	2.07	538	8
Dec	2.91	2.32	329	9
Jan	3.12	2.34	352	9
Feb	3.11	2.31	354	9
Mar	3.51	2.27	393	9
Apr	1.65	2.18	187	9
AVG	4.52	2.07	516	8

Town of Springdale

Year		Population	% Growth
1970	Census Population	182	
1980	Census Population	258	3.6%
1990	Census Population	275	0.6%
2000	Census Population	457	5.2%
2010	Census Population	529	1.5%
2015	Estimated Population	561	1.2%
2016	Estimated Population	581	3.6%
2017	Estimated Population	605	4.1%
2018	Estimated Population	628	3.8%
2019	Estimated Population	652	3.8%
2020	Estimated Population	674	3.4%

3.6% Growth rate experienced between 1970 & 1980
0.6% Growth rate experienced between 1980 & 1990
5.2% Growth rate experienced between 1990 & 2000
1.5% Growth rate experienced between 2000 & 2010

2.7% Growth rate experienced between 1970 & 2020
2.5% Growth rate to be projected

Year	Est. Residential Growth Rate	Estimated Residential ERUs	Estimated Population **
2010			529
2015	1.2%		561
2016	3.6%		581
2017	4.1%		605
2018	3.8%		628
2019	3.8%		652
2020	3.4%	307	674
2021	2.5%	315	691
2022	2.5%	323	708
2023	2.5%	331	726
2024	2.5%	339	744
2025	2.5%	347	763
2026	2.5%	356	782
2027	2.5%	365	801
2028	2.5%	374	821
2029	2.5%	383	842
2030	2.5%	393	863
2031	2.5%	403	884
2032	2.5%	413	906
2033	2.5%	423	929
2034	2.5%	434	952
2035	2.5%	445	976
2036	2.5%	456	1,001
2037	2.5%	467	1,026
2038	2.5%	479	1,051
2039	2.5%	491	1,077
2040	2.5%	503	1,104
2041	2.5%	516	1,132
2042	2.5%	529	1,160
2043	2.5%	542	1,189
2044	2.5%	555	1,219
2045	2.5%	569	1,250
2046	2.5%	583	1,281
2047	2.5%	598	1,313
2048	2.5%	613	1,346
2049	2.5%	628	1,379
2050	2.5%	644	1,414
2051	2.5%	660	1,449
2052	2.5%	677	1,485
2053	2.5%	693	1,522
2054	2.5%	711	1,561
2055	2.5%	729	1,600
2056	2.5%	747	1,640
2057	2.5%	765	1,681
2058	2.5%	785	1,723
2059	2.5%	804	1,766
2060	2.5%	824	1,810
2061	2.5%	845	1,855
2062	2.5%	866	1,901
2063	2.5%	888	1,949
2064	2.5%	910	1,998
2065	2.5%	933	2,048
2066	2.5%	956	2,099
2067	2.5%	980	2,151
2068	2.5%	1,004	2,205
2069	2.5%	1,029	2,260
2070	2.5%	1,053	2,317

3.3% *avg of input

Town of Rockville

Year		Population	% Growth
1970	Census Population		
1980	Census Population	156	
1990	Census Population	182	1.6%
2000	Census Population	247	3.1%
2010	Census Population	245	-0.1%
2015	Estimated Population	252	0.6%
2016	Estimated Population	262	4.0%
2017	Estimated Population	273	4.2%
2018	Estimated Population	282	3.3%
2019	Estimated Population	292	3.5%
2020	Estimated Population	302	3.4%

1.6% Growth rate experienced between 1980 & 1990
3.1% Growth rate experienced between 1990 & 2000
-0.1% Growth rate experienced between 2000 & 2010

1.7% Growth rate experienced between 1980 & 2020
1.5% Growth rate to be projected

Year	Est. Residential Growth Rate	Estimated Residential ERUs	Estimated Population **
2010			245
2015	0.6%		252
2016	4.0%		262
2017	4.2%		273
2018	3.3%		282
2019	3.5%		292
2020	3.4%		302
2021	1.5%		307
2022	1.5%		311
2023	1.5%		316
2024	1.5%		321
2025	1.5%		325
2026	1.5%		330
2027	1.5%		335
2028	1.5%		340
2029	1.5%		345
2030	1.5%		350
2031	1.5%		356
2032	1.5%		361
2033	1.5%		366
2034	1.5%		372
2035	1.5%		378
2036	1.5%		383
2037	1.5%		389
2038	1.5%		395
2039	1.5%		401
2040	1.5%		407
2041	1.5%		413
2042	1.5%		419
2043	1.5%		425
2044	1.5%		432
2045	1.5%		438
2046	1.5%		445
2047	1.5%		451
2048	1.5%		458
2049	1.5%		465
2050	1.5%		472
2051	1.5%		479
2052	1.5%		486
2053	1.5%		494
2054	**1.5%**		**501**
2055	1.5%		509
2056	1.5%		516
2057	1.5%		524
2058	1.5%		532
2059	1.5%		540
2060	1.5%		548
2061	1.5%		556
2062	1.5%		564
2063	1.5%		573
2064	1.5%		581
2065	1.5%		590
2066	1.5%		599
2067	1.5%		608
2068	1.5%		617
2069	1.5%		626
2070	1.5%		636

3.2% *avg of input

APPENDIX B

SEWER SYSTEM CAPACITY

Collection Basins - Total Flow, Acres by Basin, & Theoretical Populations

Existing Conditions - 2020														
Zoning Classification		Total Number of Acres of a particular Zone within each Drainage Area												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Foothill Residential		331.74	118.86	120.72	53.21	76.09	164.65	20.15	19.09	33.04	38.19	56.58	27.58	47.91
Valley Residential		0.00	35.97	1.78	32.89	11.57	18.56	2.96	12.33	0.02	0.00	16.62	1.04	13.01
Village Commercial		0.00	15.58	0.14	5.29	26.92	1.44	22.52	40.93	1.31	0.00	5.83	4.92	44.21
Central Commercial		1.14	17.85	0.00	0.00	0.00	0.72	7.69	29.45	44.11	0.88	0.00	0.00	0.00
Public Use		0.00	0.00	0.00	0.00	0.00	0.00	37.18	62.19	4.59	0.00	114.58	0.00	0.00
Agricultural		0.00	17.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Federal Lands		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Area	(ft^2)	14,500,273	8,956,234	5,342,381	3,980,856	4,991,607	8,074,730	3,942,926	7,143,080	3,619,053	1,702,137	8,433,764	1,461,258	4,579,231
	Acres	333	206	123	91	115	185	91	164	83	39	194	34	105

Existing Conditions - 2020														
Zoning Classification	ERU's per Acre	People per Acre	# People Per Basin											
			1	2	3	4	5	6	7	8	9	10	11	12	13
Foothill Residential	0.24	0.53	175	63	64	28	40	87	11	10	17	20	30	15	25
Valley Residential	0.24	0.53	-	19	1	17	6	10	2	6	0	-	9	1	7
Village Commercial	2.54	5.58	-	87	1	30	150	8	126	228	7	-	33	27	247
Central Commercial	2.54	5.58	6	100	-	-	-	4	43	164	246	5	-	-	-
Public Use	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Agricultural	0.15	0.38	-	7	-	-	-	-	-	-	-	-	-	-	-
Federal Lands	0.00	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Flow at 250 gallons per capita per day (gpcd)			45,244	68,632	16,316	18,709	49,084	27,133	45,182	102,277	67,700	6,257	17,767	10,631	69,669
			50,564	50,440	18,562	26,981	57,440	28,896	48,758	121,295	76,544	7,372	28,312	18,310	79,689

Town of Springdale ERU Estimates					
	Current	Estimated	ERC	Current ERUs	Est. ERU Buildout
Residential Connections	222	1022	1	307	1055
Hotel Rooms	1100	1666	0.5	0	0
Restaurants	12	30	5.5	0	0
Other connections ERU	24	50	2	535	1293
Totals	924	2768		669	2348

	Current Figures as of 2016				
	Total Acreage		Vacant Acreage		
Residential	1283		721		From the 2016 General Plan
Foothill Residential	*1138*		*661*		
Valley Residential	*145*		*60*		
Commercial	211		114		
Central Commercial	*69*		*32*		
Village Commercial	*142*		*81*		
	Current as of 2020		Est. at 2020		
	ERUs / Acre		ERUs / Acre		
Residential	0.24		0.24		
Commercial / Other	2.54		2.54		

Collection Basins - Total Flow, Acres by Basin, & Theoretical Populations

Future Conditions - 2070

Zoning Classification	ERU's per acre	People per acre	# People Per Basin												
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Foothill Residential	0.82	1.81	600	215	218	96	138	298	36	35	60	69	102	50	87
Valley Residential	0.82	1.81	-	65	3	60	21	34	5	22	0	-	30	2	24
Village Commercial	6.13	13.48	-	210	2	71	363	19	304	552	18	-	79	66	596
Central Commercial	6.13	13.48	15	241	-	-	-	10	104	397	595	12	-	-	-
Public Use	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agricultural	0.15	0.38	-	7	-	-	-	-	-	-	-	-	-	-	-
Federal Lands	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Flow at 250 gallons per capita per day (gpcd)			153,892	184,344	55,882	56,780	130,412	90,177	112,316	251,437	168,080	20,251	52,772	29,539	176,578

Zoning Classification			Total Number of Acres of a particular Zone within each Drainage Area												
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Foothill Residential			331.74	118.86	120.72	53.21	76.09	164.65	20.15	19.09	33.04	38.19	56.58	27.58	47.91
Valley Residential			0.00	35.97	1.78	32.89	11.57	18.56	2.96	12.33	0.02	0.00	16.62	1.04	13.01
Village Commercial			0.00	15.58	0.14	5.29	26.92	1.44	22.52	40.93	1.31	0.00	5.83	4.92	44.21
Central Commercial			1.14	17.85	0.00	0.00	0.00	0.72	7.69	29.45	44.11	0.88	0.00	0.00	0.00
Public Use			0.00	0.00	0.00	0.00	0.00	0.00	37.18	62.19	4.59	0.00	114.58	0.00	0.00
Agricultural			0.00	17.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Federal Lands			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Area	(ft^2)		14,500,273	8,956,234	5,342,381	3,980,856	4,991,607	8,074,730	3,942,926	7,143,080	3,619,053	1,702,137	8,433,764	1,461,258	4,579,231
	Acres		333	206	123	91	115	185	91	164	83	39	194	34	105

Town of Springdale ERU Estimates					
	Current	Estimated	ERC	Current ERUs	Est. ERU Buildout
Residential Connections	222	1022	1	307	1055
Hotel Rooms	1100	1666	0.5	0	0
Restaurants	12	30	5.5	0	0
Other connections ERU	24	50	2	535	1293
Totals	924	2768		669	2348

	Current Figures as of 2020				
	Total Acreage		Vacant Acreage		
Residential	1283		721		From the 2016 General Plan
Foothill Residential	1138		661		
Valley Residential	145		60		
Commercial	211		114		
Central Commercial	69		32		
Village Commercial	142		81		
	Current as of 2022		Est. at Buildout		
	ERUs / Acre		ERUs / Acre		
Residential	0.24		0.82		
Commercial / Other	2.54		6.13		

Flow into Treatment Lagoons based on Actual and Theoretical Data

Flow based on actual data received from the Town of Springdale

		total gallons/month by year							
Month	Days/Month	2013	2014	2015	2016	2017	2018	2019	Average Total Gallons/Month
January	31	NO DATA	692,000	1,507,000	1,306,000	2,241,000	2,239,000	3,103,000	1,848,000
February	28	3,356,000	2,468,000	1,905,000	2,245,000	1,985,000	2,425,000	1,568,000	2,278,857
March	31	4,501,000	3,469,000	3,717,000	4,701,000	2,009,000	4,478,000	2,133,000	3,572,571
April	30	7,393,000	5,191,000	4,269,000	6,032,000	5,320,000	4,822,000	5,795,000	5,546,000
May	31	8,049,000	4,719,000	6,547,000	5,830,000	6,163,000	5,660,000	6,594,000	6,223,143
June	30	5,797,000	5,476,000	6,226,000	6,837,000	7,147,000	4,384,000	6,672,000	6,077,000
July	31	6,800,000	7,269,000	7,142,000	6,078,000	5,992,000	4,548,000	9,615,000	6,777,714
August	31	8,371,000	6,299,000	5,625,000	6,378,000	6,917,000	7,177,000	5,341,000	6,586,857
September	30	3,072,000	3,386,000	5,123,000	5,680,000	6,116,000	5,042,000	5,052,000	4,781,571
October	31	2,387,000	4,298,000	5,626,000	5,038,000	5,521,000	6,218,000	3,996,000	4,726,286
November	30	1,350,000	2,059,000	2,921,000	3,674,000	3,525,000	4,335,000	3,820,000	3,097,714
December	31	NO DATA	2,103,000	2,448,000	2,448,000	2,036,000	3,057,000	2,870,000	2,493,667
								Actual Total Flow/Year	54,009,381

Flow based on number of ERUs according to month and Connection Data

Average Flow/ERU/Day	
47	Gallons
Average Flow/ERU/Month	
1,418	Gallons

	Springdale (gal/month)		Rockville (gal/month)		Zion N. P.	% Difference	
	Residential	Commercial	Residential	Commercial	(gal/month)	From Actual	Total gal/month
January	439,667	499,477	82,850	13,297	845,001	2%	1,880,292
February	442,504	502,715	78,412	13,103	874,422	-16%	1,911,156
March	439,667	557,599	78,412	12,884	2,533,565	1%	3,622,128
April	435,413	264,909	78,412	12,387	3,183,664	-28%	3,974,784
May	411,302	808,452	79,891	11,454	4,527,792	-6%	5,838,890
June	412,720	1,572,170	78,412	8,338	5,086,489	18%	7,158,129
July	411,302	-168,212	78,412	13,687	5,384,942	-16%	5,720,131
August	414,138	890,965	79,891	9,847	4,577,118	-9%	5,971,959
September	422,648	852,653	79,891	10,316	4,253,245	18%	5,618,752
October	429,740	876,541	78,412	11,021	3,673,207	7%	5,068,920
November	435,413	762,638	78,412	11,716	1,968,088	5%	3,256,266
December	442,504	467,043	78,412	13,165	1,468,123	-1%	2,469,247
					Theoretical Total Flow/Year		52,490,655

Lagoon Hydraulic Analysis

Existing Detention Volume

Detention Volume (Cell #1) =	Total Volume	-	Sludge Volume(2.1 feet)	=	Detention Volume	
(aeration cells)	35,028,225 gallons	-	7,485,591 gallons	=	27,542,634 gallons	
Detention Volume (Cell #2) =	Total Volume	-	Sludge Volume(.55 feet)	=	Detention Volume	
(storage cell)	28,620,802 gallons	-	1,600,308 gallons	=	27,020,494 gallons	
				Total Existing Detention Volume =	**54,563,128** gallons	

Detention Time Calculation

Rule R317-3-10-F-2a

Minimum of 30 days or value obtained from

*Note: Using alternate 45/45 effluents limits,
only 77.5% removal is required

$$\left(\frac{1}{2.3}\right) / \left(\frac{0.225}{0.06}\right) - 1 = 25.0 \text{ days}$$

so use 30.0 days

Detention Volume Required for the Aeration Cells Only

Daily Flow Rate =	8032	people	X	100	gallons / person -day	=	803,200	gallons / day
Detention Volume Required =	803200	gallons / day	X	30.00	days	=	24,096,000	gallons
						=	**3,221,390**	ft^3

Extra Volume Remaining (gallons)

3,446,634

Year	Month	Monthly Concentration (mg/l)	Monthly Concentration (lb/gal)	Days Discharged (days/month)	Monthly Loading (lb/month)	Running 12 Month Loading (lb/yr)
2020	Jan	8.60	7.17703E-05	31	645	2,619
2020	Feb	7.70	6.42595E-05	28	522	2,716
2020	Mar	5.30	4.42305E-05	31	398	3,238
2020	Apr	0.00	0	0	0	3,148
2020	May	0.00	0	0	0	2,734
2020	Jun	0.00	0	0	0	2,622
2020	Jul	0.00	0	0	0	2,622
2020	Aug	0.00	0	0	0	2,472
2020	Sep	7.20	6.00868E-05	30	523	2,277
2020	Oct	5.90	4.92378E-05	31	443	2,800
2020	Nov	0.00	0	0	0	3,243
2020	Dec	6.80	5.67486E-05	31	510	3,243
2021	Jan	7.20	6.00868E-05	31	540	3,040
2021	Feb	0.00	0	0	0	2,935
2021	Mar	7.00	5.84177E-05	31	525	2,413
2021	Apr	5.70	4.75687E-05	30	414	2,541
2021	May	0.75	6.25904E-06	31	56	2,955
2021	Jun	0.00	0	0	0	3,011
2021	Jul	1.10	9.17992E-06	28	75	3,011
2021	Aug	1.30	1.0849E-05	31	98	3,086
2021	Sep	3.60	3.00434E-05	30	261	3,183
2021	Oct	2.95	2.46189E-05	31	221	2,922
2021	Nov	0.00	0	0	0	2,700
2021	Dec	8.15	6.80149E-05	31	611	2,700
2022	Jan-Dec	3.26	2.71721E-05	30	240	2,876
2023	Jan-Dec	3.37	2.81231E-05	30	248	2,977
2024	Jan-Dec	3.49	2.91074E-05	30	257	3,081
2025	Jan-Dec	3.61	3.01261E-05	30	266	3,189
2026	Jan-Dec	3.74	3.11806E-05	30	275	3,300
2027	Jan-Dec	3.87	3.22719E-05	30	285	3,416
2028	Jan-Dec	4.00	3.34014E-05	30	295	3,536
2029	Jan-Dec	4.14	3.45704E-05	30	305	3,659
2030	Jan-Dec	4.29	3.57804E-05	30	316	3,787
2031	Jan-Dec	4.44	3.70327E-05	30	327	3,920
2032	Jan-Dec	4.59	3.83289E-05	30	338	4,057
2033	Jan-Dec	4.75	3.96704E-05	30	350	4,199
2034	Jan-Dec	4.92	4.10588E-05	30	362	4,346
2035	Jan-Dec	5.09	4.24959E-05	30	375	4,498
2036	Jan-Dec	5.27	4.39833E-05	30	388	4,656
2037	Jan-Dec	5.45	4.55227E-05	30	402	4,819
2038	Jan-Dec	5.65	4.7116E-05	30	416	4,987
2039	Jan-Dec	5.84	4.8765E-05	30	430	5,162
2040	Jan-Dec	6.05	5.04718E-05	30	445	5,342
2041	Jan-Dec	6.26	5.22383E-05	30	461	5,529
2042	Jan-Dec	6.48	5.40666E-05	30	477	5,723
2043	Jan-Dec	6.71	5.5959E-05	30	494	5,923
2044	Jan-Dec	6.94	5.79175E-05	30	511	6,131
2045	Jan-Dec	7.18	5.99447E-05	30	529	6,345
2046	Jan-Dec	7.43	6.20427E-05	30	547	6,567
2047	Jan-Dec	7.69	6.42142E-05	30	566	6,797
2048	Jan-Dec	7.96	6.64617E-05	30	586	7,035
2049	Jan-Dec	8.24	6.87879E-05	30	607	7,281
2050	Jan-Dec	8.53	7.11955E-05	30	628	7,536
2051	Jan-Dec	8.83	7.36873E-05	30	650	7,800
2052	Jan-Dec	9.14	7.62663E-05	30	673	8,073
2053	Jan-Dec	9.46	7.89357E-05	30	696	8,355
2054	Jan-Dec	9.79	8.16984E-05	30	721	8,648
2055	Jan-Dec	10.13	8.45579E-05	30	746	8,950
2056	Jan-Dec	10.49	8.75174E-05	30	772	9,264
2057	Jan-Dec	10.85	9.05805E-05	30	799	9,588
2058	Jan-Dec	11.23	9.37508E-05	30	827	9,924
2059	Jan-Dec	11.63	9.70321E-05	30	856	10,271
2060	Jan-Dec	12.03	1.00428E-04	30	886	10,630
2061	Jan-Dec	12.46	1.03943E-04	30	917	11,002
2062	Jan-Dec	12.89	1.07581E-04	30	949	11,387
2063	Jan-Dec	13.34	1.11347E-04	30	982	11,786
2064	Jan-Dec	13.81	1.15244E-04	30	1,017	12,199
2065	Jan-Dec	14.29	1.19277E-04	30	1,052	12,625
2066	Jan-Dec	14.79	1.23452E-04	30	1,089	13,067
2067	Jan-Dec	15.31	1.27773E-04	30	1,127	13,525
2068	Jan-Dec	15.85	1.32245E-04	30	1,167	13,998
2069	Jan-Dec	16.40	1.36873E-04	30	1,207	14,488
2070	Jan-Dec	16.98	1.41664E-04	30	1,250	14,995

PIPE SEGMENT: Zion National Park to Treatment Lagoons for 2070

Pipeline Data				Flow Analysis								
pipe segment number	manning's coefficient (n)	pipe segment length (ft)	pipe slope (%)	upstream fluid inflow (cfs)	cumulative pipe flow, Q (cfs)	calculated required size (in)	chosen pipe size (in)	full pipe capacity, Q_{full} (cfs)	Q / Q_{full}	full pipe velocity, V_{full} (fps)	V / V_{full}	actual pipe velocity, V (cfs)
1	0.013	351	0.49%	0.812	0.812	7.9	8	0.8	0.96	2.4	1.03	2.5
2	0.013	225	2.93%	0.000	0.812	5.6	8	2.1	0.39	5.9	0.79	4.7
3	0.013	165	0.48%	0.000	0.812	7.9	8	0.8	0.97	2.4	1.03	2.5
4	0.013	174	1.20%	0.000	0.812	6.7	8	1.3	0.61	3.8	0.90	3.4
5	0.013	231	1.72%	0.000	0.812	6.2	8	1.6	0.51	4.6	0.85	3.9
6	0.013	402	0.79%	0.000	0.812	7.2	8	1.1	0.75	3.1	0.96	3.0
7	0.013	347	1.39%	0.000	0.812	6.5	8	1.4	0.57	4.1	0.88	3.6
8	0.013	248	2.51%	0.082	0.893	6.0	8	1.9	0.47	5.5	0.83	4.6
9	0.013	146	2.90%	0.000	0.893	5.8	8	2.1	0.43	5.9	0.81	4.8
10	0.013	581	1.98%	0.000	0.893	6.3	8	1.7	0.52	4.9	0.86	4.2
11	0.013	333	0.97%	0.273	1.167	7.9	12	3.5	0.33	4.5	0.75	3.4
12	0.013	415	0.71%	0.000	1.167	8.4	12	3.0	0.39	3.8	0.79	3.0
13	0.013	295	0.75%	0.000	1.167	8.3	12	3.1	0.38	3.9	0.78	3.1
14	0.013	217	0.73%	0.000	1.167	8.4	12	3.0	0.38	3.9	0.78	3.0
15	0.013	150	1.10%	0.031	1.198	7.8	12	3.7	0.32	4.8	0.75	3.6
16	0.013	191	0.44%	0.000	1.198	9.3	12	2.4	0.51	3.0	0.85	2.6
17	0.013	260	0.51%	0.000	1.198	9.1	12	2.5	0.47	3.2	0.83	2.7
18	0.013	79	4.03%	0.000	1.198	6.1	12	7.2	0.17	9.1	0.63	5.8
19	0.013	427	1.09%	0.260	1.458	8.4	12	3.7	0.39	4.7	0.79	3.7
20	0.013	349	0.54%	0.000	1.458	9.6	12	2.6	0.55	3.4	0.88	2.9
21	0.013	340	0.53%	0.000	1.458	9.7	12	2.6	0.56	3.3	0.88	2.9
22	0.013	99	0.92%	0.000	1.458	8.7	12	3.4	0.43	4.4	0.81	3.5
23	0.013	355	0.54%	0.000	1.458	9.6	12	2.6	0.56	3.3	0.88	2.9
24	0.013	348	0.37%	0.000	1.458	10.4	12	2.2	0.68	2.7	0.93	2.6
25	0.013	342	0.31%	0.000	1.458	10.7	12	2.0	0.74	2.5	0.96	2.4
26	0.013	355	0.50%	0.389	1.847	10.7	12	2.5	0.73	3.2	0.95	3.1
27	0.013	367	0.21%	0.000	1.847	12.5	12	1.6	1.12	2.1	limits	limits
28	0.013	34	4.10%	0.000	1.847	7.2	12	7.2	0.26	9.2	0.71	6.5
29	0.013	305	0.41%	0.140	1.986	11.4	12	2.3	0.87	2.9	1.01	2.9
30	0.013	191	1.29%	0.000	1.986	9.2	12	4.1	0.49	5.2	0.84	4.3
31	0.013	389	2.13%	0.000	1.986	8.4	12	5.2	0.38	6.6	0.78	5.2
32	0.013	257	1.95%	0.174	2.160	8.8	12	5.0	0.43	6.3	0.81	5.2
33	0.013	407	0.44%	0.000	2.160	11.6	12	2.4	0.91	3.0	1.02	3.1
34	0.013	17	13.72%	0.000	2.160	6.1	12	13.2	0.16	16.8	0.63	10.6
35	0.013	410	1.60%	0.000	2.160	9.1	12	4.5	0.48	5.8	0.84	4.8
36	0.013	412	1.38%	0.000	2.160	9.4	12	4.2	0.51	5.3	0.86	4.6
37	0.013	401	0.32%	0.000	2.160	12.3	12	2.0	1.06	2.6	limits	limits
38	0.013	226	0.69%	0.000	2.160	10.7	12	3.0	0.73	3.8	0.95	3.6
39	0.013	294	1.60%	0.202	2.362	9.4	12	4.5	0.52	5.8	0.86	4.9
40	0.013	329	1.02%	0.000	2.362	10.2	12	3.6	0.65	4.6	0.92	4.2
41	0.013	362	0.70%	0.000	2.362	11.0	12	3.0	0.79	3.8	0.98	3.7
42	0.013	374	0.34%	0.000	2.362	12.6	12	2.1	1.14	2.6	limits	limits
43	0.013	325	0.51%	0.000	2.362	11.7	12	2.6	0.92	3.3	1.02	3.3
44	0.013	317	0.35%	0.000	2.362	12.5	12	2.1	1.12	2.7	limits	limits
45	0.013	265	0.39%	0.088	2.450	12.4	12	2.2	1.10	2.8	limits	limits
46	0.013	384	0.85%	0.000	2.450	10.8	12	3.3	0.75	4.2	0.96	4.0
47	0.013	367	0.27%	0.000	2.450	13.3	12	1.9	1.32	2.4	limits	limits
48	0.013	408	0.21%	0.086	2.536	14.2	12	1.6	1.56	2.1	limits	limits
49	0.013	39	1.45%	0.000	2.536	9.9	12	4.3	0.59	5.5	0.89	4.9
50	0.013	316	0.21%	0.000	2.536	14.2	12	1.6	1.57	2.1	limits	limits
51	0.013	556	0.20%	0.000	2.536	14.3	12	1.6	1.60	2.0	limits	limits
52	0.013	206	0.81%	0.000	2.536	11.0	12	3.2	0.79	4.1	0.98	4.0
53	0.013	304	0.78%	0.000	2.536	11.1	12	3.1	0.81	4.0	0.98	3.9
54	0.013	199	1.10%	0.000	2.536	10.4	12	3.7	0.68	4.8	0.93	4.4
55	0.013	189	0.28%	0.000	2.536	13.4	12	1.9	1.34	2.4	limits	limits
56	0.013	234	0.90%	0.000	2.536	10.8	12	3.4	0.75	4.3	0.96	4.1
57	0.013	88	0.84%	0.000	2.536	10.9	12	3.3	0.77	4.2	0.97	4.1
58	0.013	117	0.34%	0.285	2.822	13.5	12	2.1	1.35	2.7	limits	limits
59	0.013	315	0.56%	0.000	2.822	12.2	12	2.7	1.05	3.4	limits	limits
60	0.013	75	1.13%	0.000	2.822	10.7	12	3.8	0.74	4.8	0.96	4.6
61	0.013	218	0.32%	0.000	2.822	13.6	12	2.0	1.40	2.6	limits	limits
62	0.013	234	0.20%	0.000	2.822	14.9	12	1.6	1.78	2.0	limits	limits
63	0.013	115	0.39%	0.000	2.822	13.1	12	2.2	1.26	2.9	limits	limits
64	0.013	278	0.32%	0.000	2.822	13.6	12	2.0	1.39	2.6	limits	limits
65	0.013	250	0.32%	0.000	2.822	13.6	12	2.0	1.40	2.6	limits	limits
66	0.013	205	0.30%	0.000	2.822	13.8	12	1.9	1.45	2.5	limits	limits
67	0.013	257	0.31%	0.000	2.822	13.7	12	2.0	1.42	2.5	limits	limits
68	0.013	258	0.33%	0.000	2.822	13.5	12	2.1	1.37	2.6	limits	limits
69	0.013	141	0.32%	0.000	2.822	13.6	12	2.0	1.40	2.6	limits	limits
70	0.013	84	0.30%	0.000	2.822	13.8	12	2.0	1.45	2.5	limits	limits
71	0.013	249	0.51%	0.000	2.822	12.5	12	2.5	1.11	3.2	limits	limits
72	0.013	252	0.34%	0.000	2.822	13.5	12	2.1	1.36	2.6	limits	limits
73	0.013	92	0.39%	0.000	2.822	13.1	12	2.2	1.26	2.8	limits	limits
74	0.013	96	0.84%	0.238	3.060	11.7	12	3.3	0.93	4.2	1.03	4.3
75	0.013	146	0.92%	0.000	3.060	11.5	12	3.4	0.89	4.4	1.02	4.4

76	0.013	183	1.15%	0.000	3.060	11.0	12	3.8	0.80	4.9	0.98	4.8
77	0.013	328	0.27%	0.000	3.060	14.4	12	1.9	1.63	2.4	limits	limits
78	0.013	141	1.30%	0.000	3.060	10.8	12	4.1	0.75	5.2	0.96	5.0
79	0.013	261	0.82%	0.000	3.060	11.8	12	3.2	0.95	4.1	1.03	4.2
80	0.013	182	1.20%	0.000	3.060	10.9	12	3.9	0.78	5.0	0.97	4.9
81	0.013	174	1.57%	0.000	3.060	10.4	12	4.5	0.68	5.7	0.93	5.3
82	0.013	441	0.47%	0.000	3.060	13.1	12	2.4	1.25	3.1	limits	limits
83	0.013	303	0.76%	0.000	3.060	11.9	12	3.1	0.98	4.0	1.04	4.1
84	0.013	150	1.15%	0.000	3.060	11.0	12	3.8	0.80	4.9	0.98	4.8
85	0.013	265	0.96%	0.000	3.060	11.4	12	3.5	0.87	4.5	1.01	4.5
86	0.013	267	0.35%	0.000	3.060	13.8	12	2.1	1.44	2.7	limits	limits
87	0.013	36	0.50%	0.000	3.060	12.9	12	2.5	1.22	3.2	limits	limits
88	0.013	169	0.35%	0.000	3.060	13.8	12	2.1	1.45	2.7	limits	limits
89	0.013	149	0.30%	0.000	3.060	14.2	12	2.0	1.56	2.5	limits	limits
90	0.013	195	0.26%	0.000	3.060	14.6	12	1.8	1.68	2.3	limits	limits
91	0.013	250	0.37%	0.000	3.060	13.6	12	2.2	1.41	2.8	limits	limits
92	0.013	290	0.34%	0.000	3.060	13.8	12	2.1	1.46	2.7	limits	limits
93	0.013	329	0.22%	0.000	3.060	15.0	12	1.7	1.82	2.1	limits	limits
94	0.013	255	0.47%	0.000	3.060	13.1	12	2.4	1.25	3.1	limits	limits
95	0.013	252	0.20%	0.000	3.060	15.3	12	1.6	1.90	2.0	limits	limits
96	0.013	322	0.22%	0.000	3.060	15.0	12	1.7	1.82	2.1	limits	limits
97	0.013	320	0.58%	0.000	3.060	12.6	12	2.7	1.13	3.4	limits	limits
98	0.013	267	0.45%	0.000	3.060	13.2	12	2.4	1.28	3.0	limits	limits
99	0.013	336	0.29%	0.000	3.060	14.3	12	1.9	1.59	2.5	limits	limits
100	0.013	386	0.31%	0.000	3.060	14.1	12	2.0	1.54	2.5	limits	limits
101	0.013	288	0.26%	0.000	3.060	14.6	12	1.8	1.69	2.3	limits	limits
102	0.013	346	0.38%	0.000	3.060	13.6	12	2.2	1.39	2.8	limits	limits
103	0.013	322	0.31%	0.000	3.060	14.1	12	2.0	1.54	2.5	limits	limits
104	0.013	443	0.28%	0.000	3.060	14.4	12	1.9	1.62	2.4	limits	limits
105	0.013	373	0.27%	0.000	3.060	14.5	12	1.9	1.64	2.4	limits	limits
106	0.013	396	0.28%	0.000	3.060	14.4	12	1.9	1.62	2.4	limits	limits
107	0.013	358	0.63%	0.000	3.060	12.4	12	2.8	1.08	3.6	limits	limits
108	0.013	366	0.56%	0.000	3.060	12.6	12	2.7	1.15	3.4	limits	limits
109	0.013	55	0.78%	0.000	3.060	11.9	12	3.2	0.97	4.0	1.03	4.2
110	0.013	219	0.53%	0.000	3.060	12.7	12	2.6	1.17	3.3	limits	limits
111	0.013	173	0.72%	0.000	3.060	12.1	12	3.0	1.01	3.8	limits	limits
112	0.013	226	1.05%	0.000	3.060	11.2	12	3.7	0.84	4.7	1.00	4.6
113	0.013	214	0.41%	0.007	3.067	13.4	12	2.3	1.35	2.9	limits	limits
114	0.013	345	0.58%	0.000	3.067	12.6	12	2.7	1.12	3.5	limits	limits
115	0.013	290	0.54%	0.000	3.067	12.7	12	2.6	1.17	3.3	limits	limits
116	0.013	166	1.11%	0.000	3.067	11.1	12	3.8	0.81	4.8	0.99	4.7
117	0.013	670	0.20%	0.000	3.067	15.3	12	1.6	1.90	2.1	limits	limits
118	0.013	390	0.75%	0.000	3.067	12.0	12	3.1	0.99	3.9	limits	limits
119	0.013	65	0.72%	0.000	3.067	12.1	12	3.0	1.01	3.9	limits	limits
120	0.013	392	0.63%	0.000	3.067	12.4	12	2.8	1.08	3.6	limits	limits
121	0.013	321	0.33%	0.000	3.067	13.9	12	2.1	1.49	2.6	limits	limits
122	0.013	379	0.32%	0.000	3.067	14.1	12	2.0	1.52	2.6	limits	limits
123	0.013	261	0.38%	0.000	3.067	13.6	12	2.2	1.39	2.8	limits	limits
124	0.013	261	0.46%	0.000	3.067	13.1	12	2.4	1.27	3.1	limits	limits
125	0.013	87	0.53%	0.000	3.067	12.8	12	2.6	1.18	3.3	limits	limits
126	0.013	181	0.48%	0.000	3.067	13.0	12	2.5	1.24	3.1	limits	limits
127	0.013	307	0.33%	0.000	3.067	14.0	12	2.0	1.50	2.6	limits	limits

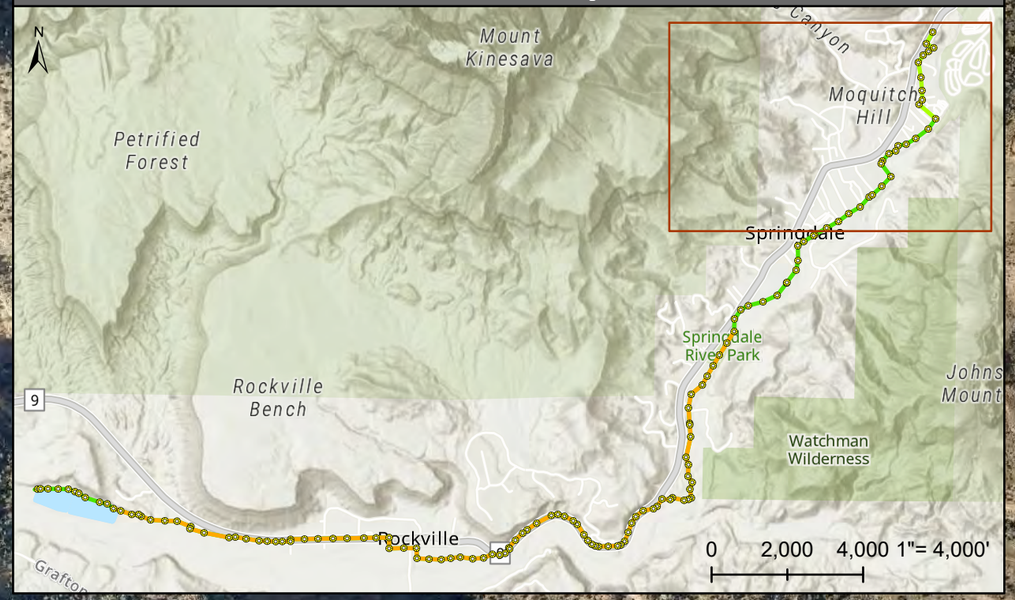
PIPE SEGMENT: Existing Zion National Park to Treatment Lagoons

Pipeline Data				Flow Analysis								
pipe segment number	manning's coefficient (n)	pipe segment length (ft)	pipe slope (%)	upstream fluid inflow (cfs)	cumulative pipe flow, Q (cfs)	calculated required size (in)	chosen pipe size (in)	full pipe capacity, Q_{full} (cfs)	Q / Q_{full}	full pipe velocity, V_{full} (fps)	V / V_{full}	actual pipe velocity, V (cfs)
1	0.013	351	0.49%	0.405	0.405	6.1	8	0.8	0.48	2.4	0.84	2.0
2	0.013	225	2.93%	0.000	0.405	4.3	8	2.1	0.20	5.9	0.66	3.9
3	0.013	165	0.48%	0.000	0.405	6.1	8	0.8	0.48	2.4	0.84	2.0
4	0.013	174	1.20%	0.000	0.405	5.1	8	1.3	0.31	3.8	0.74	2.8
5	0.013	231	1.72%	0.000	0.405	4.8	8	1.6	0.25	4.6	0.71	3.2
6	0.013	402	0.79%	0.000	0.405	5.5	8	1.1	0.38	3.1	0.78	2.4
7	0.013	347	1.39%	0.000	0.405	5.0	8	1.4	0.28	4.1	0.72	3.0
8	0.013	248	2.51%	0.027	0.433	4.6	8	1.9	0.23	5.5	0.68	3.7
9	0.013	146	2.90%	0.000	0.433	4.5	8	2.1	0.21	5.9	0.67	4.0
10	0.013	581	1.98%	0.000	0.433	4.8	8	1.7	0.25	4.9	0.70	3.4
11	0.013	333	0.97%	0.124	0.557	6.0	12	3.5	0.16	4.5	0.63	2.8
12	0.013	415	0.71%	0.000	0.557	6.4	12	3.0	0.18	3.8	0.65	2.5
13	0.013	295	0.75%	0.000	0.557	6.3	12	3.1	0.18	3.9	0.64	2.5
14	0.013	217	0.73%	0.000	0.557	6.4	12	3.0	0.18	3.9	0.65	2.5
15	0.013	150	1.10%	0.010	0.566	5.9	12	3.7	0.15	4.8	0.62	3.0
16	0.013	191	0.44%	0.000	0.566	7.0	12	2.4	0.24	3.0	0.69	2.1
17	0.013	260	0.51%	0.000	0.566	6.8	12	2.5	0.22	3.2	0.68	2.2
18	0.013	79	4.03%	0.000	0.566	4.6	12	7.2	0.08	9.1	limits	limits
19	0.013	427	1.09%	0.105	0.671	6.3	12	3.7	0.18	4.7	0.64	3.1
20	0.013	349	0.54%	0.000	0.671	7.2	12	2.6	0.25	3.4	0.71	2.4
21	0.013	340	0.53%	0.000	0.671	7.2	12	2.6	0.26	3.3	0.71	2.3
22	0.013	99	0.92%	0.000	0.671	6.5	12	3.4	0.20	4.4	0.66	2.9
23	0.013	355	0.54%	0.000	0.671	7.2	12	2.6	0.26	3.3	0.71	2.4
24	0.013	348	0.37%	0.000	0.671	7.8	12	2.2	0.31	2.7	0.74	2.0
25	0.013	342	0.31%	0.000	0.671	8.0	12	2.0	0.34	2.5	0.76	1.9
26	0.013	355	0.50%	0.158	0.829	7.9	12	2.5	0.33	3.2	0.75	2.4
27	0.013	367	0.21%	0.000	0.829	9.3	12	1.6	0.50	2.1	0.85	1.8
28	0.013	34	4.10%	0.000	0.829	5.3	12	7.2	0.11	9.2	limits	limits
29	0.013	305	0.41%	0.042	0.871	8.4	12	2.3	0.38	2.9	0.78	2.3
30	0.013	191	1.29%	0.000	0.871	6.8	12	4.1	0.22	5.2	0.67	3.5
31	0.013	389	2.13%	0.000	0.871	6.1	12	5.2	0.17	6.6	0.63	4.2
32	0.013	257	1.95%	0.070	0.941	6.4	12	5.0	0.19	6.3	0.65	4.1
33	0.013	407	0.44%	0.000	0.941	8.5	12	2.4	0.40	3.0	0.79	2.4
34	0.013	17	13.72%	0.000	0.941	4.5	12	13.2	0.07	16.8	limits	limits
35	0.013	410	1.60%	0.000	0.941	6.7	12	4.5	0.21	5.8	0.67	3.8
36	0.013	412	1.38%	0.000	0.941	6.9	12	4.2	0.22	5.3	0.68	3.6
37	0.013	401	0.32%	0.000	0.941	9.0	12	2.0	0.46	2.6	0.83	2.1
38	0.013	226	0.69%	0.000	0.941	7.8	12	3.0	0.32	3.8	0.74	2.8
39	0.013	294	1.60%	0.076	1.017	6.9	12	4.5	0.23	5.8	0.68	3.9
40	0.013	329	1.02%	0.000	1.017	7.5	12	3.6	0.28	4.6	0.72	3.3
41	0.013	362	0.70%	0.000	1.017	8.0	12	3.0	0.34	3.8	0.76	2.9
42	0.013	374	0.34%	0.000	1.017	9.2	12	2.1	0.49	2.6	0.84	2.2
43	0.013	325	0.51%	0.000	1.017	8.5	12	2.6	0.40	3.3	0.79	2.6
44	0.013	317	0.35%	0.000	1.017	9.1	12	2.1	0.48	2.7	0.84	2.2
45	0.013	265	0.39%	0.029	1.046	9.0	12	2.2	0.47	2.8	0.83	2.4
46	0.013	384	0.85%	0.000	1.046	7.8	12	3.3	0.32	4.2	0.74	3.1
47	0.013	367	0.27%	0.000	1.046	9.7	12	1.9	0.56	2.4	0.88	2.1
48	0.013	408	0.21%	0.025	1.071	10.3	12	1.6	0.66	2.1	0.92	1.9
49	0.013	39	1.45%	0.000	1.071	7.1	12	4.3	0.25	5.5	0.70	3.8
50	0.013	316	0.21%	0.000	1.071	10.3	12	1.6	0.66	2.1	0.92	1.9
51	0.013	556	0.20%	0.000	1.071	10.4	12	1.6	0.68	2.0	0.93	1.9
52	0.013	206	0.81%	0.000	1.071	8.0	12	3.2	0.33	4.1	0.75	3.1
53	0.013	304	0.78%	0.000	1.071	8.0	12	3.1	0.34	4.0	0.76	3.0
54	0.013	199	1.10%	0.000	1.071	7.5	12	3.7	0.29	4.8	0.73	3.5
55	0.013	189	0.28%	0.000	1.071	9.7	12	1.9	0.57	2.4	0.88	2.1
56	0.013	234	0.90%	0.000	1.071	7.8	12	3.4	0.32	4.3	0.74	3.2
57	0.013	88	0.84%	0.000	1.071	7.9	12	3.3	0.33	4.2	0.75	3.1
58	0.013	117	0.34%	0.106	1.178	9.7	12	2.1	0.56	2.7	0.88	2.3
59	0.013	315	0.56%	0.000	1.178	8.8	12	2.7	0.44	3.4	0.82	2.8
60	0.013	75	1.13%	0.000	1.178	7.7	12	3.8	0.31	4.8	0.74	3.6
61	0.013	218	0.32%	0.000	1.178	9.8	12	2.0	0.59	2.6	0.89	2.3
62	0.013	234	0.20%	0.000	1.178	10.8	12	1.6	0.74	2.0	0.96	1.9
63	0.013	115	0.39%	0.000	1.178	9.4	12	2.2	0.53	2.9	0.86	2.5
64	0.013	278	0.32%	0.000	1.178	9.8	12	2.0	0.58	2.6	0.89	2.3
65	0.013	250	0.32%	0.000	1.178	9.8	12	2.0	0.59	2.6	0.89	2.3
66	0.013	205	0.30%	0.000	1.178	9.9	12	1.9	0.60	2.5	0.90	2.2
67	0.013	257	0.31%	0.000	1.178	9.9	12	2.0	0.59	2.5	0.90	2.3
68	0.013	258	0.33%	0.000	1.178	9.7	12	2.1	0.57	2.6	0.88	2.3
69	0.013	141	0.32%	0.000	1.178	9.8	12	2.0	0.58	2.6	0.89	2.3
70	0.013	84	0.30%	0.000	1.178	9.9	12	2.0	0.60	2.5	0.90	2.2
71	0.013	249	0.51%	0.000	1.178	9.0	12	2.5	0.46	3.2	0.83	2.7
72	0.013	252	0.34%	0.000	1.178	9.7	12	2.1	0.57	2.6	0.88	2.3
73	0.013	92	0.39%	0.000	1.178	9.5	12	2.2	0.53	2.8	0.86	2.5
74	0.013	96	0.84%	0.070	1.248	8.4	12	3.3	0.38	4.2	0.78	3.3
75	0.013	146	0.92%	0.000	1.248	8.2	12	3.4	0.36	4.4	0.77	3.4
76	0.013	183	1.15%	0.000	1.248	7.9	12	3.8	0.33	4.9	0.75	3.7
77	0.013	328	0.27%	0.000	1.248	10.3	12	1.9	0.67	2.4	0.93	2.2
78	0.013	141	1.30%	0.000	1.248	7.7	12	4.1	0.31	5.2	0.74	3.8
79	0.013	261	0.82%	0.000	1.248	8.4	12	3.2	0.39	4.1	0.79	3.2
80	0.013	182	1.20%	0.000	1.248	7.8	12	3.9	0.32	5.0	0.74	3.7
81	0.013	174	1.57%	0.000	1.248	7.4	12	4.5	0.28	5.7	0.72	4.1
82	0.013	441	0.47%	0.000	1.248	9.3	12	2.4	0.51	3.1	0.85	2.7
83	0.013	303	0.76%	0.000	1.248	8.5	12	3.1	0.40	4.0	0.79	3.1
84	0.013	150	1.15%	0.000	1.248	7.9	12	3.8	0.33	4.9	0.75	3.7
85	0.013	265	0.96%	0.000	1.248	8.2	12	3.5	0.36	4.5	0.77	3.4
86	0.013	267	0.35%	0.000	1.248	9.9	12	2.1	0.59	2.7	0.89	2.4

87	0.013	36	0.50%	0.000	1.248	9.2	12	2.5	0.50	3.2	0.85	2.7
88	0.013	169	0.35%	0.000	1.248	9.9	12	2.1	0.59	2.7	0.89	2.4
89	0.013	149	0.30%	0.000	1.248	10.1	12	2.0	0.63	2.5	0.91	2.3
90	0.013	195	0.26%	0.000	1.248	10.4	12	1.8	0.68	2.3	0.93	2.2
91	0.013	250	0.37%	0.000	1.248	9.7	12	2.2	0.57	2.8	0.89	2.5
92	0.013	290	0.34%	0.000	1.248	9.9	12	2.1	0.60	2.7	0.90	2.4
93	0.013	329	0.22%	0.000	1.248	10.7	12	1.7	0.74	2.1	0.96	2.1
94	0.013	255	0.47%	0.000	1.248	9.3	12	2.4	0.51	3.1	0.85	2.7
95	0.013	252	0.20%	0.000	1.248	10.9	12	1.6	0.78	2.0	0.97	2.0
96	0.013	322	0.22%	0.000	1.248	10.7	12	1.7	0.74	2.1	0.96	2.0
97	0.013	320	0.58%	0.000	1.248	9.0	12	2.7	0.46	3.4	0.83	2.9
98	0.013	267	0.45%	0.000	1.248	9.4	12	2.4	0.52	3.0	0.86	2.6
99	0.013	336	0.29%	0.000	1.248	10.2	12	1.9	0.65	2.5	0.92	2.3
100	0.013	386	0.31%	0.000	1.248	10.1	12	2.0	0.63	2.5	0.91	2.3
101	0.013	288	0.26%	0.000	1.248	10.4	12	1.8	0.69	2.3	0.94	2.2
102	0.013	346	0.38%	0.000	1.248	9.7	12	2.2	0.57	2.8	0.88	2.5
103	0.013	322	0.31%	0.000	1.248	10.1	12	2.0	0.63	2.5	0.91	2.3
104	0.013	443	0.28%	0.000	1.248	10.3	12	1.9	0.66	2.4	0.92	2.2
105	0.013	373	0.27%	0.000	1.248	10.3	12	1.9	0.67	2.4	0.93	2.2
106	0.013	396	0.28%	0.000	1.248	10.3	12	1.9	0.66	2.4	0.92	2.2
107	0.013	358	0.63%	0.000	1.248	8.8	12	2.8	0.44	3.6	0.82	2.9
108	0.013	366	0.56%	0.000	1.248	9.0	12	2.7	0.47	3.4	0.83	2.8
109	0.013	55	0.78%	0.000	1.248	8.5	12	3.2	0.39	4.0	0.79	3.2
110	0.013	219	0.53%	0.000	1.248	9.1	12	2.6	0.48	3.3	0.84	2.8
111	0.013	173	0.72%	0.000	1.248	8.6	12	3.0	0.41	3.8	0.80	3.1
112	0.013	226	1.05%	0.000	1.248	8.0	12	3.7	0.34	4.7	0.76	3.5
113	0.013	214	0.41%	0.025	1.272	9.7	12	2.3	0.56	2.9	0.88	2.5
114	0.013	345	0.58%	0.000	1.272	9.0	12	2.7	0.47	3.5	0.83	2.9
115	0.013	290	0.54%	0.000	1.272	9.2	12	2.6	0.49	3.3	0.84	2.8
116	0.013	166	1.11%	0.000	1.272	8.0	12	3.8	0.34	4.8	0.76	3.6
117	0.013	670	0.20%	0.000	1.272	11.0	12	1.6	0.79	2.1	0.98	2.0
118	0.013	390	0.75%	0.000	1.272	8.6	12	3.1	0.41	3.9	0.80	3.2
119	0.013	65	0.72%	0.000	1.272	8.7	12	3.0	0.42	3.9	0.81	3.1
120	0.013	392	0.63%	0.000	1.272	8.9	12	2.8	0.45	3.6	0.82	3.0
121	0.013	321	0.33%	0.000	1.272	10.0	12	2.1	0.62	2.6	0.90	2.4
122	0.013	379	0.32%	0.000	1.272	10.1	12	2.0	0.63	2.6	0.91	2.3
123	0.013	261	0.38%	0.000	1.272	9.8	12	2.2	0.57	2.8	0.89	2.5
124	0.013	261	0.46%	0.000	1.272	9.4	12	2.4	0.53	3.1	0.86	2.7
125	0.013	87	0.53%	0.000	1.272	9.2	12	2.6	0.49	3.3	0.84	2.8
126	0.013	181	0.48%	0.000	1.272	9.4	12	2.5	0.51	3.1	0.86	2.7
127	0.013	307	0.33%	0.000	1.272	10.1	12	2.0	0.62	2.6	0.91	2.4

Town of Springdale Sewer System Main Line - Segments 1-26

Location Map



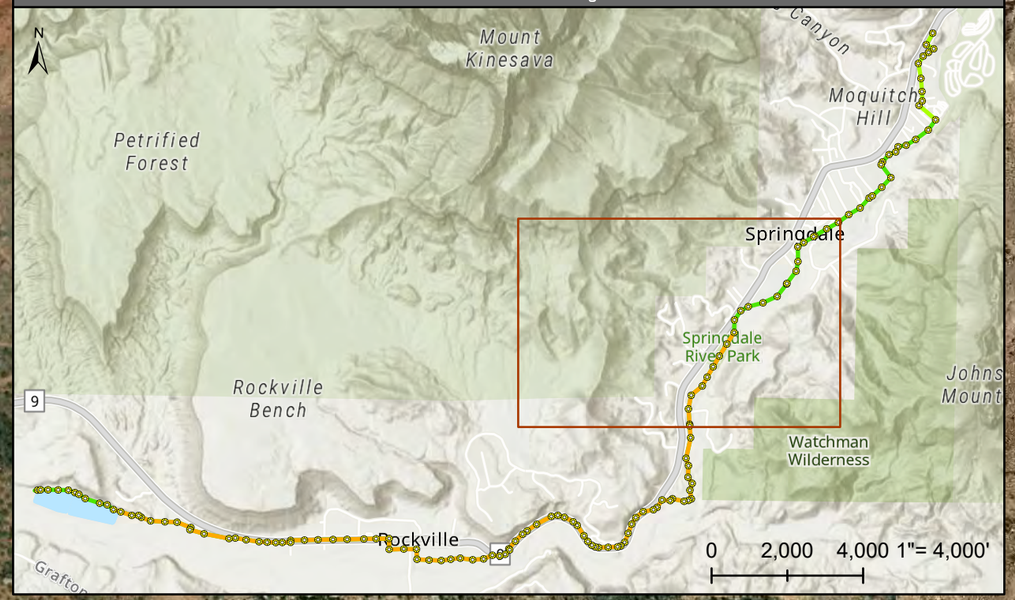
Legend

- Sewer Manhole
- 8" Sewer Gravity Main
- 12" Sewer Gravity Main
- Upsize to 15" Sewer Gravity Main

N 0 250 500 1" = 500'

Town of Springdale Sewer System Main Line - Segments 27-48

Location Map



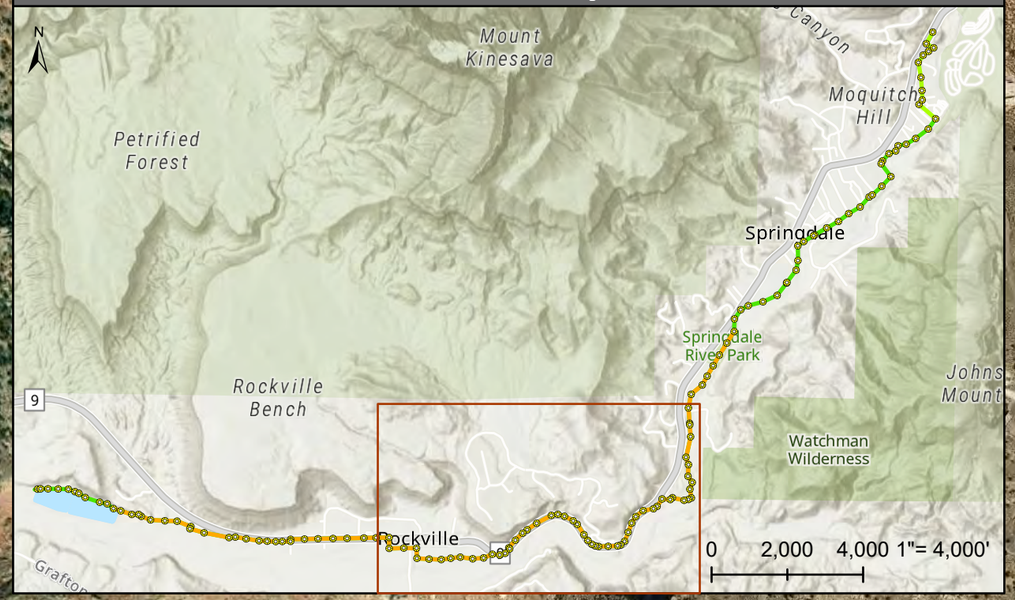
Legend

- Sewer Manhole
- 8" Sewer Gravity Main
- 12" Sewer Gravity Main
- Upsize to 15” Sewer Gravity Main

N 0 250 500 1" = 500'

Town of Springdale Sewer System Main Line - Segments 49-101

Location Map



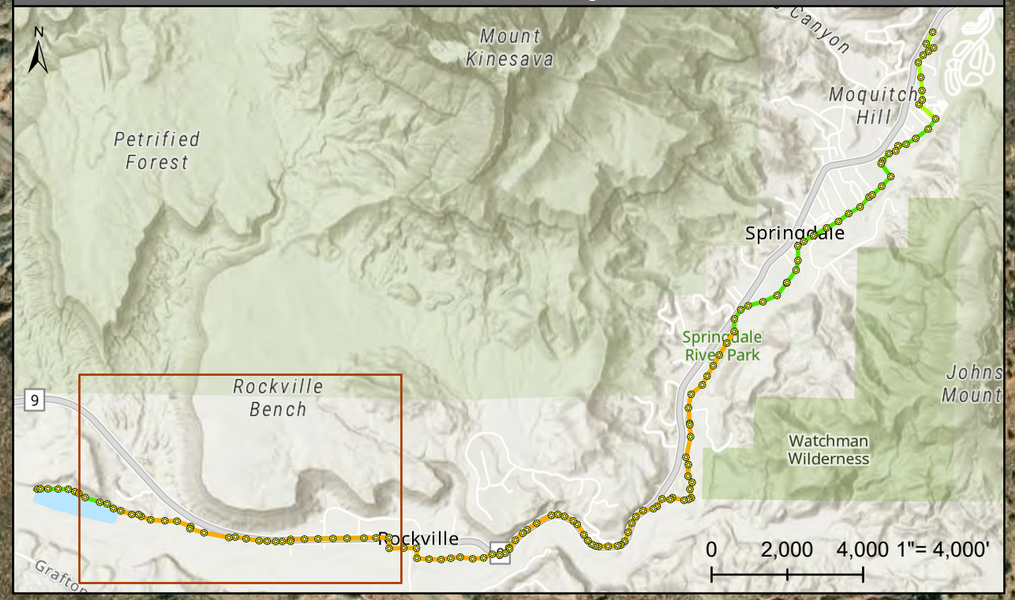
Legend

- Sewer Manhole
- 8" Sewer Gravity Main
- 12" Sewer Gravity Main
- Upsize to 15" Sewer Gravity Main

N 0 250 500 1" = 500'

Town of Springdale Sewer System Main Line - Segments 102-130

Location Map



Legend

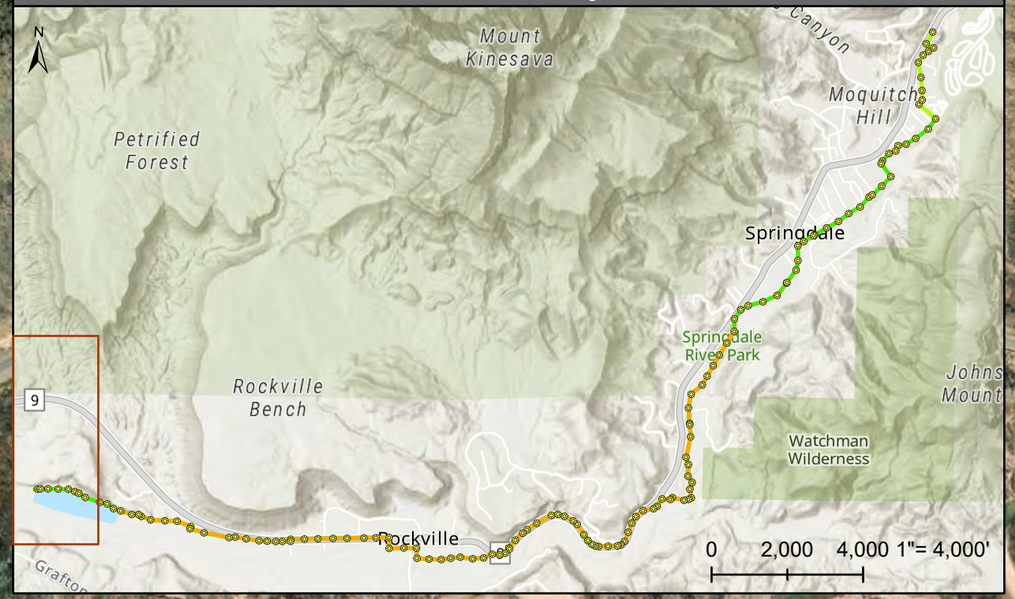
- Sewer Manhole
- 8" Sewer Gravity Main
- 12" Sewer Gravity Main
- Upsize to 15" Sewer Gravity Main

N 0 250 500 1" = 500'

131 130 129 128 127 126 125 124 123 122 121 120 119 118 117 116 115 114 113 112 111 110 109 108 107 106 105 104 103 102 101 100

Town of Springdale Sewer System Main Line - Segments 131-138

Location Map



Legend

- Sewer Manhole
- 8" Sewer Gravity Main
- 12" Sewer Gravity Main
- Upsize to 15” Sewer Gravity Main

N 0 250 500 1" = 500'

APPENDIX C

ENGINEER'S OPINION OF PROBABLE COST

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Upsize Sewer Main
Town of Springdale

21-May-21
CSJ/bcw

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	1	LS	$ 104,500.00	$ 104,500.00
2	Pre-Construction DVD	1	LS	$ 1,250.00	$ 1,250.00
3	Materials Sampling & Testing	1	LS	$ 10,000.00	$ 10,000.00
4	Traffic Control	1	LS	$ 25,000.00	$ 25,000.00
5	Subsurface Investigation	16	HR	$ 150.00	$ 2,400.00
6	15" PVC SDR-35 Sewer Main (Installation, Bedding, & Backfill)	10,350	LF	$ 95.00	$ 983,250.00
7	4" PVC SCR-35 Service Lateral Pipe (Installation, Bedding, & Backfill)	20	EA	$ 6,000.00	$ 120,000.00
8	48" Precast Concrete Manhole	30	EA	$ 6,500.00	$ 195,000.00
9	Untreated Base Course (Road Restoration, Assumed 18")	45,120	SF	$ 2.50	$ 112,800.00
10	Asphalt Restoration (Assumed 6")	45,120	SF	$ 8.00	$ 360,960.00
11	Temporary Bypass Pumping	1	LS	$ 200,000.00	$ 200,000.00
12	Surface Restoration	1	LS	$ 80,000.00	$ 80,000.00
			SUBTOTAL		**$ 2,195,160.00**
			CONTINGENCY	20%	**$ 439,000.00**
			CONSTRUCTION TOTAL		**$ 2,634,160.00**
INCIDENTALS					
1	Funding & Administrative Services	1	Est.	$ 8,000.00	$ 8,000.00
2	Engineering Design	1	Est.	$ 148,000.00	$ 148,000.00
3	Bidding & Negotiating	1	Est.	$ 7,500.00	$ 7,500.00
4	Construction Administration & Observation	1	Est.	$ 132,000.00	$ 132,000.00
5	Topo Survey & GIS Mapping	1	Est.	$ 20,000.00	$ 20,000.00
6	Construction Staking	1	Est.	$ 10,000.00	$ 10,000.00
7	Miscellaneous Engineering Services	1	Est.	$ 10,000.00	$ 10,000.00
			SUBTOTAL		**$ 335,500.00**
			TOTAL PROJECT COST		**$ 2,969,660.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416
Engineer's Opinion of Probable Cost

Camera Inspection of Collection System 21-May-21
Town of Springdale CSJ/bcw

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
SECTION 1					
1	Mobilization for Section1	1	LS	$ 2,000.00	$ 2,000.00
2	Cleaning and Video of Section 1	21,000	LF	$ 1.33	$ 28,000.00
3	Engineering for Section 1	1	LS	$ 2,400.00	$ 2,400.00
SECTION 2					
4	Mobilization for Section 2	1	LS	$ 2,000.00	$ 2,000.00
5	Cleaning and Video of Section 2	21,000	LF	$ 1.33	$ 28,000.00
6	Engineering for Section 2	1	LS	$ 2,400.00	$ 2,400.00
SECTION 3					
7	Mobilization for Section 3	1	LS	$ 2,000.00	$ 2,000.00
8	Cleaning and Video of Section 3	21,000	LF	$ 1.33	$ 28,000.00
9	Engineering for Section 3	1	LS	$ 2,400.00	$ 2,400.00
			SUBTOTAL		**$ 97,200.00**
			CONTINGENCY	20%	**$ 19,000.00**
			TOTAL PROJECT COST		**$ 116,200.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Plant Headworks Replacement 21-May-21
Town of Springdale CSJ/bcw

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	1	LS	$ 25,000.00	$ 25,000.00
2	Install New Headworks Structure (Powered Screen)	1	LS	$ 300,000.00	$ 300,000.00
3	Removal and Disposal of Existing Headworks	1	LS	$ 75,000.00	$ 75,000.00
4	Misc Connections and Piping	1	LS	$ 35,000.00	$ 35,000.00
5	Temporary Bypass Pumping	1	LS	$ 50,000.00	$ 50,000.00
6	Electrical Improvements	1	LS	$ 40,000.00	$ 40,000.00
			SUBTOTAL		**$ 525,000.00**
			CONTINGENCY	25%	**$ 131,000.00**
			CONSTRUCTION TOTAL		**$ 656,000.00**
INCIDENTALS					
1	Funding & Administrative Services	1	Est.	$ 5,000.00	$ 5,000.00
2	Engineering Design	1	Est.	$ 44,000.00	$ 44,000.00
3	Permitting	1	Est.	$ 3,500.00	$ 3,500.00
4	Bidding & Negotiating	1	Est.	$ 6,500.00	$ 6,500.00
5	Construction Administration & Observation	1	Est.	$ 33,000.00	$ 33,000.00
6	Miscellaneous Engineering Services	1	Est.	$ 2,500.00	$ 2,500.00
			SUBTOTAL		**$ 94,500.00**
			TOTAL PROJECT COST		**$ 750,500.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Transfer Structure
Town of Springdale

21-May-21
CSJ/bcw

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	1	LS	$ 5,400.00	$ 5,400.00
2	Reconstruct Transfer Structure	1	LS	$ 75,000.00	$ 75,000.00
3	Misc Connections and Piping	1	LS	$ 7,500.00	$ 7,500.00
4	Temporary Bypass Pumping	1	LS	$ 25,000.00	$ 25,000.00
			SUBTOTAL		**$ 112,900.00**
			CONTINGENCY	25%	**$ 28,000.00**
			CONSTRUCTION TOTAL		**$ 140,900.00**
INCIDENTALS					
1	Funding & Administrative Services	1	Est.	$ 5,000.00	$ 5,000.00
2	Engineering Design	1	Est.	$ 12,000.00	$ 12,000.00
3	Bidding & Negotiating	1	Est.	$ 6,500.00	$ 6,500.00
4	Construction Administration & Observation	1	Est.	$ 7,000.00	$ 7,000.00
5	Miscellaneous Engineering Services	1	Est.	$ 2,500.00	$ 2,500.00
			SUBTOTAL		**$ 33,000.00**
			TOTAL PROJECT COST		**$ 173,900.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Disk/Sand Filter
Town of Springdale

21-May-21
CSJ/bcw

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	1	LS	$ 53,800.00	$ 53,800.00
2	Install Sand/Disk Filtration Unit	1	LS	$ 600,000.00	$ 600,000.00
3	Misc Connections and Piping	1	LS	$ 30,000.00	$ 30,000.00
4	Electrical Improvements	1	LS	$ 45,000.00	$ 45,000.00
5	Relocate/Reconstruct Existing UV Building	1	LS	$ 400,000.00	$ 400,000.00
			SUBTOTAL		**$ 1,128,800.00**
			CONTINGENCY	25%	**$ 282,000.00**
			CONSTRUCTION TOTAL		**$ 1,410,800.00**
INCIDENTALS					
1	Funding & Administrative Services	1	Est.	$ 8,000.00	$ 8,000.00
2	Engineering Design	1	Est.	$ 102,000.00	$ 102,000.00
3	Topo Survey	1	Est.	$ 3,000.00	$ 3,000.00
4	Permitting	1	Est.	$ 8,500.00	$ 8,500.00
5	Bidding & Negotiating	1	Est.	$ 6,500.00	$ 6,500.00
6	Construction Administration & Observation	1	Est.	$ 71,000.00	$ 71,000.00
7	Miscellaneous Engineering Services	1	Est.	$ 7,500.00	$ 7,500.00
			SUBTOTAL		**$ 206,500.00**
			TOTAL PROJECT COST		**$ 1,617,300.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

SUNRISE ENGINEERING, INC.
11 North 300 West, Washington, Utah 84780
Tel: (435) 652-8450 Fax: (435) 652-8416

Engineer's Opinion of Probable Cost

Erosion Control
Town of Springdale

21-May-21
CSJ/bcw

NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
GENERAL CONSTRUCTION					
1	Mobilization	1	LS	$ 8,400.00	$ 8,400.00
2	Earthwork/Excavation/Compaction	1	LS	$ 45,000.00	$ 45,000.00
3	Install Reno Mattress, Riprap, and Filter Fabric	1	LS	$ 115,000.00	$ 115,000.00
4	SWPPP & Silt Fence	1	LS	$ 5,000.00	$ 7,500.00
			SUBTOTAL		**$ 175,900.00**
			CONTINGENCY	25%	**$ 44,000.00**
			CONSTRUCTION TOTAL		**$ 219,900.00**
INCIDENTALS					
1	Funding & Administrative Services	1	Est.	$ 5,000.00	$ 5,000.00
2	Engineering Design	1	Est.	$ 18,000.00	$ 18,000.00
3	Topo Survey	1	Est.	$ 3,000.00	$ 3,000.00
4	Bidding & Negotiating	1	Est.	$ 6,500.00	$ 6,500.00
5	Construction Administration & Observation	1	Est.	$ 11,000.00	$ 11,000.00
6	Miscellaneous Engineering Services	1	Est.	$ 2,500.00	$ 2,500.00
			SUBTOTAL		**$ 46,000.00**
			TOTAL PROJECT COST		**$ 265,900.00**

In providing opinions of probable construction cost, the Client understands that the Engineer has no control over costs or the price of labor, equipment or materials, or over the Contractor's method of pricing, and that the opinion of probable construction cost provided herein is made on the basis of the Engineer's qualifications and experience. The Engineer makes no warranty, expressed or implied, as to the accuracy of such opinions compared to bid or actual costs.

APPENDIX D

PERFORMANCE EVALUATION OF WASTEWATER LAGOON SYSTEM

• Performance Evaluations
• Troubleshooting & Optimization
• Hydraulics Optimization
• Training

2122 East Leland Circle Mesa, AZ 85213 1 (480) 274-8410

Date: February 20, 2020

JOE BARKER
Utility Supervisor
Town of Springdale Utah
118 Lion Blvd
Springdale, UT 84767

Re: Performance Evaluation of the Town of Springdale Utah Wastewater Lagoon System

Joe,

Enclosed is the February 20, 2020 report for H&S Environmental's (H&S) performance evaluation of the Town of Springdale Utah's Wastewater Lagoon System.

The purpose of this report is to identify operational conditions and practices that should prevail to keep the Town of Springdale Utah Wastewater Lagoon System in long-term sustained permit compliance.

All facility data, sludge depth data, and other field data used in this report were compiled by The Town of Springdale, Utah (Springdale), and H&S Environmental, LLC (H&S). The conclusions reached in this performance evaluation are based on four (4) primary data sources: 1) four (4) days of field testing and sampling, observations, and interviews with operations personnel at Springdale and 2) the statistical analysis of four (4) years and seven (7) months (4.58 years) of DMR data from US EPA's ECHO database with 3) 18.8 years of BOD and TSS DMR data from the ICIS database and 4) the analysis of intra-pond grab samples sent to the Chemtech-Ford Laboratory in Sandy (Chemtech).

Summary:

The water quality grab samples pulled for Chemtech lab analysis on January 23, 2020, showed a compliant effluent BOD and excellent ammonia removal. Lab results also show dilute influent BOD and TSS concentrations making for very poor BOD and TSS removal efficiency. Effluent TSS and BOD and TSS percent removal would have been out of compliance on the day of field testing.

Dissolved oxygen measured above five (5) mg/l at the influent end of the primary treatment cell before sunrise and throughout the day. Morning dissolved oxygen (DO) testing from the surface to the bottom of Cell # 1 shows more than sufficient dissolved oxygen to remove all organic and inorganic loading to the system. In all cells, pH was below the permitted limit of 9 and above 6. Laboratory and field effluent ammonia numbers were below 1 mg/l. Intra-pond field testing show increasing levels of Nitrate and Phosphorous from Cell 1 to Cell 2 available to feed algae for continued TSS violations. The onset of a blue-green algae bloom was observed on the surface of Cell # 2. Ammonia removal efficiency, as tested by Chemtech-Ford, was 97%. Field testing through each of the treatment cells using a HACH DR1900 Portable Spectrophotometer showed ammonia removal efficiency ranged from 95.1 to 97.0%.

During field testing, Cells 1 & 2 were sludge judged. At the present average water level of 8.12 feet in Cell # 1, sludge occupies 25.8 % of Cell # 1's treatment capacity with a 6.02-foot water cap

remaining to treat the daily load. 2.10 feet of sludge has accumulated in Cell # 1. Sludge can be seen at the surface of Cell # 1 and is stirred up with the boat prop as the boat moves across the surface of Cell # 1.

Cell # 2 has accumulated an average of 0.55 feet of sludge, leaving an 8.87-foot water cap to treat the daily load. Cell # 1 should be desludged to restore the treatment capacity and to remove the energy driving the algae growth that leads to effluent TSS violations.

Sludge was measured at the discharge structure of Cell # 2 and has not accumulated to any significant degree in the discharge area of Cell # 2. With effluent discharge pipes six (6) and three (3) feet off the bottom of of the discharge end of Cell # 2, low sludge volume in this area means that little sludge probably leaves with the Cell # 2 final effluent and that algae and other floating material probably makes up the bulk of the TSS discharged with the effluent.

Low influent TSS resulting in reduced overall TSS removal efficiency does not appear to be directly related to precipitation based on researching historical precipitation rates for the Springdale area. Statistically, the relationship between flows and influent TSS concentrations is not significant, and when rain events are matched to low influent TSS incidence, there is no correlation. When looking at the flows and influent TSS graphically, there does seem to be some relation to high flow and low influent TSS leading to low TSS removal efficiency. The lack of statistical correlation between flow and TSS removal efficiency may indicate the influence of other factors on dilute influent TSS leading to poor TSS removal efficiency.

Since May 31, 2015, the Springdale lagoon system has violated its permit limits a total of sixty-eight (68) times. TSS limits are violated seventy (70) percent of the time at the Springdale lagoon system. Effluent BOD_5 & TSS DMR values are trending downward over the past 4.58 years. Influent Flow and BOD_5 trending up.

Based on Cell # 1 BOD removal efficiency of fifty-six (56) percent, increasing levels of nitrate and ortho-phosphorous from Cell # 1 to Cell # 2, and high levels of effluent TSS, sludge should be removed from Cell # 1 to stop the stimulation of algae growth leading to high levels of TSS. The last eleven permit violations are for TSS violations. Winter, Spring, Summer, or Fall algae cause TSS violations at the Springdale wastewater lagoon system.

This performance evaluation addresses opportunities to optimize the performance of the Town of Springdale Utah wastewater stabilization pond system for long-term sustained compliance.

Thank you.

Sincerely,

Steve Harris
President
H&S Environmental, LLC

PERFORMANCE EVALUATION REPORT

Facility Name:	Town of Springdale Utah Wastewater Lagoon System
Client:	Town of Springdale Utah
Date of Field Inspection:	January 21, 22, 23, & 24, 2020
Data Review:	Compliance Sample Data from 2015 to 2019 from USEPA, ECHO TSS and BOD_5 analyzed by using 2001 to 2019 ICIS data Data from Field Grab Samples by H&S on January 23, 2020 Dissolved Oxygen & pH sampling by Springdale & H&S Lab Analysis by Chemtech-Ford Laboratories, Sandy Utah Engineering Plans for Springdale by Alpha Engineering Company St George Utah
Inspection Participants:	
H&S Environmental, LLC:	Steven M. Harris
Springdale, Utah:	Joe Baker Wastewater Supervisor Bronson Cottan, Operator Rob Totten, Public Works Director
Rural Water Association: of Utah	Philip Harold, Wastewater Technician

---

Report Prepared By:
Steve Harris,
President, H&S Environmental, LLC
February 20, 2020

Section 1

Introduction and Background

1.0 Scope and Purpose

In October of 2019, H&S Environmental, LLC began discussions with Joe Barker about methods to optimize the Springdale wastewater stabilization pond system to meet future discharge permit limits better. After several discussions, a four (4) day site visit, and a thorough review of the data, Steve Harris of H&S Environmental, LLC (H&S) prepared this performance review of the Town of Springdale Utah wastewater lagoon system.

The information used in this performance and optimization evaluation includes the following:

- Interviews with Springdale wastewater supervisor Joe Barker on the history and general condition of the lagoon system
- Reviews of grab sample lab results from Chemtech-Ford & H&S
- Analysis of 2015 through 2019 effluent sampling results as reported by USEPA ECHO
- An on-site inspection and testing of the Town of Springdale Utah pond system in January 2020
- Reviews of Joe Baker's operations and sampling protocols at Springdale, Ut
- Analysis of specialized intra-pond sampling results from Chemtech-Ford, Sandy Utah

The purpose of this evaluation is to identify ways to improve the treatment process to meet all permit requirements in a long-term sustained manner.

The focus of this report then is to offer solutions to keep effluent BOD, TSS, ***E. coli***, Dissolved Oxygen (DO), and pH under the permit limitations and in control. To determine if in-pond optimization is possible H&S Environmental will analyze and evaluate lagoon system performance with respect to (i) historical data reviewed, (ii) additional data gathered from field testing, (iii) samples delivered to Chemtech-Ford Laboratories collected from the on-site visit by Joe Barker and (iv) a review of sampling and testing protocols practiced by Springdale, Utah personnel.

This report covers the performance of the Town of Springdale Utah Wastewater Lagoon System as it existed up to January 2020.

Findings

Section 2 – Findings

2.0 Findings

Based on the results of four (4) years and seven (7) months of DMR wastewater data analyzed from May 31, 2015, to December 31, 2019 (4.6 years) and specialized on-site testing, the following conclusions can be made about the Town of Springdale Utah wastewater lagoon system:

Section 2 – Findings

1. Regarding permit compliance, grab sample testing by Chemtech Labs on January 23, 2020, show the Springdale pond system would be compliant for BOD, DO & pH. Final effluent ammonia concentrations were at or below one (1) mg/l showing excellent treatment and good pond health. On the day of field sampling, the Springdale system would not be compliant for Effluent TSS or BOD and TSS removal efficiency. DMR data indicate the Springdale pond system violated its effluent TSS and BOD and TSS Removal Efficiency limits as recently as December 31, 2019. The current overall performance of the pond system is fair, with an average 4.6-year average effluent BOD_5 of 24.45 mg/l. BOD reduction to 24.45 mg/l while compliant equates to an overall average BOD_5 removal efficiency of 87.8% based on 4.6-years of DMR data. With a diffused air system, BOD_5 removal efficiency should be around 97%

The 4.6- year trend in effluent BOD_5 and TSS is downward, indicating improvement. The average 5-year effluent TSS results are 50.53 mg/l indicating persistent permit exceedance. When considering 4.6 years of sampling events, the Effluent TSS limits have been exceeded 36.8 percent of the time, and TSS Removal limits have been violated 32.3 percent of the time. The Springdale wastewater lagoon system will more than likely exceed its TSS limits in the future unless some intervention is made. This may be due to sludge accumulation stimulating algae growth for TSS violations.

Statistically speaking, effluent TSS and BOD are NOT positively correlated where; ***"Effluent BOD tends to be larger for larger TSS."*** A correlation between the two (R^2 = .0074, n=24) means that efforts to minimize TSS will not directly reflect the effluent BOD result. A lack of correlation between effluent and influent BOD is most unusual and indicates sludge is feeding soluble BOD and nutrients back to the water column to feed algae growth.

A water quality spot check was made on Jan 23, 2020, and Chemtec Labs yielded an effluent BOD_5 of 15 mg/l, a $CBOD_5$ of 13, a $SCBOD_5$ of 7 mg/l, and an effluent TSS of 51 mg/l indicating algae reduction would solve both BOD and TSS problems.

2. Based on the average measured flowrate of 0.131 MGD (data from 84 sampling dates from Feb 2013 to December 2019, 7 years) and average actual water depths of 8.12 and 9.42 feet in Cells 1 and 2 respectively, with 3:1 slopes, the average total theoretical retention time of this system is estimated at 404 days with sludge accumulation.

At 200.07 mg/l average influent BOD_5 and flow of 0.131 MG, loading to this system is 218.6 lbs. / BOD /day. Sized at 12.88 acres loading to the primary treatment cell is 16.9 lbs./ac/day. If we consider Cell # 1 to be two (2) cells divided by a baffle, then loading to Cell # 1 becomes 33.73 lbs/acre/day. As judged by the residual dissolved oxygen levels measured in Cell # 1 and throughout the treatment system, daily loading is being oxidized using existing blowers and diffusers. This conclusion is supported by a Cell # 1 effluent BOD of 35 mg/l yielding a theoretical Cell # 1 BOD removal efficiency of 82.5%...eighty (80) being optimal. Before ammonia removal can occur, BOD_5 must be 30 mg/l or lower. In the Springdale lagoon system, this happens in Cell # 2. The actual BOD_5 removal efficiency of Cell # 1 is 55.70% due to the dilute nature (Influent BOD: 79 mg/l) of the influent. Field-tested effluent ammonia concentrations from Cells 1 and 2 were 11.44 and 1.09 respectively with a final effluent ammonia concentration measured by Chemtech Labs of 1 mg/l.

Section 2 – Findings - Continued

3. Effluent ammonia concentrations over the past 4.6 years for the Springdale, Wastewater Lagoon System, averaged 2.07 mg/l with 5-year average wintertime ammonia consistently below 1 mg/l.

Field testing during January (water temperature between 4.6- 5.4 degrees Celsius) showed populations of nitrifying bacteria. NBOD is a measure of the relative number of nitrifying bacteria capable of converting ammonia to nitrate. NBOD is determined by subtracting CBOD from BOD. $BOD_5 – CBOD_5 = NBOD_5$. Springdale NBOD at the time of Chemtech testing was fifteen (15) mg/l indicating the presence of nitrifying bacteria.

Nitrifying bacteria convert ammonia to nitrate. Nitrate is consumed by heterotrophic bacteria and algae in pond systems and is typically at very low concentrations entering and leaving pond systems. For the Springdale system, effluent nitrate concentrations averaged 3.96 mg/l indicating nitrification with nitrate residuals capable of stimulating algae growth. Overall, ammonia removal efficiency measured by Chemtech Labs was 96.75 percent. Field testing showed between 95.01 and 96.94 percent ammonia removal with the production of nitrate.

4. pH is steady in this system, with only two (2) pH violations since May 2015. There is a 4.6 -year pH range of 8.1 to 9.12. Over this period, pH in the Springdale system averaged 8.1 (pH Max) using 24 sampling events. pH is essential to killing pathogens, controlling odors, and volatilizing ammonia in lagoon systems.

5. During the field testing beginning at 7:00 AM (before sunrise), dissolved oxygen concentrations ranged from 5.63 mg/l at the surface of Cells 1 inlet area to 13.92 at the effluent area of Cell # 2. This pond system was designed to operate by keeping DO levels at 2 mg/l or higher throughout the day and night. Permit limits require 4 mg/l at the effluent. Dissolved oxygen is essential for removing ammonia and controlling odors with pH and the UVB in sunlight, killing pathogens naturally in lagoon systems. The Town of Springdale may consider saving money on electricity by rehabilitating its recirculation system and running fewer blowers during the day. Recirculation not only provides the dissolved oxygen necessary for oxidizing BOD and ammonia but also provides oxygen in the form of nitrate…NO3. Recirculation is typically run only during the afternoon hours when Cell # 2 DO is the highest. A DO probe should dictate when and for how long a recirculation system should run. Aeration and recirculation will cool treatment cells off during the winter. Colder water will retain greater amounts of dissolved oxygen (DO).

6. The diffusers appear to be unobstructed by the sludge blanket in Cells # 1.

7. From May 2015 to December 2019, the trend in effluent BOD_5 is down while the influent BOD is up. The system is currently BOD_5 compliant with the latest BOD violation occurring in December of 2017. There have been only two (2) effluent BOD violations in 4.6 years and nine (9) BOD percent removal violations over the same period. The average 4.6-year effluent BOD_5 concentration is 24.45 mg/l. A grab sample, Final Effluent water quality spot check, was made from the effluent weir on January 23, 2020, and yielded effluent BOD_5 of 15 mg/l for an overall BOD_5 percent removal of 81.01 %.

8. From 2015 to 2019, effluent TSS concentrations are down with an average 4.6-year monthly average effluent TSS concentration of 50.53 mg/l, ….8.53 mg/l over the permitted limit of 45. Since May 2015,

Section 2 – Findings - Continued

…there have been fifteen (15) effluent TSS violations and eighteen (18) TSS percent removal violations. There is a strong possibility that the lagoon System will violate its effluent TSS limits in the future.

9) There is a substantial amount of sludge accumulated in Cell # 1. When sludge judging Cell # 1, the trolling motor prop hit the top of the sludge blanket leaving behind a black wake in the north side of the pond. Cell # 1 is divided into two parts by a baffle; Aerated Cell # 1 and Aerated Cell # 2, as designated by Alpha Engineering. Cell # 2 is designated as the "Storage Cell." On average, there is twenty-nine (29) percent (8 inches) more sludge in Aerated Cell # 1 than Aerated Cell # 2. Aerated Cell # 1 has accumulated an average of 2.44 feet of sludge, and Aerated Cell # 2 has accumulated an average of 1.73 feet of sludge. The average over the whole of Cell # 1(Aerated Cells 1 & 2) is 2.10 feet. Cell # 2 (the Storage Cell) has accumulated an average of 0.55 feet of sludge.

Most of the sludge in Cell # 1 has accumulated in the north and east parts of the cell.

Sludge was measured on each side of the Cell # 1 baffle separating Aerated Cell # 1 from Aerated Cell # 2. There were twenty-five (25) percent more sludge on the east side of the baffle when compared to the west side of the baffle. Sludge blanket differences between the two sides of the baffle were 4.60 feet on the east side of the baffle and an average of 3.44 feet on the west side of the baffle.

Sludge stores and then releases nutrients that are stored in the dead bacteria and algae cells that make up the sludge blanket. This nutrient feedback is unpredictable and difficult to measure and most likely related to temperatures, mixing, and currents created by the wind and wave action over the treatment cell surface. This nutrient feedback stimulates algae growth for TSS problems**.**

Section 3 – Recommendations

RECOMMENDATIONS

Based on the results of 4.6 and 18.8 years of DMR recorded data available through the USEPA's ECHO and ICIS databases, a four (4) day site visit sampling and performing, intra-pond BOD_5, ammonia, nitrate, DO, pH and temperature testing, below are recommendations for improved stabilization pond performance for long-term sustained compliance using the existing wastewater stabilization pond system.

A review of the specific effluent violations since April 2014 show that most of the effluent permit exceedances at the Springdale wastewater pond system can be traced to algae growth. These effluent permit violations include BOD exceedances and pH violations.

Eight (8) recommendations for lagoon system compliance are:

Section 3 – Recommendations - Continued

1. Remove sludge from Cell # 1
2. Discover the cause of dilute TSS and BOD concentrations entering the treatment system by continuing to video and smoke test the collection system. Excess flows causing dilute TSS and BOD may be coming from the National Park or some other source. Controlling I&I can be one of the best lagoon upgrades for improved performance and permit compliance.
3. Consider the addition of an automated barscreen at the headworks to remove trash
4. Quarterly perform diagnostic BOD and TSS sampling to understand the nature of the TSS in the effluent. DMR data should be added to a spreadsheet and trended over time.
5. Pulling samples at the beginning of the month may give Springdale operations staff enough time to take another set of samples for a higher average monthly influent TSS or BOD
6. Perform a dissolved oxygen and pH profile during the summer months to see if the treatment cells stratify.
7. Repair multiple level effluent valving to be able to choose discharge water quality from different stratified water column layers
8. Open and close effluent valving periodically to see if effluent water turbidity changes. Select valve/discharge pipe giving the least turbid water for TSS reduction.
9. As a last resort, consider rapid infiltration basins or sand filtration for algae cell removal before discharge. Both have proven to remove algae cells and keep/get wastewater pond systems in compliance. This strategy is much more cost-effective than building an activated sludge system to solve an algae problem in a wastewater lagoon system.

1) Remove Sludge from Cells 1 & 2

Sludge is composed of dead bacteria and algae cells, along with un-oxidized organic matter. As it sits at the sludge water interface, sludge exerts an oxygen demand that can be measured. Sludge also occupies valuable treatment capacity originally designed into the system by engineers to remove BOD and ammonia. Sludge begins to affect water quality and should be removed when it reaches over eighteen (18) inches in thickness. The average 2.10 feet of sludge accumulated in Cell # 1 occupies twenty-six (26) percent of Cell # 1's treatment capacity at present average treatment cell depth of 8.12 feet.

Also, consider that the nutrients once assimilated by bacteria, algae, and protozoa release as these organisms die, re-releasing nutrients back into the water column. Nutrient feedback affects treatment efficiency. Sludge stores and then releases ammonia, phosphorous, CO_2, and organic acids that stimulates algae growth that, in turn, affect BOD, TSS removal efficiency.

2) Investigate Possible Additions to the Influent flow to Discover the Source of Low Influent TSS and BOD_5 Concentrations

Continue to video and smoke test the collection system. Excess flows causing dilute TSS and BOD may be coming from snowmelt, springs, or cleaning of the National Park or some other source. Data show a dilute influent during some rain events. In many cases, the best upgrade to a lagoon system can be made in the collection system. Tightening up the collection system will help prevent percent removal exceedances and increase retention time for higher rates of ammonia removal. Reducing I&I will also reduce the stress on lift station pumps. Separate flow metering equipment may need to be set up on the National Park collection system. Flow into the pond may be more than the water they purchase from the Town. The Utah Rural Water Association may have the equipment and personnel to help measure flows and locate the sources of infiltration and inflow.

Section 3 – Recommendations - Continued

3) <u>A Headworks Structure Will Keep the Bulk of the Trash from Entering the Cell # 1 Sludge Blanket and lower Influent BOD After the Influent Sampling Point.</u>

It is best to keep trash out of the treatment cells by installing a headworks screening system. An automated bar screen will extend the service life of the diffusers and the pond system as a whole by removing the garbage from the system. The screenings then can be taken to the landfill where this type of trash belongs. A headworks will also reduce the influent BOD (after the influent sampling point), leading to better BOD and ammonia percent removal and decrease the sludge accumulation rate. Over the long term, a trash-free sludge blanket is less expensive to remove and will remove some energy from the algae growth environment.

4) <u>Perform Diagnostic BOD, TSS, and Ammonia Tests on Each Cell in the System.</u>

Intra-pond testing will help operations staff focus on specific areas where problems (opportunities for optimization) are occurring. Pinpointing where, when, and why a problem is occurring saves time and money and simplifies the job of lagoon optimization for permit compliance.

More than any other process control test, Cell # 1 effluent BOD_5, and BOD and ammonia removal efficiency will tell operations personnel when the influent loading is becoming a problem. Cell # 1 BOD_5 removal efficiency should be analyzed monthly. Determining removal efficiency requires pulling a BOD_5 sample from the effluent of Cell # 1 at the same time an influent BOD_5 sample is drawn. Compare the two results. Cell # 1 removal efficiency should be at least eighty (80) percent. This type of testing should be done monthly at the Springdale pond system because removal efficiency directly affects ammonia removal and the energy required for algae growth leading to TSS problems.

As much as possible, treatment should be "pushed back" to Cell # 1. Higher levels of treatment in Cell # 1 will allow for better TSS, BOD, and ammonia and nitrate removal in Cell # 2. Cell # 2 should be for settling dead bacteria and algae cells and killing pathogens, not removing BOD_5. Properly functioning, Cell # 1 (specifically, Aerated Cell # 1) should be for BOD_5 removal and the beginning of ammonia removal. Aerated Cell # 2 and Cell # 2 should be for nutrient removal and for settling bacteria and dead algae cells. This objective is more easily accomplished by getting the most productivity out of Cell # 1 as possible. For the Springdale system, this starts with getting Cell # 1 desludged.

5) <u>Sample at the Beginning of the Month</u>

Consider sampling at the beginning of the month and pull a second sample Blower run time should be managed using Springdale's dissolved oxygen (DO) meter. Always keep DO at or slightly above two (2) mg/l at all times. Keeping DO above two (2) mg/l is important for ammonia removal and to keep odors down. The best time to measure DO is before sunrise…before algae can contribute DO to the system. Remember, algae consume oxygen under dark conditions; in the BOD_5 test bottle and at night in the treatment cells. During the winter, aeration will cool influent water temperature. Cooler water temperatures affect ammonia removal.

Check the math and reported values the State and USEPA use…they can make mistakes

Section 3 – Recommendations - Continued

6) <u>Repair Multiple Level Effluent Draw-Off Structure to Take Advantage of Stratification and the Water Quality Differences in Each Strata</u>

During the summer when pond water stratifies… a functioning multiple level draw-off structure allows the operator to select the quality of water he discharges from the plant. Water chemistry changes with changing depth. This is especially true for TSS. Algae grow and thrive in the upper three (3) feet (photic zone) of the treatment cell. TSS, while a permit limit in and of itself also dramatically affects BOD. Because algae consume oxygen (respiration) in the BOD bottle over the five (5) day BOD_5 test, algae can inflate BOD numbers. It is not uncommon to have a BOD of 100 mg/l and a filtered BOD (BOD test with no algae) of 6 mg/l. A multiple level effluent draw-off structure also affects pH, coliform, and dissolved oxygen concentrations.

7) <u>Consider Sand Filtration or a Rapid Infiltration Basin Before Building an Activated Sludge Plant</u>

Sand filters have been used for decades across this country to effectively polish wastewater lagoon effluents down to the single-digit TSS and BOD levels at a relatively low cost. In fact, effluents from intermittent sand filters rival the water quality of packaged activated sludge systems. Intermittent sand filters apply pond effluent to a sand filter media bed on an intermittent basis and because these filters remove pollutants physically and biologically, they are also known to remove ammonia as well as BOD and TSS effectively. San filters are a viable option for TSS and BOD permit compliance. The USEPA speaks favorably of sand filtration in the latest USEPA manual on wastewater pond systems. Please see attachments for more information on sand filtration with references to the USEPA.

Figure 1. Cell # 2 of the Springdale Utah Wastewater Pond System. Looking East

Section 4 – Data Analysis

Data Analysis

Sludge Accumulation

Aside from occupying valuable capacity and lowering a treatment cell's retention time, sludge releases nutrients and soluble BOD back into the water column to feed algae. Once it reaches about eighteen (18) inches in thickness, it is time to consider removal to maintain compliance with permit limits. Seen below is the sludge blanket profile of Cells 1 and 2 of the Town of Springdale's Wastewater treatment lagoon system. These data were collected on January 23 & 24, 2020.

Figure 2. Cell # 1 Sludge Blanket Locations.

Notice in Figure 2 above how sludge has accumulated to the North side of the treatment cell. Much of the faster flow probably travels along the south levee, dropping solids out to the north as the flow slows. Laminar forces are what cause flows to pass along dike walls, creating short-circuiting.

Because of diffuser manifolds and the baffle, flow-path tracking drogues could not be used to test for short-circuiting. Dye testing using Rhodamine WT, Fluorescent dye, or CFD modeling would be required to prove a short-circuit in Cell # 1.

Sludge should be removed from Cell # 1.

Section 4 – Data Analysis

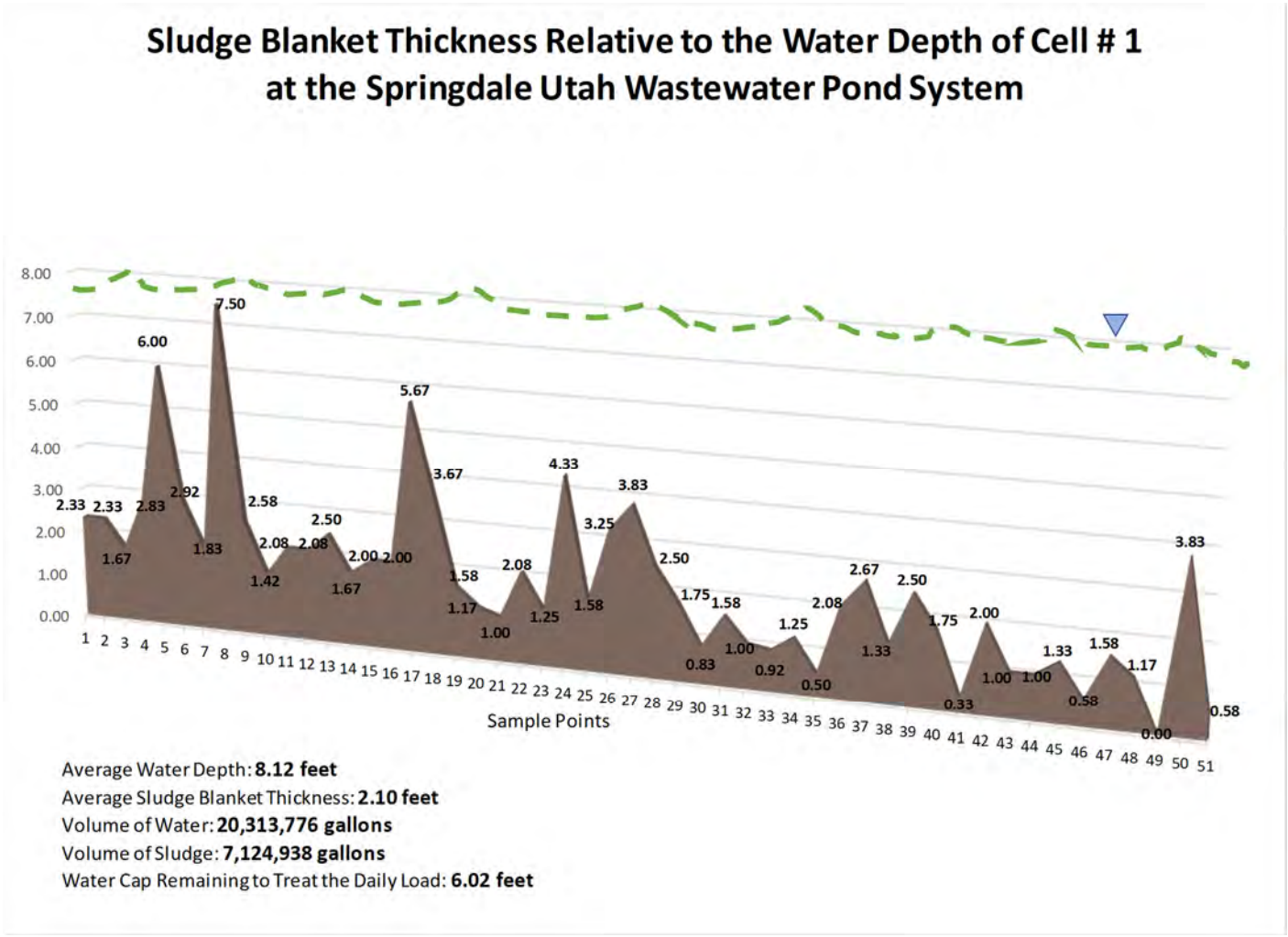


Figure 3. Sludge Blanket Thickness Relative to Water Depth

Section 4 – Data Analysis

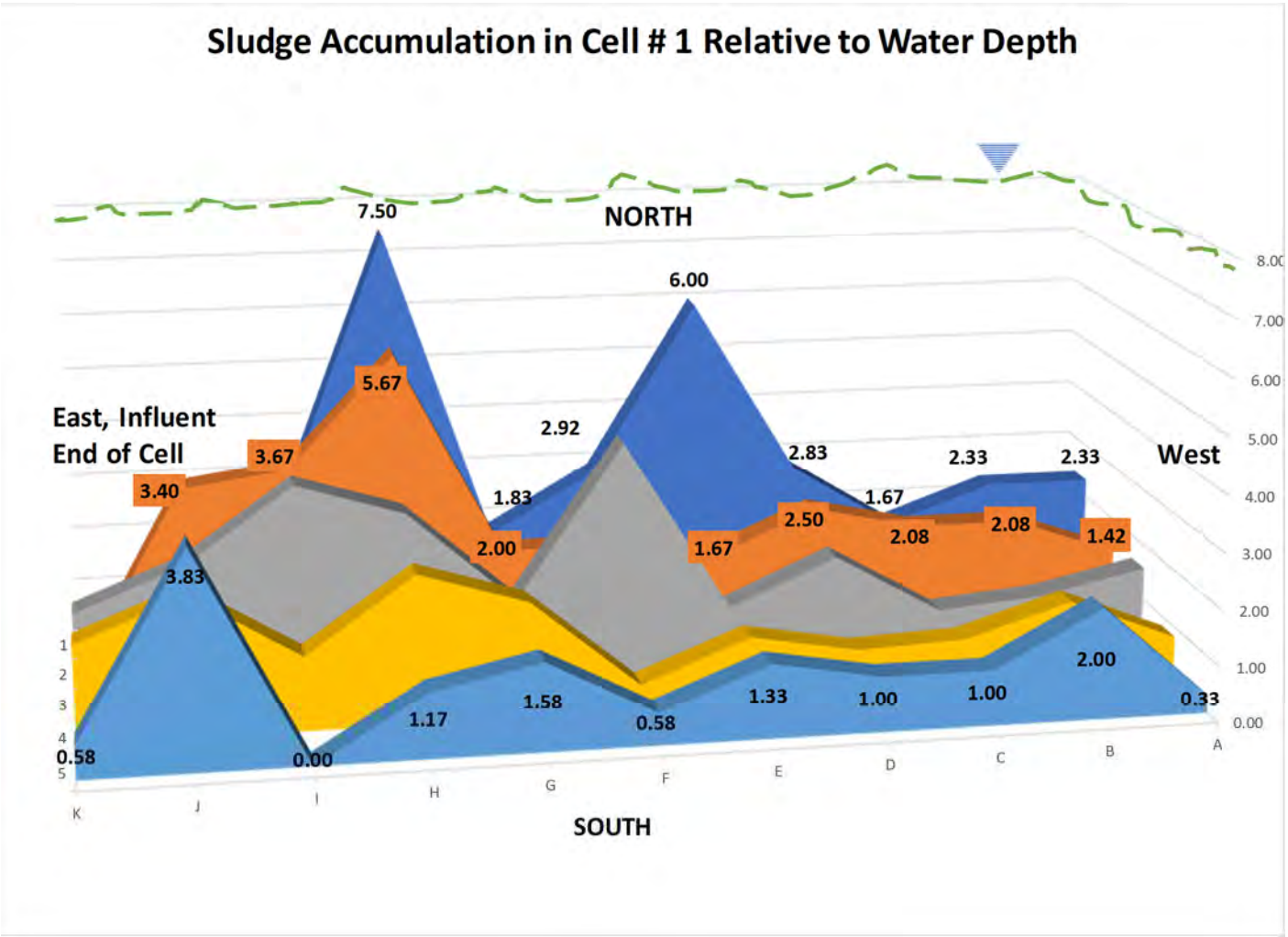


Figure 4. Sludge Accumulation in Cell # 1

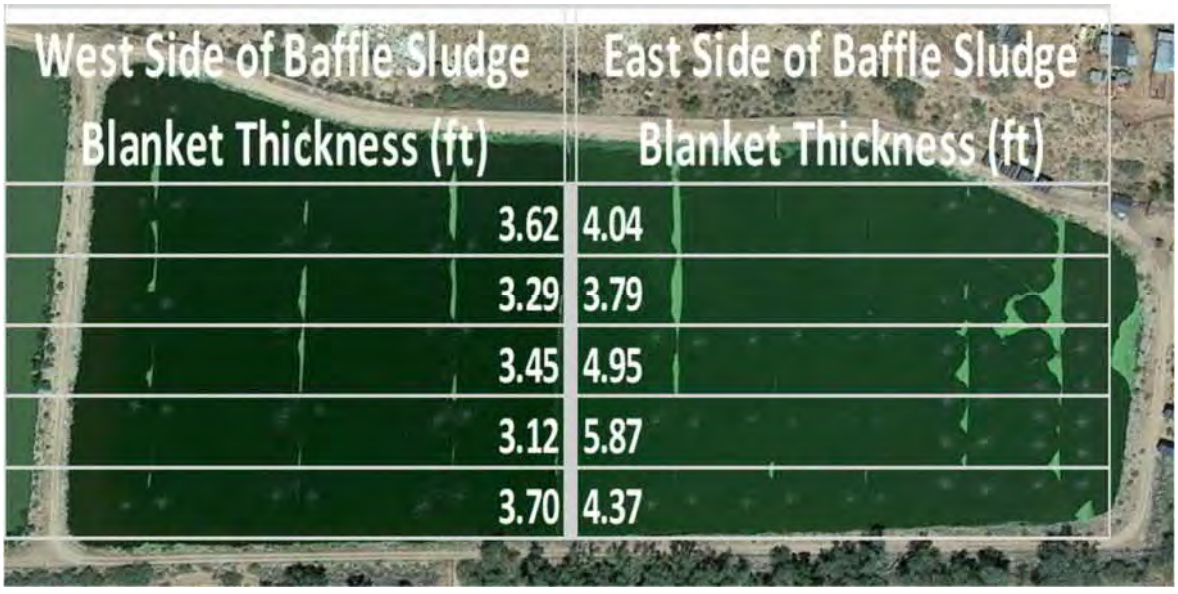


Figure 5. Sludge was Measured on Each Side of the Baffle Separating Aeration Cell # 1 from Aeration Cell # 2

Average sludge blanket thickness on the West side of the baffle: 3.44 feet thick, on the East side of the baffle: 4.60 feet thick.

Section 4 – Data Analysis

	A	B	C	D	E	F	G
1							
2				0.67		0.42	0.33
3	0.67	0.58	0.58	0.42			
4	2.42	0.67	0.42	0.50			
5	0.42	0.75	0.33		0.75		0.67
6	0.00	0.50					
7	1.00	0.42	0.67	0.25			0.17
8	0.00	0.67		0.25			
9	0.00	1.00	0.67	0.50	0.33	0.42	0.33

Storage Cell, Cell # 2

Figure 6. Sludge Blanket Thickness Locations in Cell # 2, the Discharge Cell

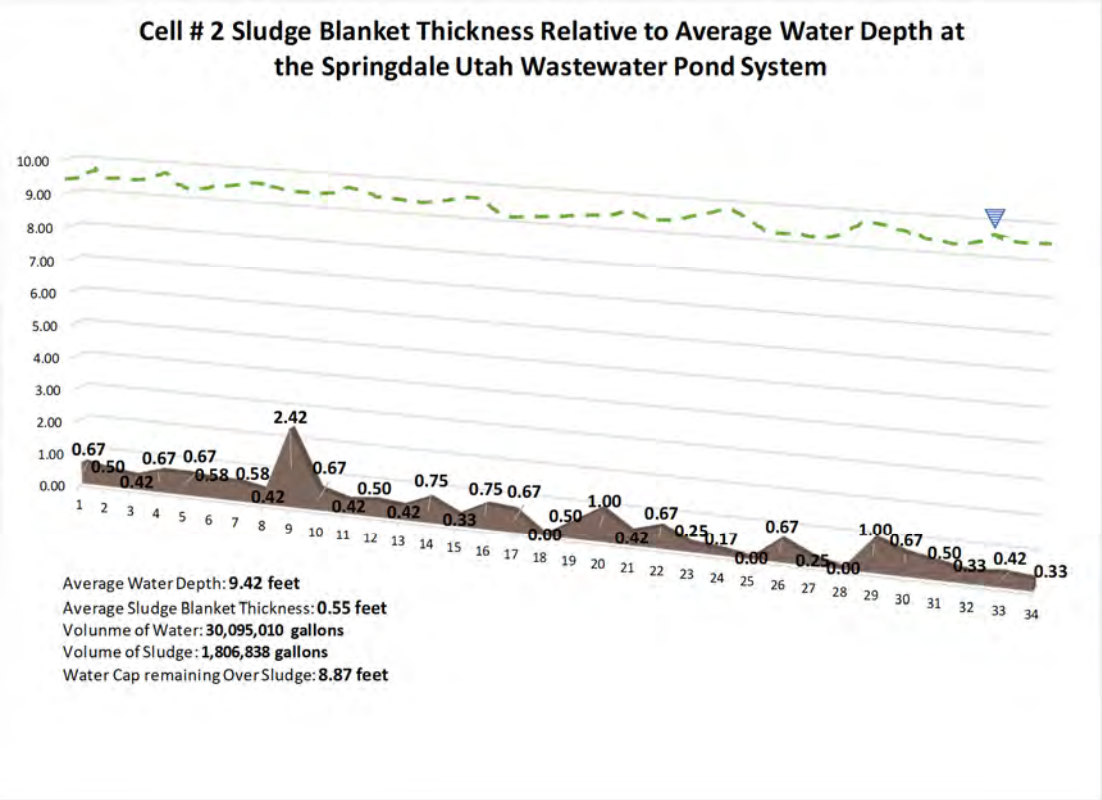


Figure 7. Sludge Blanket Thickness Profile of Cell # 2, the Storage Cell

Section 4 – Data Analysis Cont-

Sludge should be removed from Cell # 1. Removal options include dredging, pressing, and hauling off-site. Sludge can also be dredged and applied to a Geo-Tube or drying bed to dry out on-site for two (2) years. Drying on-site allows for the removal of the water, reducing tipping fees and hauling costs. When dredging, the treatment cell must typically be taken offline. For Springdale, this means bypassing Cell # 1 and introducing the influent now into Cell # 2. Usually, aeration resources are moved temporarily from the dredged cell to the new primary treatment cell.

If time permits, mixing a sludge blanket can remove several feet over time. The disadvantage of treating in place by mixing is that you run the risk of freeing ammonia, nitrate, phosphate, CO_2, and organic acids to feed an algae bloom. With mixing, you run the risk of over-mixing and causing a DO crash violating DO permit limits. (Please see attachment on pond mixing) There are proven chemical additives from the agricultural industry that can accelerate sludge removal on-site in association with mixing so the treatment cells being desludged can remain online.

Aeration and Dissolved Oxygen

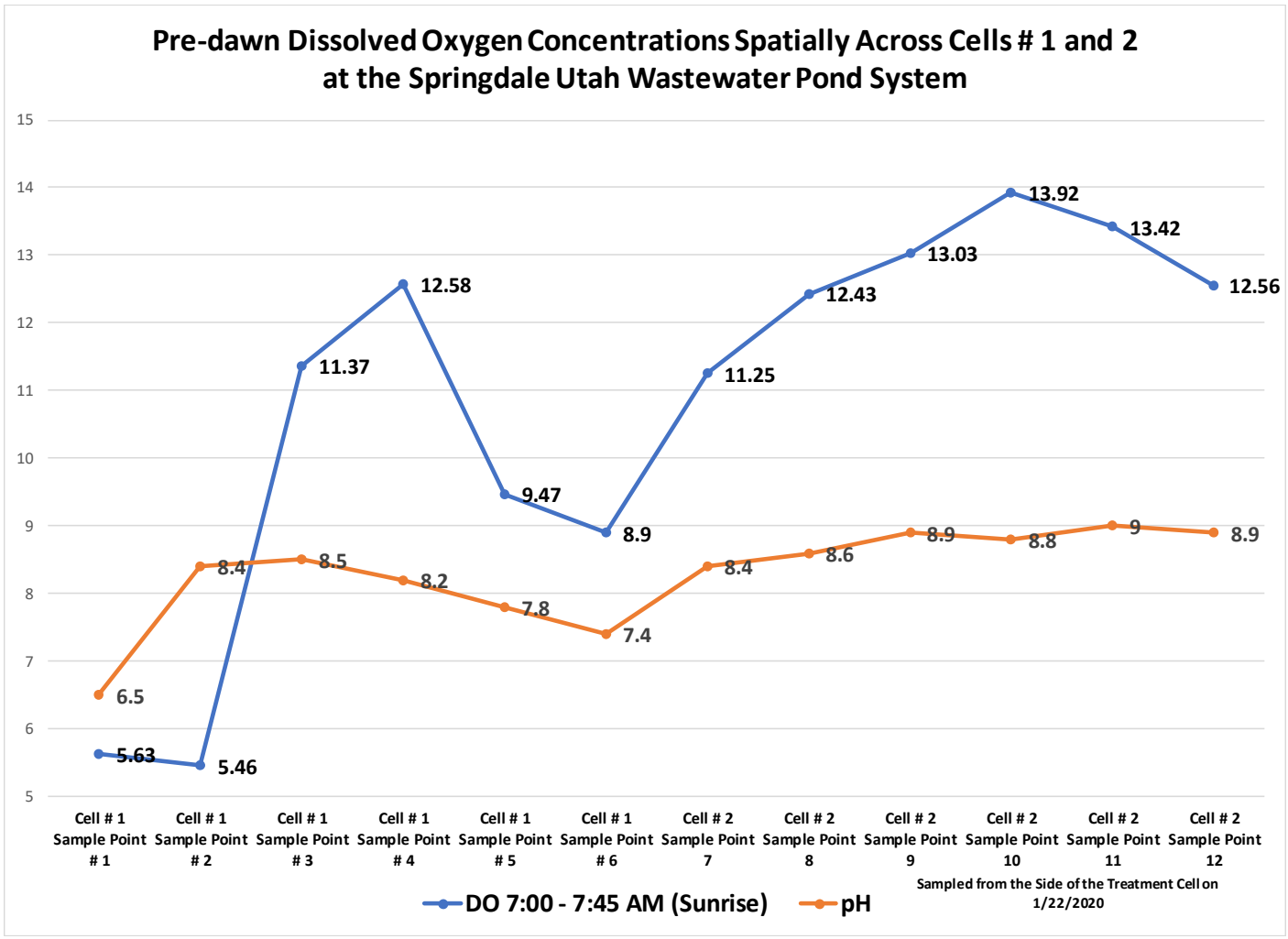


Figure 8. Pre-Dawen Dissolved Oxygen Concentrations from the Surface of the Pond System

Figure 8 above shows DO measurement before the influence of photosynthesis on the pond system. The DO concentrations during the evening and early morning hours remain sufficient enough to oxidize the organic and inorganic load the system receives daily.

Section 4 – Data Analysis Cont-

Figure 9. Dissolved Oxygen Locations Before Sunrise at the Springdale Wastewater Lagoon System. Sampled from 7:00 to 7:45 AM on January 22, 2020. Water Temperature Averaged 4.8 degrees C

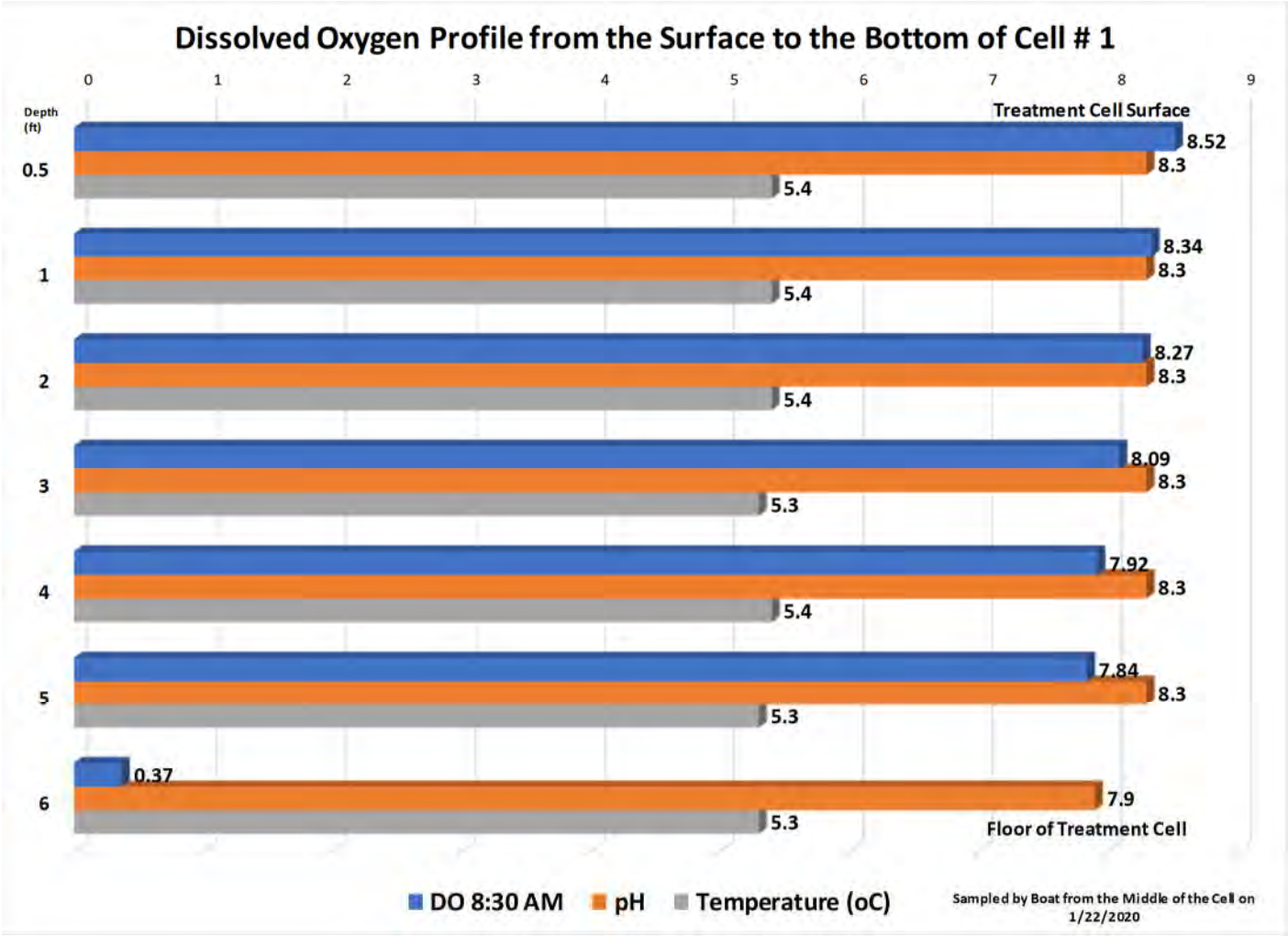


Figure 10. Dissolved Oxygen Profile of Cell # 1 Taken at 9:15 AM on January 22, 2020. Dissolved Oxygen Concentrations Remain Sufficient All the Way Down to the Sludge Water Interface

Section 4 – Data Analysis Cont-

There is more than enough air being supplied to the Springdale Utah wastewater pond system to satisfy the inorganic and organic oxidation demand of the daily load placed on the Springdale wastewater pond system.

Four (4) years and seven (7) months of testing for DMR requirements show consistently sufficient DO to oxidize the daily organic and inorganic load the lagoon system receives. In the past five (5) years, there has been only one (1) DO violation, and that was in September 2014.

For future reference, there are seven (7) indicators that the dissolved oxygen levels in the Springdale pond system would be too low:

1) Poor Cell # 1 BOD_5 removal efficiency
2) The poor ammonia removal efficiency
3) Odors
4) Popping sludge in Cells 1 & 2
5) ***Daphnia*** turned red in the treatment cells
6) Low DO measurements both day **and** night. The best, most meaningful time to measure DO is before sunrise before algae have had the chance to produce dissolved oxygen
7) Increasing trends in effluent BOD_5 and TSS after all the Cells have been desludged

Figure 11. The Beginning of a Blue Green Algae Bloom in Springdale's Cell # 2...the Storage Cell. Blue-green algae odors could be detected at this time

Blue-green algae have an air vacuole in their filamentous bodies that keep them floating above the single-celled algae. A floating mat of Blue-green algae creates a competitive exclusion that is designed by Nature to outcompete the single-celled planktonic algae floating beneath them. Blue-green algae smell and excrete toxins that are dangerous for animals to drink.

Mixing by boat or through a trash pump should begin immediately before the Blue-green algae populations explode, creating odors and other problems.

Section 4 – Data Analysis Cont-

Water Quality Results

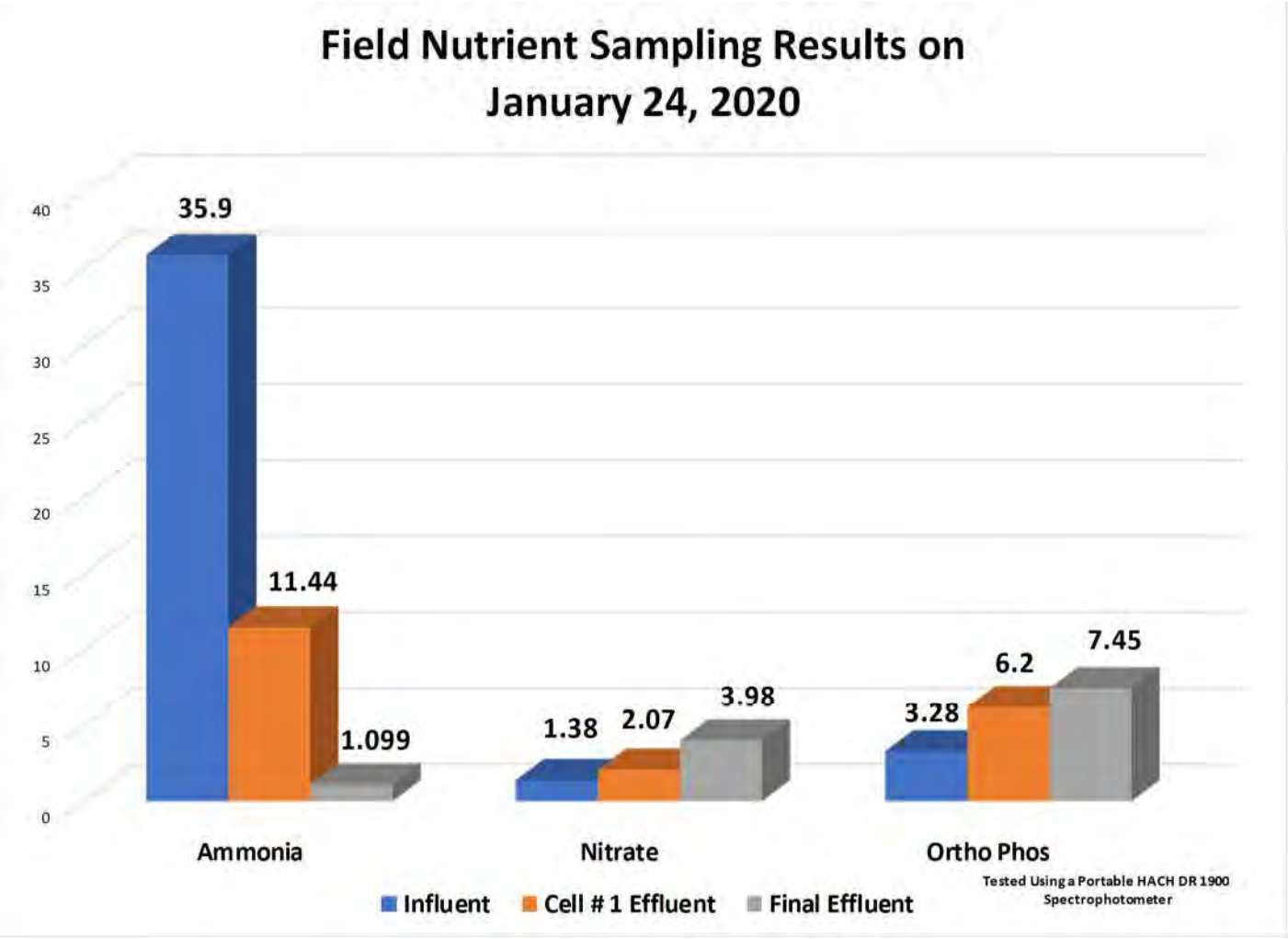
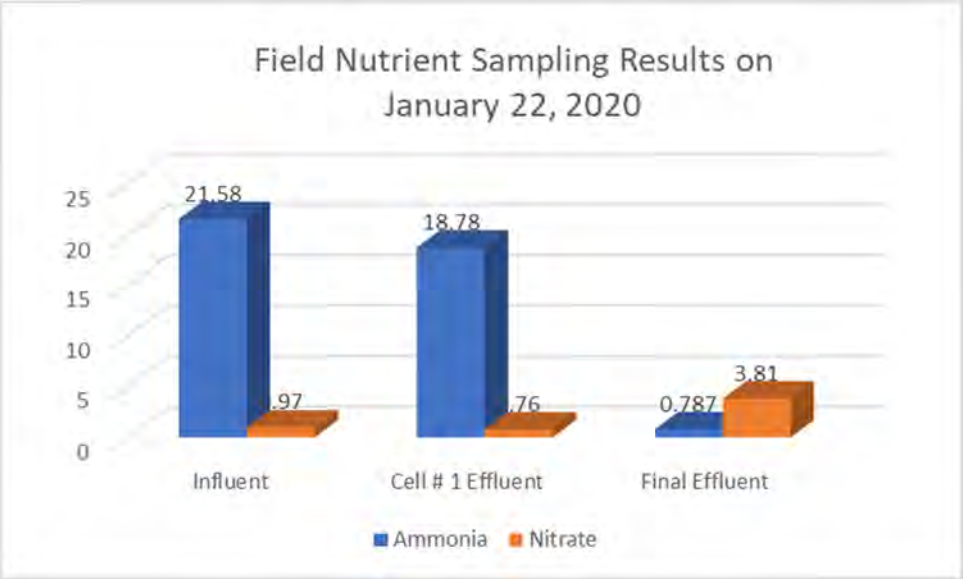


Figure 12. Nutrient Concentrations Between Each Treatment Cell in the Springdale Wastewater Lagoon System

Notice in the Figure above how Nitrate and Phosphorus, Reactive (Ortho) increase from treatment cell to treatment cell. Increasing nutrient concentrations is an indication of benthal feedback…the sludge blanket feeding once assimilated nutrients BACK into the water column. These nutrients, with the CO_2 and organic acid production from the sludge blanket, feed algae populations for TSS exceedances.

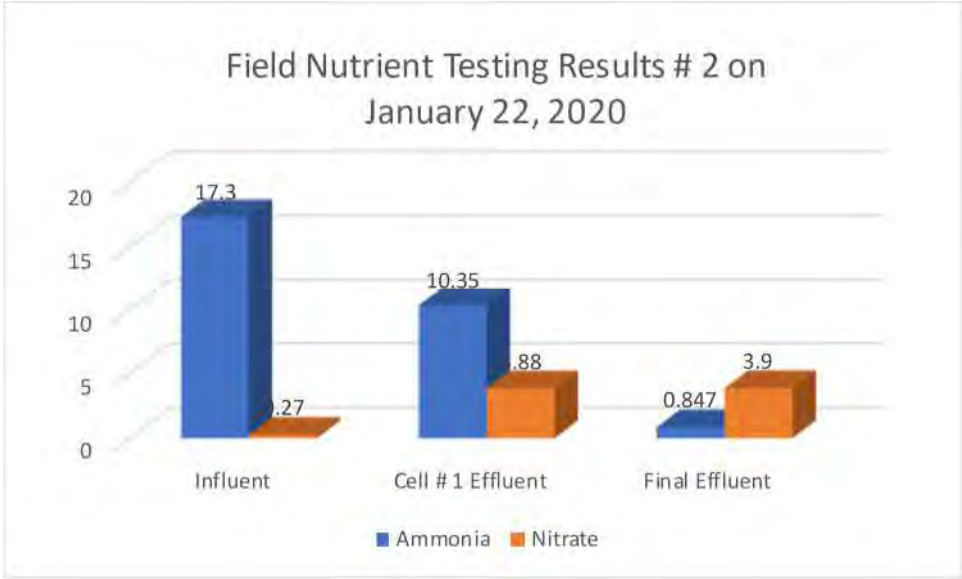
Below are the results of three (3) other field nutrient sampling test results.

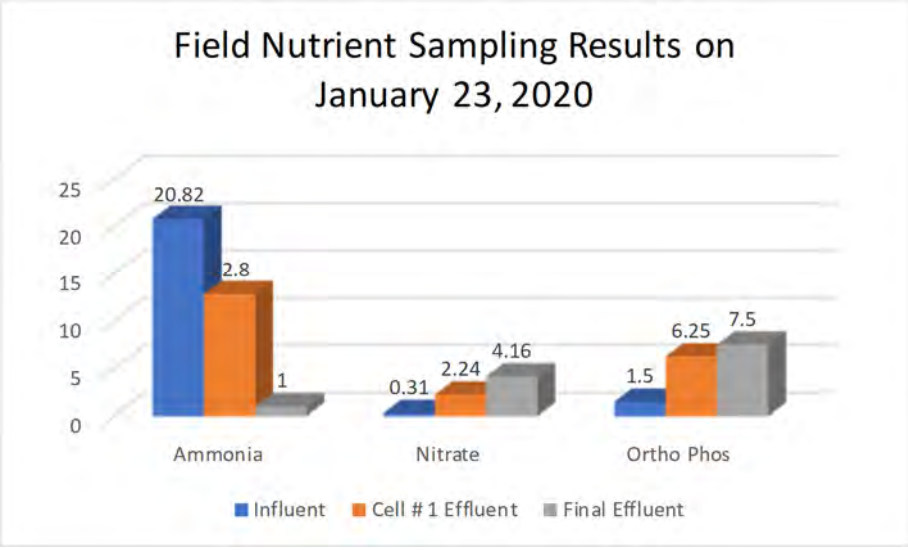
Section 4 – Data Analysis Cont-



Figures 13, 14, &15.

Looking from One Treatment Cell to the Other We See an Increase in Nitrate and Phosphorous Concentrations





Section 4 – Data Analysis Cont-

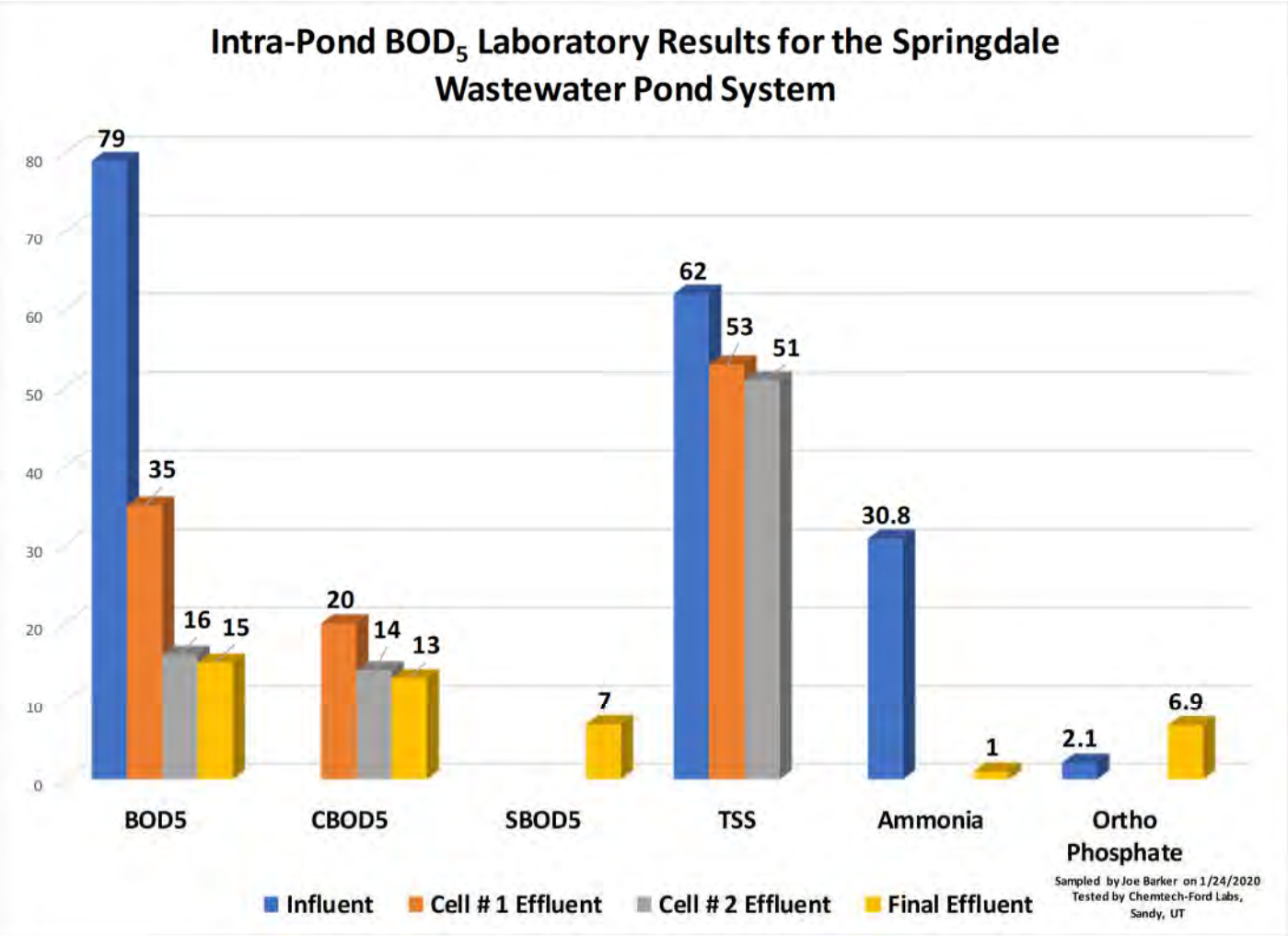


Figure 16. Chemtech Laboratory Water Quality Lab Results for the Springdale Wastewater Lagoon System

The Figure above tells us seven (7) things:

1) Because of the dilute influent BOD, Cell # 1 BOD removal efficiency is a mere 55.7%. It should be at least 80%. The system is compliant and yet non-compliant for BOD. I&I? Probably!
2) Ammonia removal begins when the BOD is below 30 mg/l. For the Springdale wastewater pond system, this happens after Cell # 1 (Aerated Cell # 2). BOD_5 should be between 15 to 25 mg/l at the outfall of Cell # 1 (Aeration Cell # 2).
3) The $CBOD_5$ test is the BOD_5 test performed with suppressive chemicals that "put to sleep" the nitrifying bacteria that convert ammonia to nitrate. Nitrification (the conversion of ammonia to nitrate) uses lots of oxygen. $BOD_5 - CBOD_5 = NBOD_5$. NBOD is a measure of the relative number of nitrifying bacteria in a system. In other words, NBOD is a measure of a pond system's ability to remove ammonia through nitrification. The presence of (the production of or increase in) nitrate is an indication of nitrification as an ammonia removal pathway. This nitrification process affects algae production leading to TSS issues.
4) $SBOD_5$ is a measure of the BOD without algae. Because algae consume oxygen at night and under dark conditions in the BOD test bottle, it is important to understand algae's influence on the BOD_5 test. (See Attachments. "Algae's Influence on the BOD_5 Test)
5) Even with a higher, non-dilute influent TSS of 250 mg/l (actual TSS was 62 mg/l), Effluent is still in violation for percent removal and the concentration based measure of effluent TSS in mg/l.

Section 4 – Data Analysis Cont-

6) The Springdale wastewater pond system does an excellent job of ammonia removal even during the winter
7) Phosphorous levels climb as water passes through the treatment system

During winter-time field testing, the Springdale wastewater pond system was pH compliant. Historically the Springdale system has violated its pH permit limits three (3) times in 20,15, 2017, and 2018. pH never exceeded 9.11 SU. When pH becomes problematic, discharge from the lower discharge pipe at the outfall of Cell # 2.

High pH in a pond system is the result of algae affecting the bicarbonate cycle. Algae consume CO_2 as a carbon source, and when CO_2 is exhausted, the carbon in available bicarbonate is used. When bicarbonate is consumed hydroxyl ions are produced, and this causes the pH to rise. This is why pH changes through the day and night and from the surface of the pond to the bottom of the pond. pH also changes from one cell to another, usually increasing in latter treatment cells.

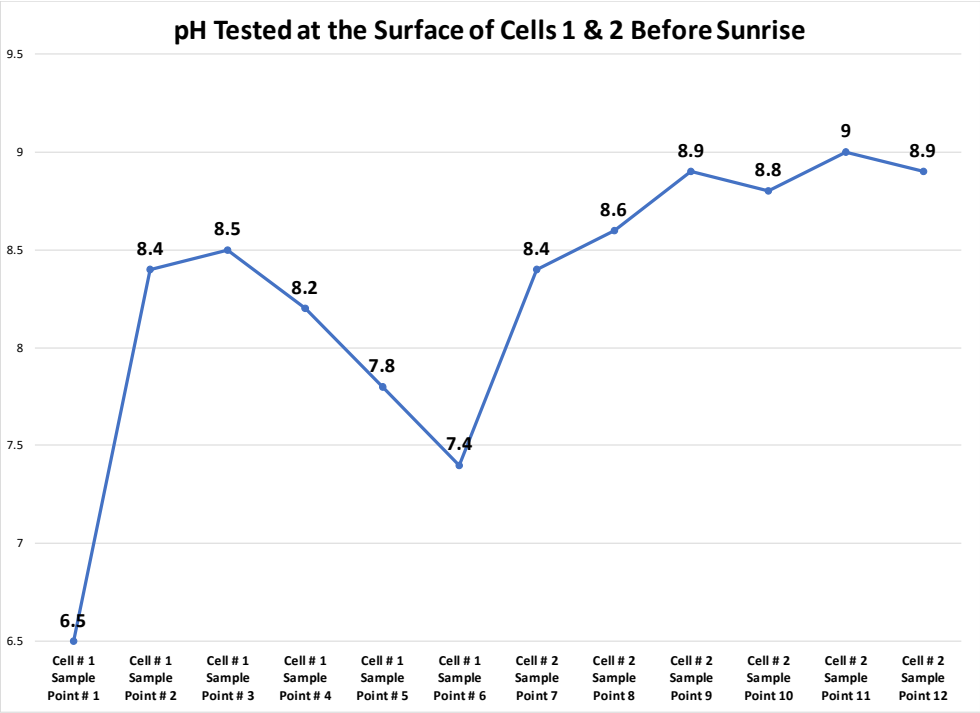


Figure 17. pH as Measured Spatially Across the Springdale Wastewater Pond System

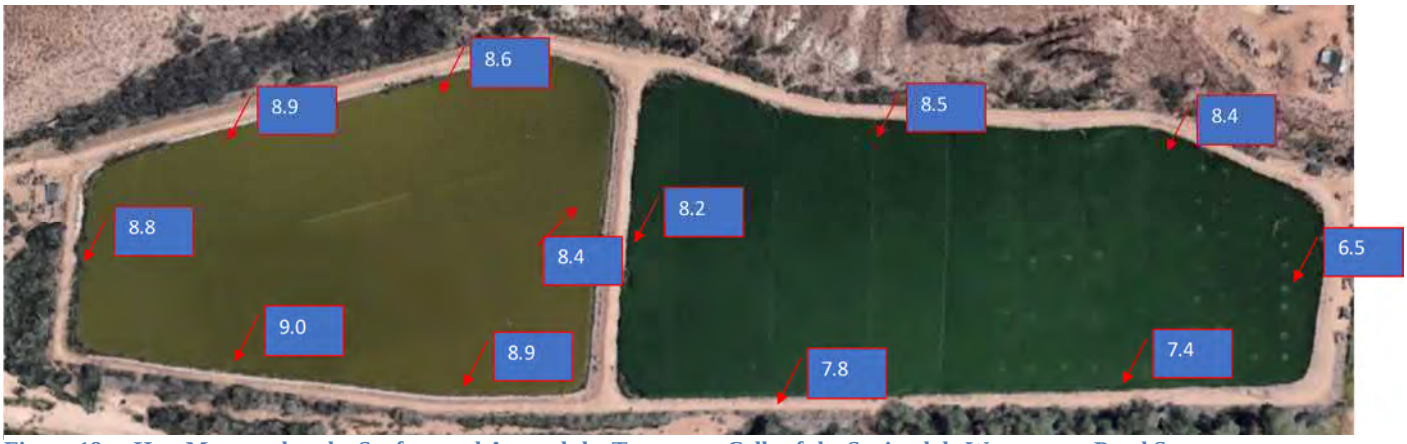


Figure 18. pH as Measured at the Surface and Around the Treatment Cells of the Springdale Wastewater Pond System

The difference in pH and DO from one side of a treatment cell to the other may indicate the direction the pond system loading is flowing. While the difference in DO is inconclusive, the pH is evident (see Figure 9 above). Primary loading from the collection system is typically close to neutral.

Section 4 – Data Analysis Cont-

DMR Data Analysis

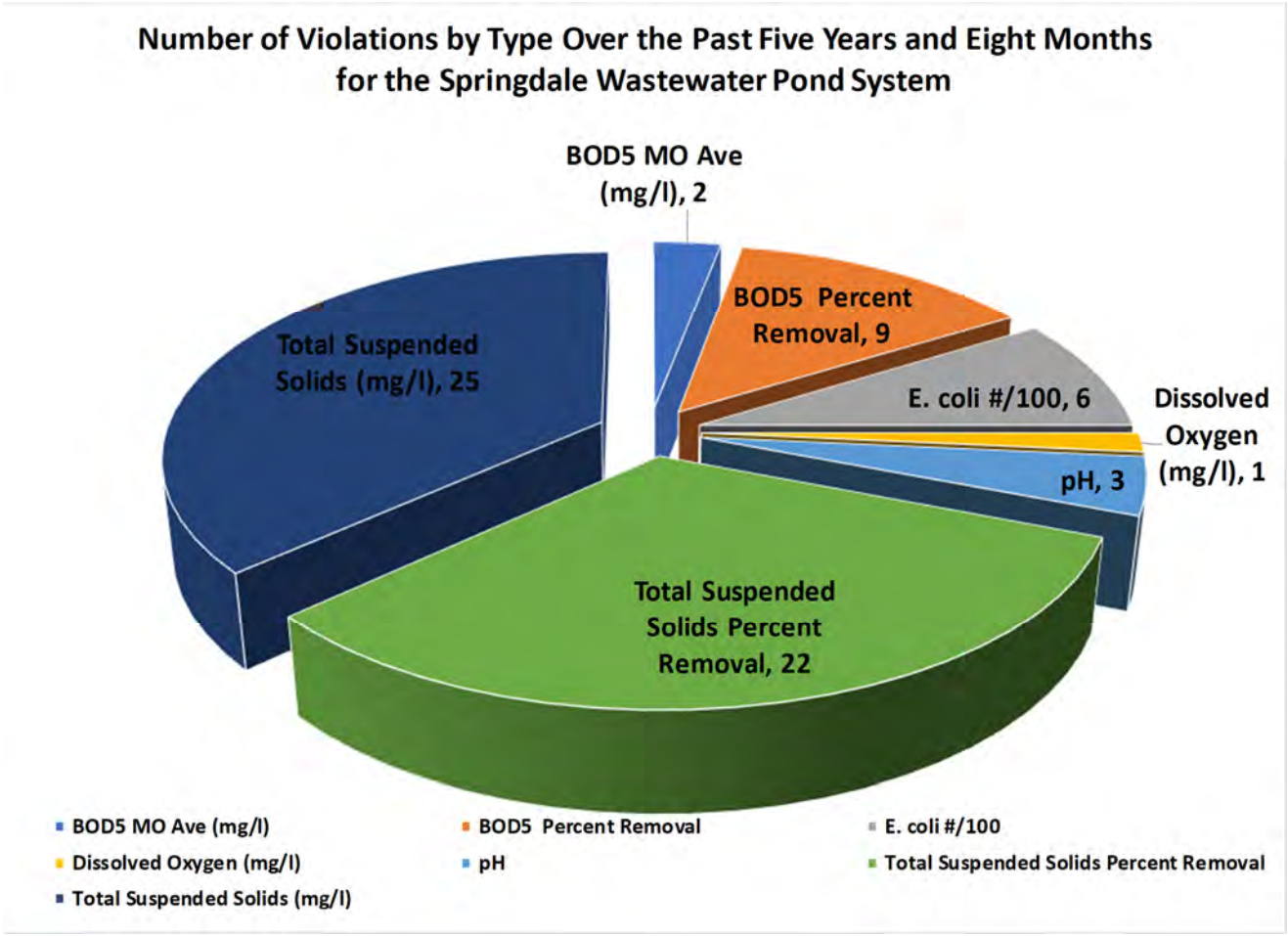


Figure 19. Most of the Permit Violations for the Town of Springdale's Wastewaeter Pond System are for TSS Violations

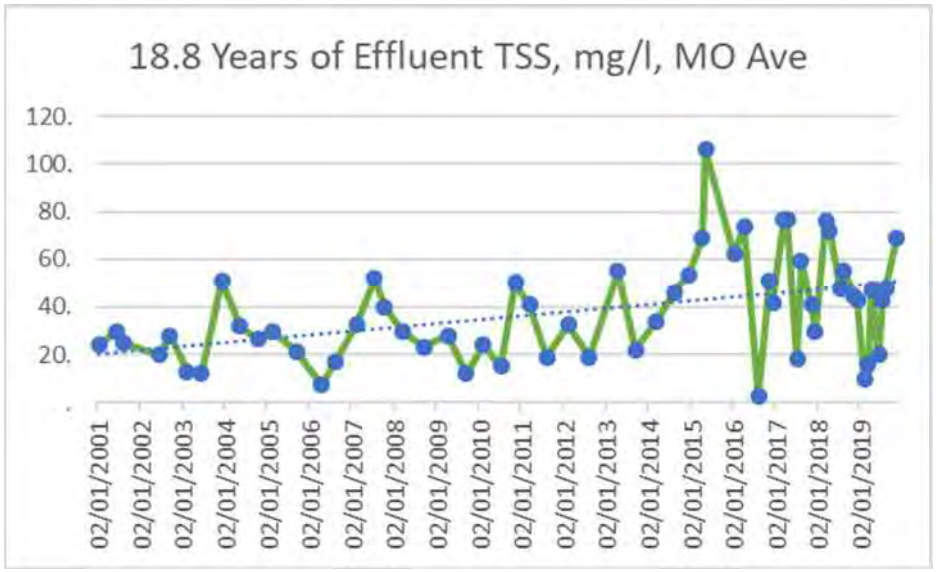


Figure 20. The Trend of Eighteen Years of Effluent TSS

Yearly Increases in Effluent TSS are an indication that the nutrient release of accumulated sludge is causing increases in effluent TSS concentrations.

Section 4 – Data Analysis Cont-

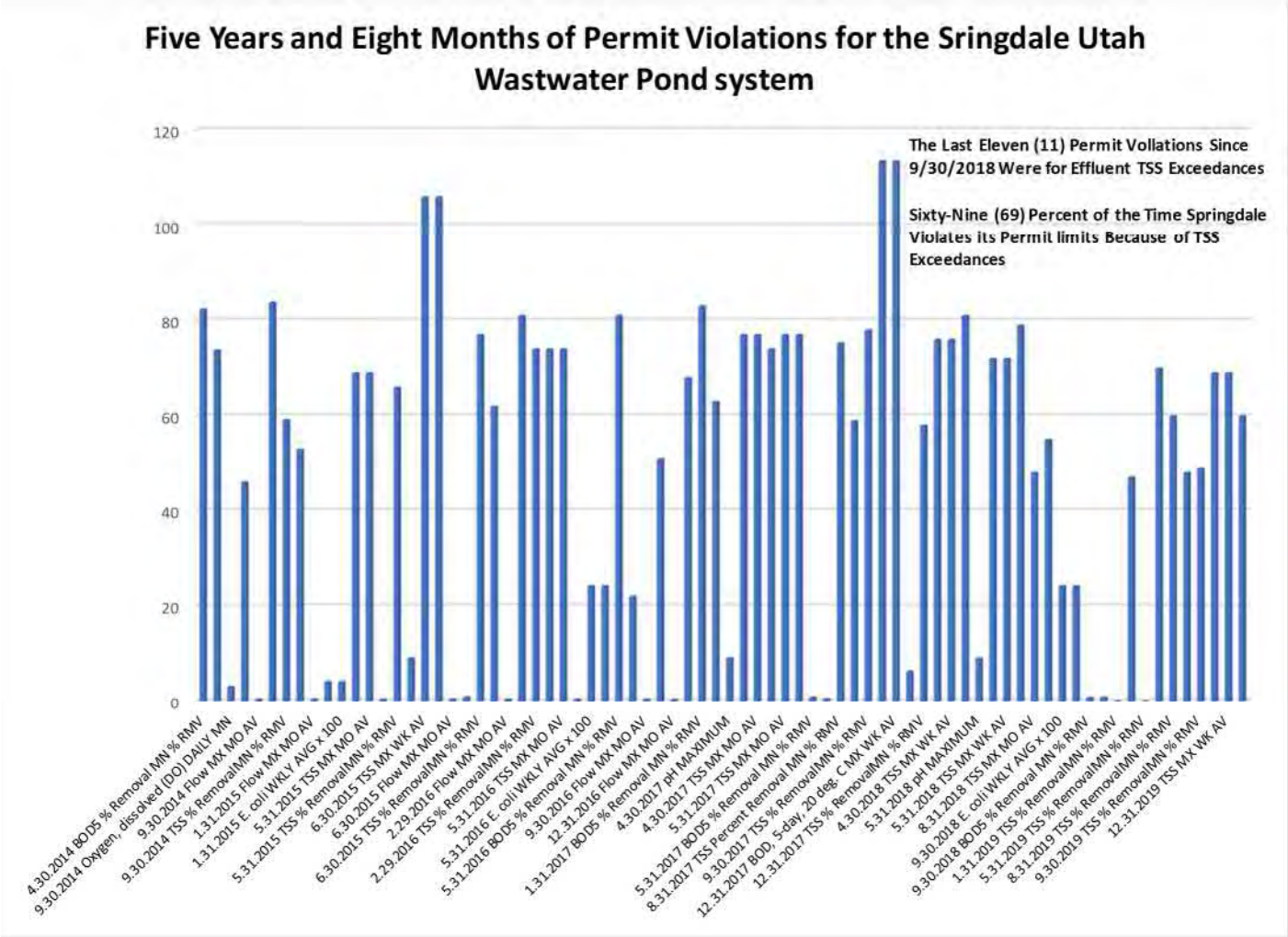


Figure 21. Effluent Permit Violations by Date showing TSS to Out of compliance Most of the Time

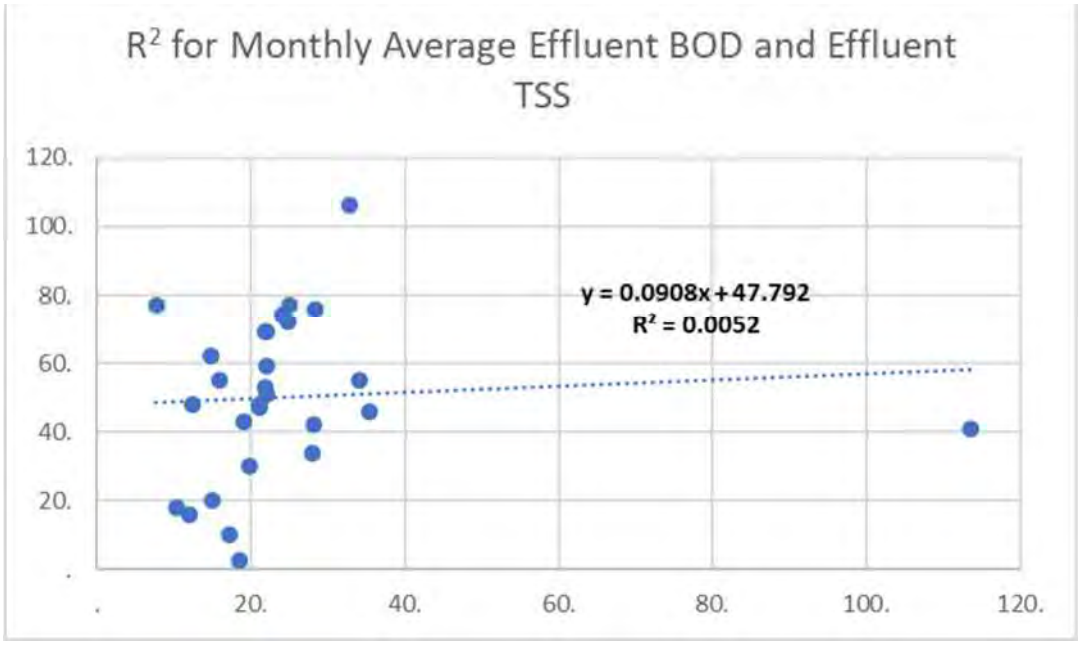


Figure 22. R^2 is a Statistical Measure of the Relationship Between Two (2) Variables

Section 4 – Data Analysis Cont-

In most cases, effluent TSS and BOD are strongly related because BOD is a test for oxygen depletion. Algae under dark conditions (at night in a pond system) and when sitting in a BOD_5 test bottle for five (5) days under dark conditions consume oxygen. This means that a measure of algae, TSS, and a measure of organic matter loading, BOD_5, should track together.

The lack of correlation suggests some other source is feeding algae (TSS) populations. In situations like this, it is usually sludge stimulating algae growth.

Effluent TSS concentrations are increasing at a greater rate than Influent TSS concentrations suggesting algae feeding off of nutrients released from the sludge blanket.

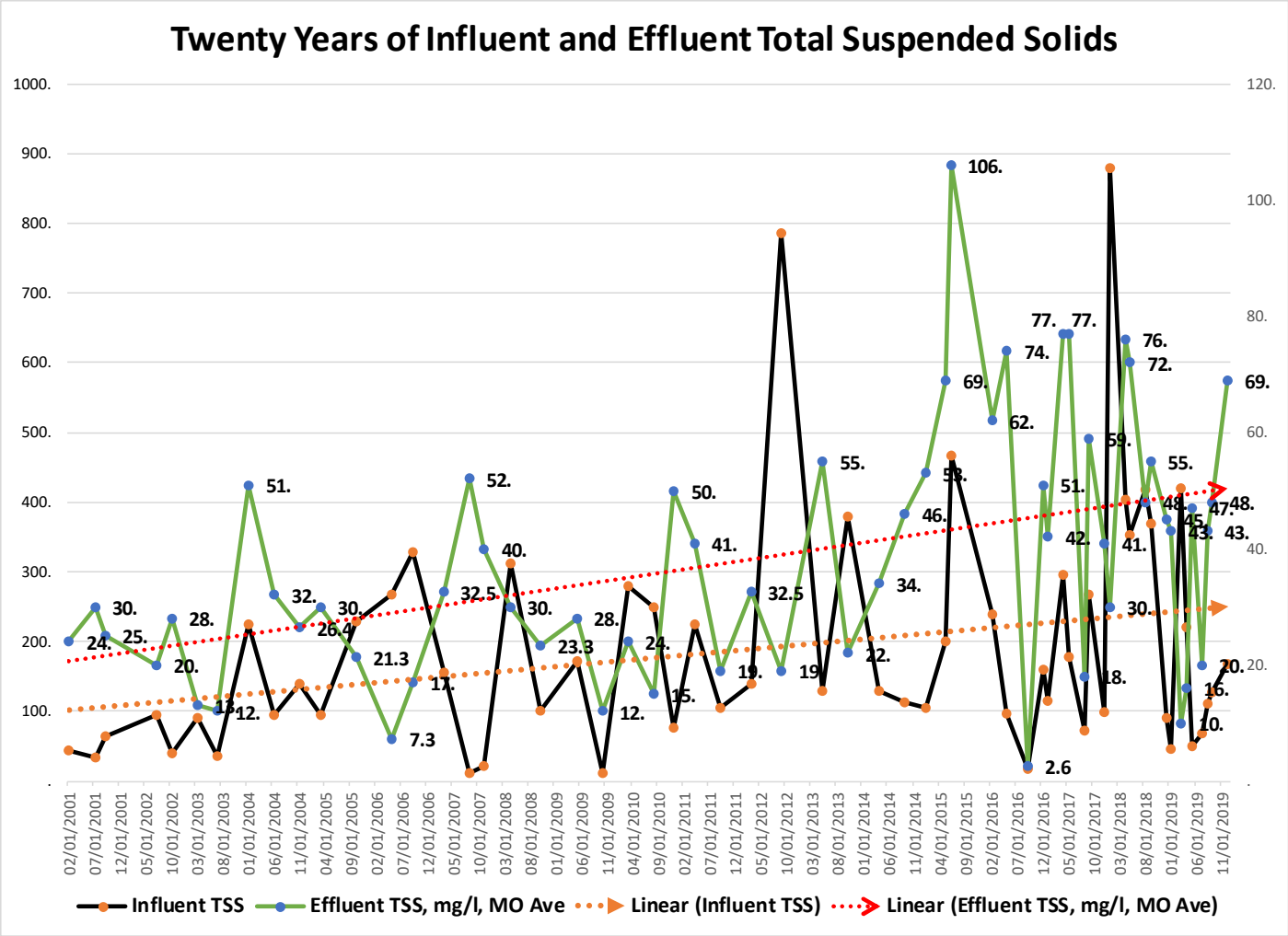
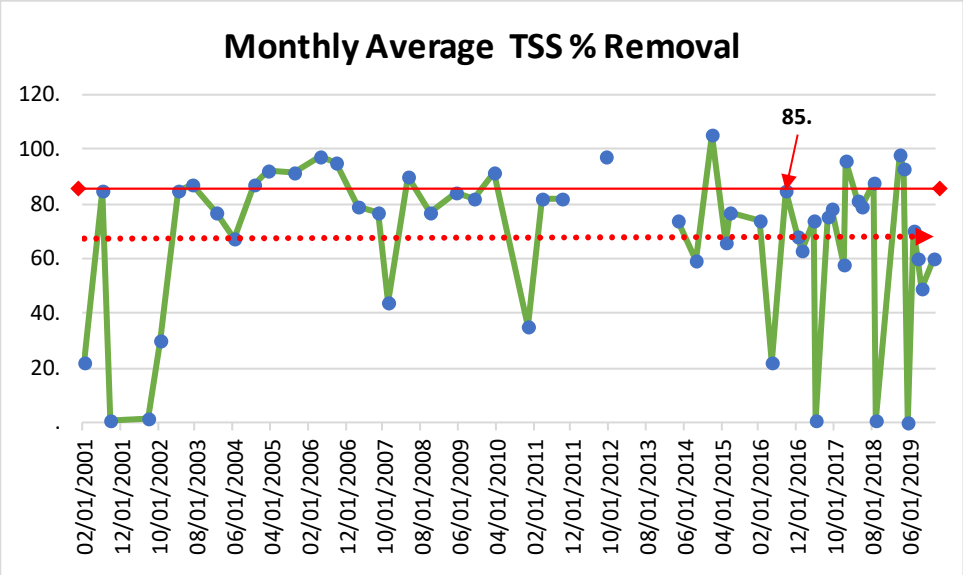
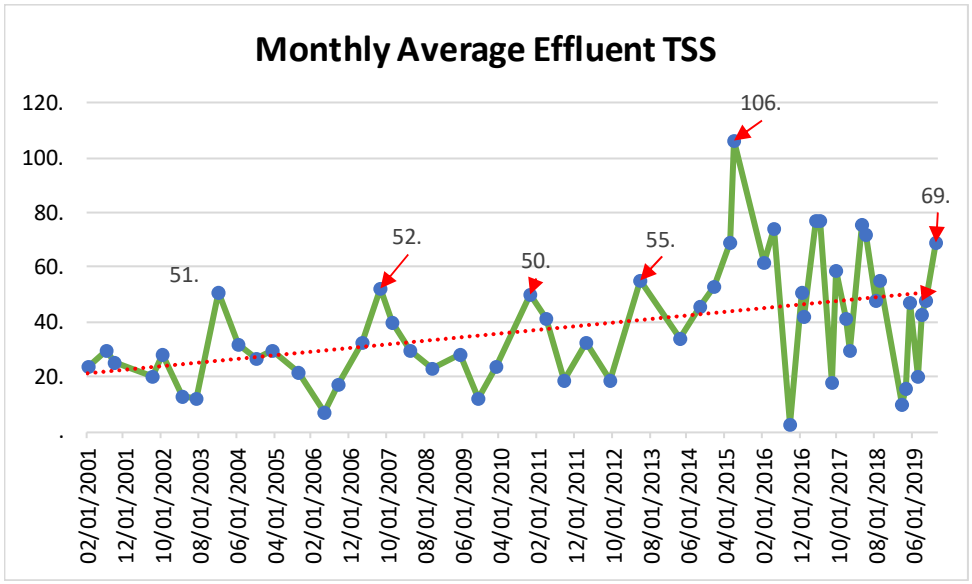
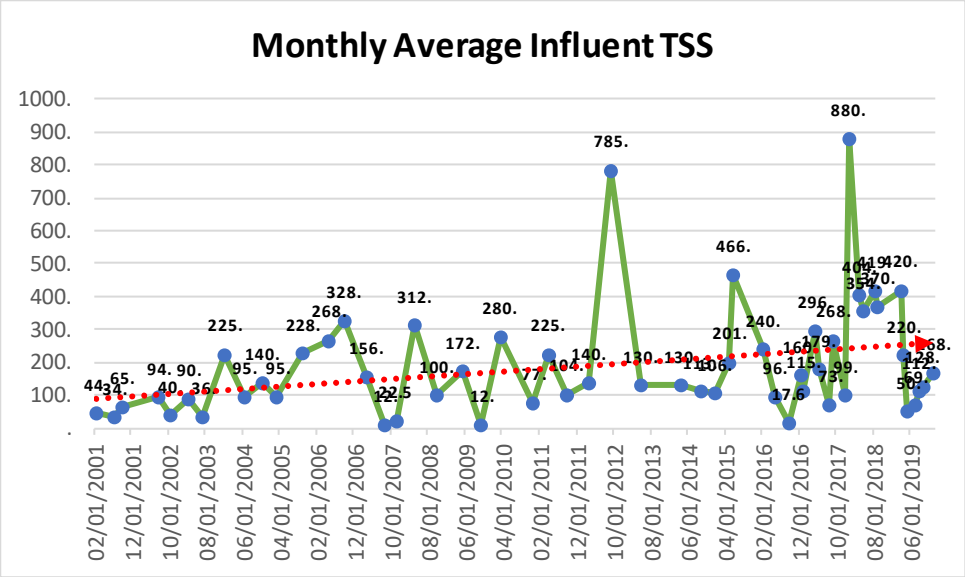


Figure 23. Influent and Effluent TSS for the Springdale Wastewater Pond System Showing Yearly Increases in Both Concentrations

Section 4 – Data Analysis Cont-







Figures 24, 25, & 26

4.6 Years of DMR Data for TSS Concentrations and Percent Removal

Section 4 – Data Analysis Cont-

Because algae consume oxygen for five (5) days in the BOD_5 test bottle, reducing algae concentrations will reduce BOD_5 levels. This relationship between algae and BOD_5 will become more apparent as soluble BOD_5 ($SBOD_5$) tests are run more frequently.

Because algae significantly influence effluent BOD concentrations, it is a wise practice to run a filtered BOD test ($SBOD_5$) on the effluent and compare the filtered with the BOD_5 and $CBOD_5$ test. Running a filtered BOD5 (SCBOD) is how to determine one cause of increasing effluent BOD.

In a study of twenty-four (24) Colorado pond systems, it was discovered that sixty-seven percent (67%) of the BOD violations in this study were from algae overgrowth. (Richard & Bowman (1991))

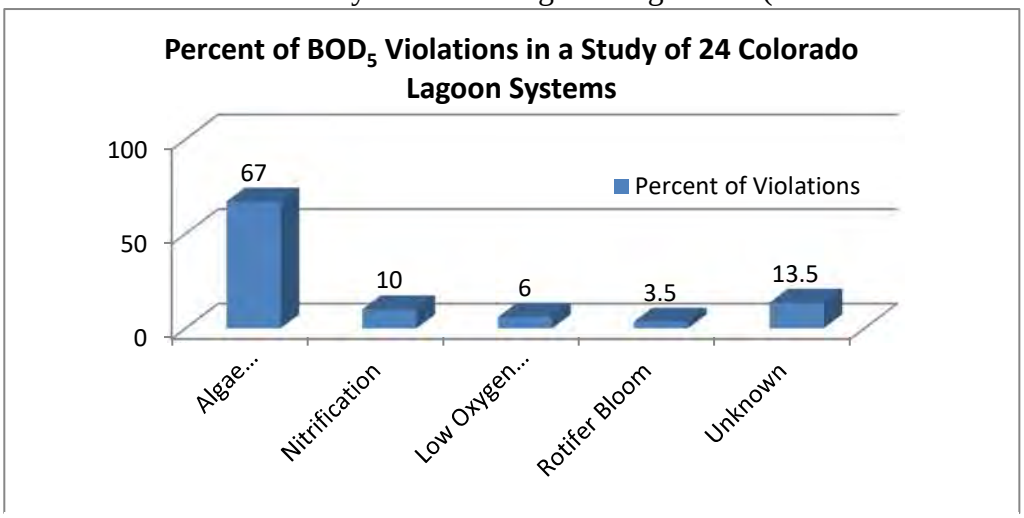


Figure 27. Colorado Study showing Algae to be the Cause of Most BOD Violations

Dead and decaying algae get into the BOD_5 test bottle and directly add to the BOD load but also the surviving algae consume oxygen under dark conditions in the BOD_5 test bottle and darkened BOD_5 incubator. This oxygen-consuming metabolic process is known as respiration and happens at night in ponds and incubators used in the BOD_5 test. The idea here is to have the pond's effluent free of algae to lower BOD and TSS.

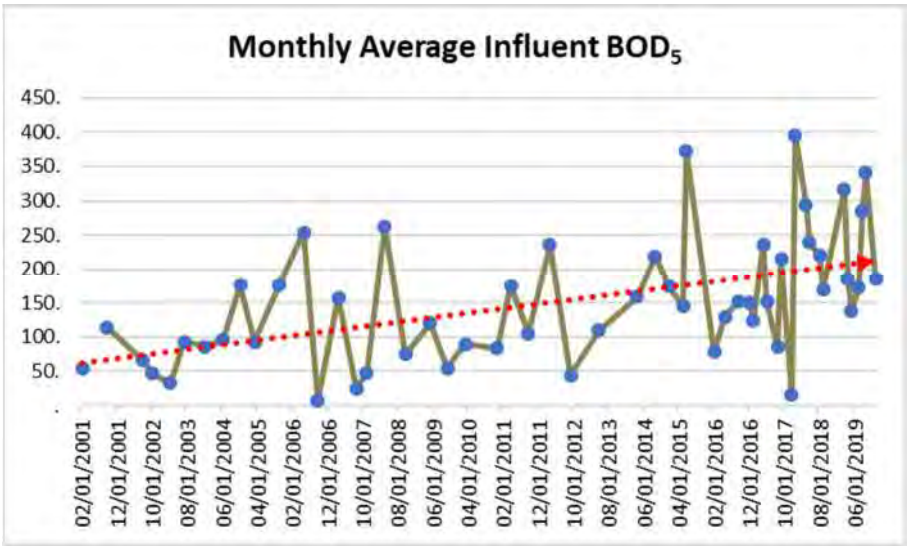
High algae growth typically leads to elevated BOD_5. It is widely accepted that an algae concentration of greater than 3.5×10^5/ml generally causes an effluent BOD_5 concentration of greater than 30 mg/L.

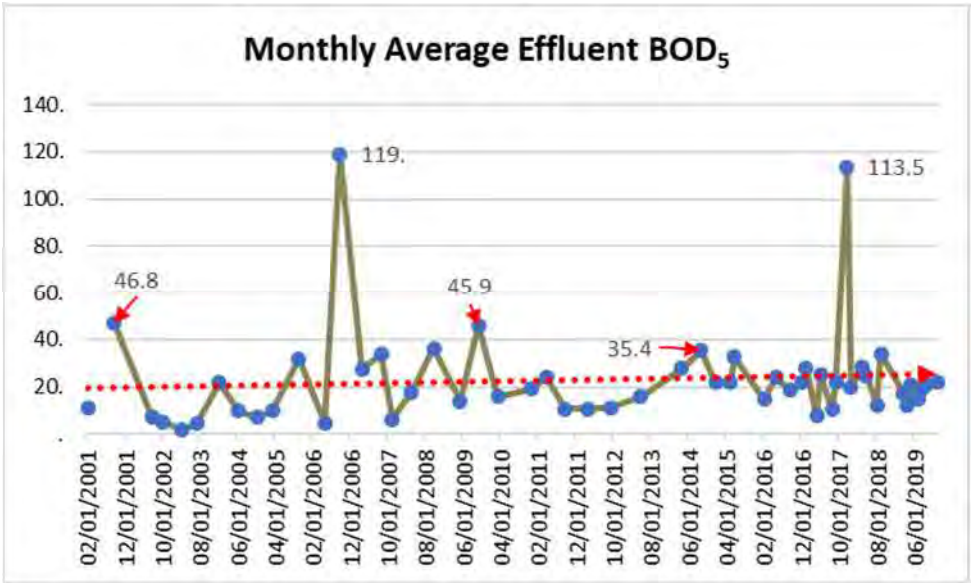
To confirm this fact, a filtered or soluble carbonaceous (SCBOD) test should be performed. SCBOD is a testing procedure where the effluent BOD_5 sample is run and the sample split, so the other half of the BOD sample can be passed through a TSS filter first before running the second BOD test. Comparing the BOD to the Filtered BOD (SBOD) will indicate algae's influence on the BOD test results and prove the need or not to separate algae as part of some tertiary treatment strategy to lower TSS.

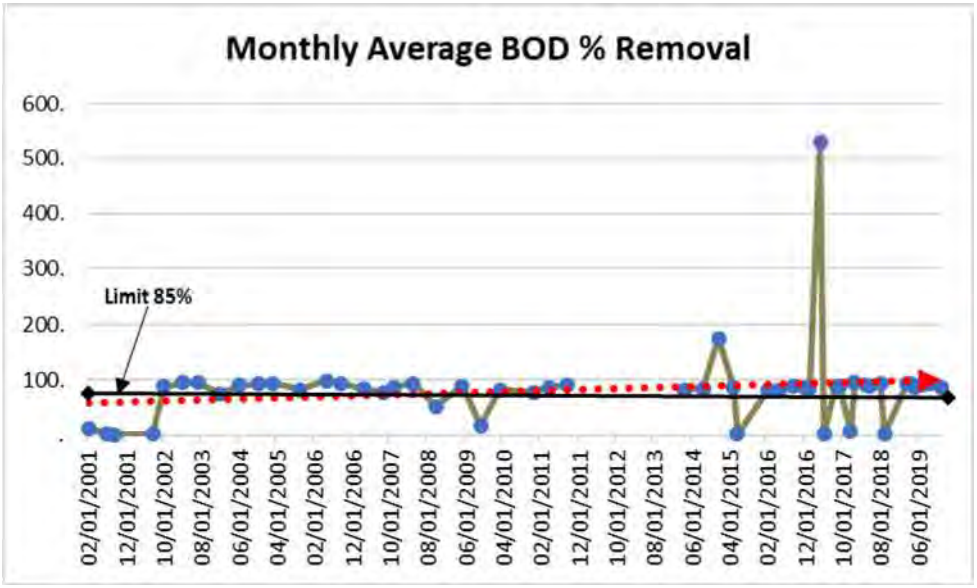
A wastewater lagoon operators' job is to discharge as few algae cells as possible and NO ammonia.

Remember, TSS can be composed of sludge, algae, clay from erosion, duckweed particles or anything else that floats, has mass, and leaves with the effluent.

Section 4 – Data Analysis Cont-







Figures 28, 29, & 30. Monthly Average BOD Concentrations and BOD_5 Percent Removal for the Springdale Wastewaer Pond System

Section 4 – Data Analysis Cont-

There appears to be I&I in the Springdale collection system. The Village of Springdale should continue to work on controlling Infiltration and Inflow into its collection system.

In many cases, the best upgrade to a pond system is made in the collection system. Reducing infiltration and inflow (I&I) will allow for greater retention times, lower pump run times, and perhaps reduced frequencies of discharge. It will also make percent removal permit limits easier to meet. The Rural Water Association of Utah has the equipment and expertise to smoke test collection systems to identify where to reduce storm event flows.

Separately measuring the flow from the Park is in order.

Adding clear water to sewer systems increases the hydraulic load on the system and causes permit percent removal non-compliance because of the dilute influent compared to the treated effluent.

I & I can cause water to flow backward through the sanitary sewer pipe, flooding basements or households and causing manholes to pop open, releasing wastewater onto the streets. As a result of inflow and infiltration, poorly treated wastewater can be discharged to the receiving waters.

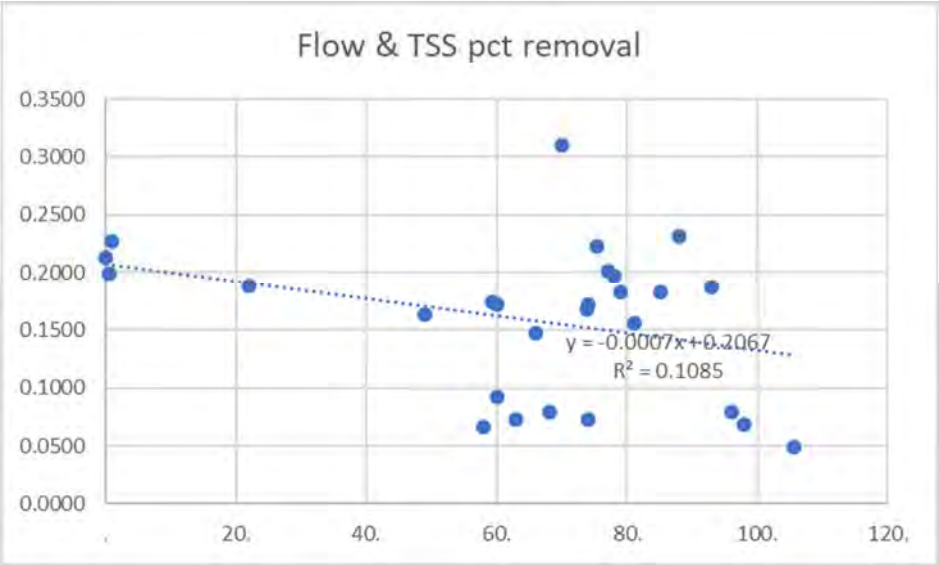
Overflow occurrences put public health at risk and violate state and federal environmental regulations. Sanitary sewer overflows release wastewater and potential pathogens onto streets, into the creek, and basements increasing health risks. As wastewater overflows into creeks, rivers, lakes, and streams, it contaminates the waterways and all organisms coming in contact with the contaminated water.
In many cases, the best upgrade for a lagoon system occurs in the collection system.

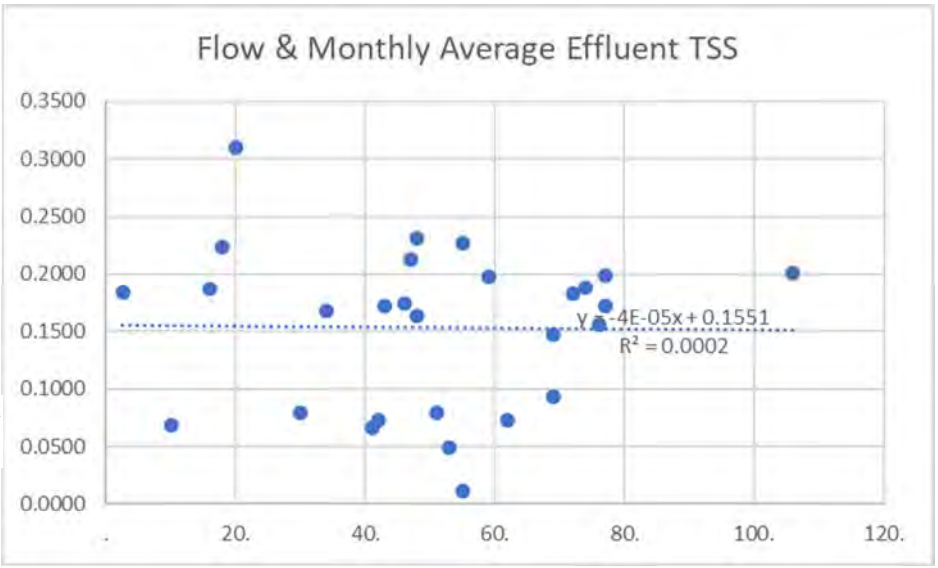
Smoke testing is one of the most efficient and most cost-effective ways to locate and identify the source of an inflow or infiltration problem. It is important to find and identify these sources because they may seriously affect the efficiency of the wastewater treatment facility and increase operating expenses. Some examples of the impact that inflow and infiltration may cause are:

- Pump station handling large volumes of unnecessary water
- Hydraulic overloads that greatly reduce system efficiency by lowering retention times pushing water out
- Increased operating expenses due to the processing of groundwater and stormwater that do not require treatment
- Unnecessary equipment wear. Pump impeller damage due to excess grit pumping.
- Increases collection system maintenance and cleaning" (Nebraska Rural Water Association, See references)

Section 4 – Data Analysis Cont-

Statistically, the flow does not influence TSS percent removal or Effluent TSS to any significant degree, as seen in the two (2) charts below.





Figures 31 & 32. There is no Apparent Relationship Between Flow and TSS

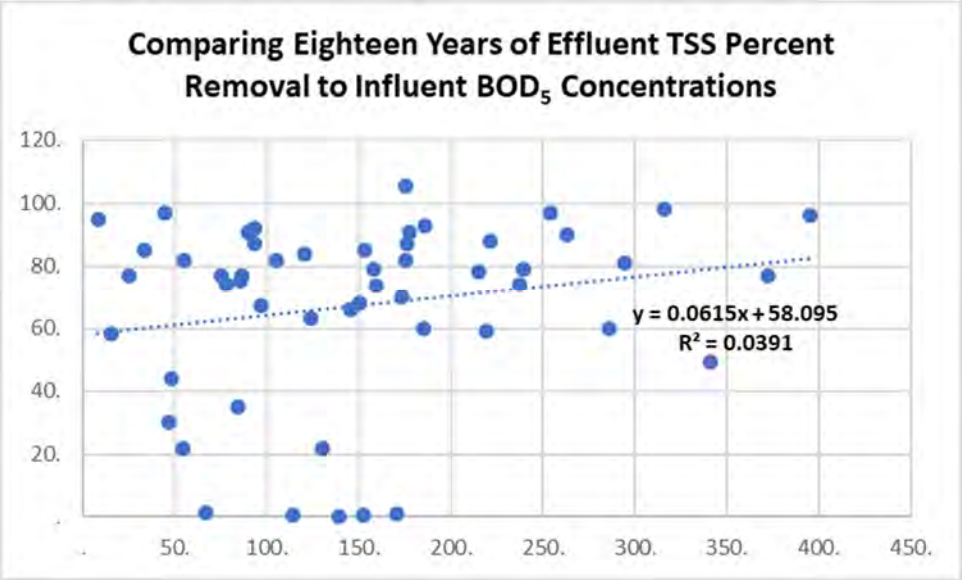
Neither BOD, flow (other than too much of it for Percent Removal Violations), or influent ammonia concentrations seem to affect effluent TSS concentrations or TSS percent removal results.

The closer a data point can fit onto a trend line when evaluating two variables, the more one data point can be used to predict the value of the other. If a data point can fit tightly on a trend line between two variables, to the extent those two variables fit on a shared line, the more the two variables are related.

Statistically, the DMR data points taken over the years are scattered and do not readily fit on a trend line. When looking at effluent TSS and TSS Percent Removal, none of the measured variables are closely related. This lack of correlation suggests some other source influencing effluent TSS and Percent TSS Removal.

If all else can be ruled out, then nutrient feedback from sludge is the only remaining variable that can be causing algae growth (TSS violations). Nutrient feedback from the sludge blanket is challenging to measure directly, but the phosphorus and nitrate feedback measured during field testing suggest sludge removal will help reduce TSS exceedances by controlling the nutrients feeding algae growth.

Section 4 – Data Analysis Cont-



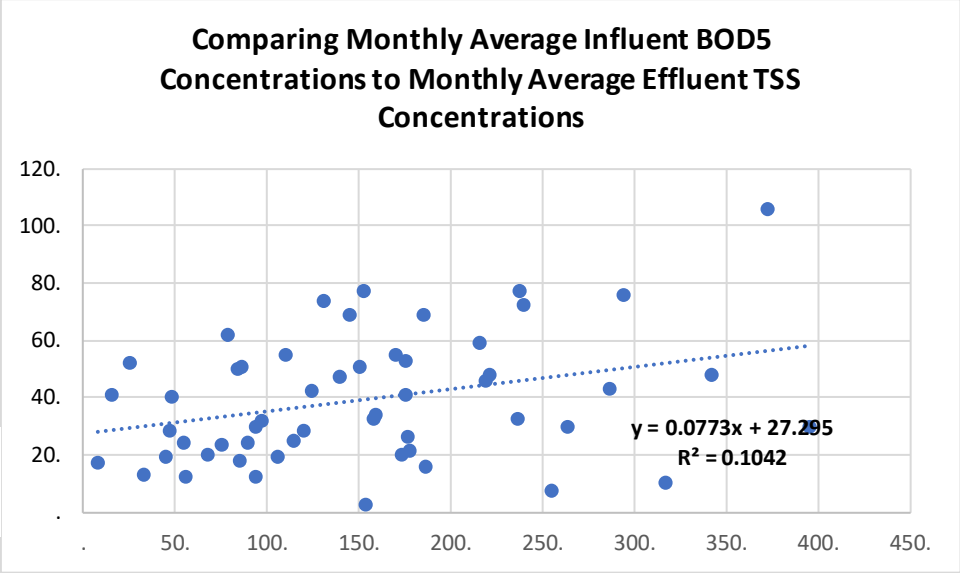


Figure 33 & 34. Regression Analysis Results for Effluent TSS and Percent TSS Removal

Section 4 – Data Analysis Cont-

Sometimes it pays to check and see if the DMR data have been appropriately reported, as seen in the chart below.

Date	TSS Effluent MO Ave	TSS Influent MO Ave	TSS Percent Removal from ECHO	TSS % Removal Calculated by Springdale	Effluent Limt Exceedance Report, US EPA ECHO TSS Percent Removal DMR Value	Limit Value	% Exceedance
5/31/2015	69	201	66	65.67			
6/30/2015	106	466	77	77.25			
2/29/2016	62	240	74	74.17			
5/31/2016	74	96	22	22.92			
9/30/2016	2.6	17.6	85	85.23			
12/31/2016	51	160	68	68.13			
1/31/2017	42	115	63	63.48			
4/30/2017	77	296	74	73.99			
5/31/2017	77	179	0.56	56.98	0.56	85	563
8/31/2017	18	73	75.3	75.34			
9/30/2017	59	268	78	77.99			
12/31/2017	41	99	58	58.59			
1/31/2018	30	880	96	96.59			
4/30/2018	76	404	81	81.19			
5/31/2018	72	354	79	79.66			
8/31/2018	48	419	88	88.54			
9/30/2018	55	370	0.85	85.14	0.85	85	561
12/31/2018	45	90	89.5	50.00			
1/31/2019	43	46	0.07	6.52	0.07	85	566
3/31/2019	10	420	98	97.62			
4/30/2019	16	220	93	92.73			
5/31/2019	47	50	0.06	6.00	0.06	85	566
7/31/2019	20	69	70	71.01			
8/31/2019	43	112	60	61.61			
9/30/2019	48	128	49	62.50			
12/31/2019	69	168	60	58.93			

Figure 35. DMR Data Appearing in ECHO and ICIS has been Entered Improperly

Figure 36. The Final Effluent on the Last Day of Field Sampling

Section 5 – Summary

The Springdale wastewater pond system has faithfully served the Town of Springdale for 24 years. Sludge has been accumulating at a rate of 1.05 inches per year, and now it has accumulated to the point where it should be removed.

The DMR data, the Chemtech Laboratory results, and the field-testing results from January 2020 all seem to suggest that sludge is fueling algae growth for TSS violations.

Fundamentally the pond system at Springdale is healthy and doing a good job. Effluent ammonia, DO, pH, and BOD_5 are excellent and well within permit limits.

During the process of converting ammonia to nitrate and organic matter into bacteria bodies, sludge is formed and must be removed periodically.

The solution for long-term permit limit compliance for the Springdale system is straightforward and includes sludge removal. All other changes to the system, like adding headworks or repairing and rehabilitating the effluent valving system or other improvements, are secondary to removing sludge. A solution to the dilute influent TSS and BOD must be found. A separate flow meter should be installed in the Park collection system to monitor flows.

Section 6 – Conclusions

CONCLUSIONS

The Springdale pond system does an outstanding job of BOD_5 and ammonia removal. Removing the energy driving the robust algae growth is essential to meeting permit limits in a long-term sustained manner. Sludge must be removed, and the source of the dilution of influent BOD and TSS must be found and removed.

Focusing on these two problems and finding solutions to them can help the Springdale wastewater pond system meet permit requirements in a long-term sustained manner.

There is a ***where,* a *when,* and a *why*** to lagoon problem solving and optimization. Determining where treatment is or is not occurring is essential to optimizing the Town of Springdale Utah wastewater lagoon system and keeping this system in compliance over the years to come. Please see Diagnostic BODs in the Appendix and commit to routinely performing these kinds of tests.

Thank you for the opportunity to serve the good people of Springdale, Utah.

Steve Harris
President
H&S Environmental, LLC

Appendix A

Treatment Cell Volume Calculations

Sludge Volume Calculator, Springdale, Utah							
The Lagoon is irregular in shape with 3:1 sloping sides.							
Note: As-Builts show rounded corners and calculations are for square corners. Difference is small and can be ignored as the sludge is uneven.							
Water and Sludge Depth Averages are Used. Length and Width of Cells are Estimated Using Google Earth							
Item	Units	**Cell # 1**	**Plus Cell # 1A (1/2)**	**Plus Cell # 1B**	**Cell # 2**	**Minus Cell # 2 B (1/2)**	**Totals**
Bottom Length	feet	**1175**	**(1/2) 1174**	**237**	**879**	**789**	
Bottom Width	feet	**258**	**(1/2) 221**	**23**	**540**	**94**	
Side Slopes	1 to	**3**	**3**	**3**	**3**	**3**	
Average Sludge Depth	feet	**2.1**	**2.1**	**2.1**	**0.55**	**0.55**	
As-Built Bottom Elevation	feet	**3280.60**	**3280.60**	**3280.60**	**3475.30**	**3475.30**	
As-Built Top-of-Bank Elevation	feet	**3288.72**	**3288.72**	**3288.72**	**3484.72**	**3484.72**	
Bottom Area	sq ft	303,150	129,727	5,451	474,660	42,083	
Top of Sludge Length	feet	1187.6	(1/2) 1186.6	249.6	882.3	(1/2) 792.3	
Top of Sludge Width	feet	270.6	(1/2) 233.6	35.6	543.3	(1/2) 97.3	
Top of Sludge Area	sq ft	321,365	(1/2) 277189.76	8,886	479,354	(1/2) 77090.79	
Sludge Volume	cu ft	655,740	281,738	15,054	262,354	20,798	
Sludge Volume	gallons	4,904,937	2,107,400	112,601	1,962,406	155,568	**9,242,912**
Embankment Height	feet	10.00	10.00	10.00	12.00	12.00	
Freeboard Required	feet	**2**	**2**	**3**	**2**	**2**	
Useable Lagoon Depth Minus Sludge ie. "Water Cap"	feet	6.02	6.02	6.02	8.87	8.87	
Top of Water Max Length	feet	1223	612	285	934	423	
Top of Water Max Width	feet	307	111	72	595	75	
Top of Water Max Area	sq ft	375,461	67,932	20,520	555,730	31,725	
Lagoon Volume	cu ft	2,042,619	594,954	78,173	4,569,780	(327,338)	
Lagoon Volume	gallons	15,278,791	4,450,253	584,732	34,181,952	4,086,542	**58,582,269**
Retention Times Using Existing Water Depths & 145,000 GPD flow. Assuming NO Short-Circuiting	days	**105**	**31**	**4**	**236**	**28**	**404**
Notes:							
Elevations Used are from Alpha Engineering Co, St George, UT January 12, 1996. Using Actual Average Water Depths of 8.12 & 9.42 feet							
This is an Estimate Only Using Averages, Measurements from Google Earth, and Elevations from a Plan Set Before Construction							
Do not use to estimate dredging costs							

Attachments

1) Diagnostic BODs
2) Algae's Contribution to the BOD_5 Test Result
3) The Importance of Mixing Lagoon Sludge Blankets
4) Sludge Removal Chemical Information

References

Environ Microbiol Rep. 2009 Dec;1(6):510-7. doi: 10.1111/j.1758-2229.2009.00058.x. Epub 2009 Jul 31.
Mallard ducks - a waterfowl species with high risk of distributing Escherichia coli pathogenic for humans.
Ewers C1, Guenther S, Wieler LH, Schierack P.

Gomez, E., Paing, J., Casellas, C., Picot, B. (2000) Characterization of phosphorous in sediments from waste stabilization ponds. ***Wat. Sci. Technol.*** Vol 42 Nos 10-11 pp. 257-264

Gronszy, M.C., Bian, Y., Konichi, D., Jogan, M., and Engle, R. (1971) Oxidation reduction potential for nitrogen and phosphorous removal in a fed batch reactor. Paper presented at the 65th WEFTEC conference As quoted form December 1997 Operations Forum, Water Environment Federation 149

Middlebrooks J.E. et al (1999) Nitrogen removal in Wastewater Stabilization Lagoons Presented at the 6th National Drinking water and Wastewater Treatment Technology Transfer Workshop, Kansan Town, Missouri August 2-4, 1999

Middlebrooks, E.J. and Pano, A. (1983) Nitrogen Removal in Aerated Lagoons. ***Water Research,*** 17,10, 1369-1378

The Benefits of Smoke Testing a Collection System, www.nerwa.org/gwnews/jh306.pdfhe Nebraska Rural Water Association

Rich, L.G. (1999) High Performance Aerated Lagoon Systems. American Academy of Environmental Engineers, Annapolis, Maryland. ISBN 1-883767-27-X

Richard, M.G. and Bowman, R. (1991) Troubleshooting the Aerated and Facultative, Waste Treatment Lagoon, Presented at the U.S. EPA's Natural/Constructed Wetlands Treatment Systems Workshop, Denver, CO.

Scott, P.H., Gross, P.M., Baskavan, K. and Connor, M.A. (1994) Experimental Studies for Improved Nitrification in Shallow Lagoon Systems ***Wat.Sci.Technol.*** Vol. 29 No. 4 pp. 325-338

U.S. EPA (1975) Process Design Manual for Nitrogen Control EPA 625/77/007 Washington D.C. U.S. EPA (1993) Nitrogen Control Manual EPA 625/R-93/010

US EPAS, Cincinnati, Ohio Ferrara, R.A. and Avci C.B. (1982) Nitrogen dynamics in waste stabilization ponds. ***J. Wat. Pollut. Control Fed.*** 54(4) 361-369

US EPA Contract No. EP-C-08015 Work Assignment 2-54, Water and energy Audit Report for the Springdale Tribe water and wastewater facilities, final Report 1 December 20, 2010, Prepared by the Cadmus Group, Inc., Watertown, MA

APPENDIX E

SPRINGDALE'S UPDES PERMIT

State of Utah
GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Erica Brown Gaddis, PhD
Director

May 1, 2019

CERTIFIED MAIL
(Return Receipt Requested)

Stanley J. Smith, Mayor
Springdale Town Offices
PO Box 187
118 Lion Blvd
Springdale, UT 84767
VIA EMAIL

Subject: UPDES Permit UT0025224
Springdale Lagoons

Dear Mayor Smith:

Enclosed is a signed copy of the Utah Pollutant Discharge Elimination System (UPDES) Renewal Permit No. UT025224, for the above referenced facility. This permit will become effective on May 1, 2019, subject to the right of appeal in accordance with the provisions of *Utah Administrative Code,* Section R305-7.

As the State agency charged with the administration of issuing UPDES Permits, we are continuously looking for ways to improve our quality of service to you. In an effort to improve the State UPDES permitting process we are asking for your input. Please take a few moments to complete an online survey (Go to https://deq.utah.gov/division-water-quality and click on the "Feedback" link on the right side of page.) The results will be used to improve our quality and responsiveness to our permittees and give us feedback on customer satisfaction. We will address the issues you have identified on an ongoing basis.

If you have any questions regarding this matter, please contact Kelsey Christiansen at (801) 536-4318 or kelseychristiansen@utah.gov.

Sincerely,

Matthew Garn, P.E., Manager
UPDES Surface Water Section

MG/KC/blj

Enclosures (3):
1. Springdale UPDES FSSOB 2019 (DWQ-2018-001103)
2. Springdale UPDES Permit 2019 (DWQ-2018-001104)
3. Springdale WLA 2019 (DWQ-2018-001105)

Cc: Via Email w/Enclosures
Rick Wixom, Town Manager, Town of Springdale
Robert Totten, Public Works Superintendent, Town of Springdale
Amy Clark, EPA Region VIII
DWQ Info and Data Services Section

Via Email w/out Enclosures
Jeremy Roberts, Southwest Public Health Department
Paul Wright, South West Utah District Engineer

DWQ-2019-004062
FILE: UPDES Section 1 & 3

FACT SHEET AND STATEMENT OF BASIS
SPRINGDALE WASTEWATER LAGOONS
RENEWAL PERMIT: DISCHARGE
UPDES PERMIT NUMBER: UT0025224
MINOR MUNICIPAL

FACILITY CONTACTS

Person Name:	Stanley J. Smith
Position:	Mayor
Person Name:	Rick Wixom
Position:	City Manager
Person Name:	Robert Tottem
Position:	Public Works Superintendent
Phone Number:	(435) 243-3686
Facility Name:	Springdale Wastewater Lagoons
Mailing and Facility Address:	Springdale City Offices PO Box 187 118 Lion Blvd Springdale, Utah 84767
Telephone:	(435) 772-6907

DESCRIPTION OF FACILITY

The Springdale Wastewater Lagoons (Springdale) serves the towns of Springdale and Rockville, as well as Zion National Park. This facility was originally designed as a total containment lagoon system, but has expanded to discharge because of growth in the area. The permit to discharge was first issued in 1995. This facility has a total design population equivalent of 4500 people and an influent organic loading of 765 lbs. per day for BOD5 and 900 lbs. a day for TSS. Since this facility discharges as needed, there is not any increase or decrease between wet weather and dry weather flows. This facility has a grinder, two aerated primary cells, and one secondary cell for sedimentation and clarification. The effluent is treated with ultraviolet light for disinfection. The total surface area of the lagoons is 19.38 acres, and has a capacity of 52 million gallons. The average influent design flow is 0.29 MGD. The facility is located in Springdale, Washington County, Utah, with latitude 37°09'45" and longitude 113°04'17", with STORET Number 495088, and outfall 001 discharging to the Virgin River. Springdale only discharges on a periodic basis.

SUMMARY OF CHANGES FROM PREVIOUS PERMIT

1. TMDL Monitoring

Temperature and Boron are being sampled in support of the work being done for the TMDL currently underway for the Virgin River. The Pollutants of Concern (POC) will be monitored and reported, but will not have a limit associated with them. Springdale will report the results of all POC sampling. If Springdale samples more frequently than required in the permit, the additional data will be entered into the DMR.

2. Alternative Limits for Lagoons

Alternative effluent limitations on total suspended solids (TSS), biochemical oxygen demand (BOD5) and percent removal for BOD5 and TSS are being included in the renewal permit. The alternative BOD5 and TSS effluent concentrations limits for discharging domestic wastewater lagoons may be adjusted up to 45 mg/L for a monthly average and 65 mg/L weekly average. This is in accordance with the UAC R317-1-3.2.G. These limits are being included in the permit.

3. Monitoring Changes

The monitoring frequency is being updated to reflect the historic flows and follow the DWQ Monitoring, Recording, and Reporting Guidelines policy. The frequency will be increased from monthly to twice monthly.

With the change in the BOD5 and TSS effluent concentration limits in the permit being justified in part on the high influent concentrations for BOD5 and TSS, and the only data available on those pollutants is during months with a discharge, more influent data will be wanted for evaluation during future renewals. To accomplish this influent monitoring for the facility during months that do not have a discharge will be required at a frequency of once a month.

4. TBPEL Rule

Water Quality adopted UAC R317-1-3.3, Technology-Based Phosphorus Effluent Limit (TBPEL) Rule on December 16, 2014. No TBPEL will be instituted for discharging treatment lagoons. Instead, each discharging lagoon was evaluated to determine the current annual average total phosphorus load measured in pounds per year based on monthly average flow rates and concentrations. Absent field data to determine these loads, and in case of intermittent discharging lagoons, the phosphorus load cap will be estimated by the Director.

The TBPEL discharging treatment works are required to implement, at a minimum, monthly monitoring of the following beginning July 1, 2018:

R317-1-3.3, E, 1, a.	Influent for total phosphorus (as P) and total Kjeldahl nitrogen (as N) concentrations;
R317-1-3.3, E, 1, b.	Effluent for total phosphorus and orthophosphate (as P), ammonia, nitrate-nitrite and total Kjeldahl nitrogen (an N);

In R317-1-3.3, E, 3 the rule states that all monitoring shall be based on 24-hour composite samples by use of an automatic sampler or a minimum of four grab samples collected a minimum of two hours apart.

A cap of 125% of the current annual total phosphorus load has been established and is referred to as phosphorus loading cap. It is the intent of *UAC R317-3.3.B* to provide capacity for growth within your facility's service area by setting the loading cap at 125 percent of your current annual total phosphorus load. Springdale's current annual total phosphorus load was calculated based on the data reported on your monthly discharge monitoring reports.

The permit was modified to include the new phosphorus loading cap. Springdale's phosphorus loading cap is 3,490 lbs/year and the modified permit went into effect July 1, 2018.

The phosphorus annual loading cap is defined as

"Annual Loading Cap" is the highest allowable phosphorus loading discharged over a calendar year, calculated as the sum of all the monthly loading discharges measured during a calendar year divided by the number of monthly discharges measured during that year.

The reported monthly loading is calculated as shown here;

$$Monthyl\ Mass\ Loading, \frac{lbs}{Month}$$
$$= (Ave\ Flow) * (Ave\ Concetration) * \left(8.34 \frac{lbs}{gal}\right) * \left(\frac{Days\ Discharged}{Month}\right)$$

The annual total phosphorus loading

$$Annual\ Mass\ Loading, lbs = Sum\ \left(Monthyl\ Mass\ Loading, \frac{lbs}{Month}\right)$$

Once the lagoon's phosphorus loading cap has been reached, the owner of the facility will have five years to construct treatment processes or implement treatment alternatives to prevent the total phosphorus loading cap from being exceeded.

The permit effluent limits will incorporate the following change as a result of the phosphorus loading cap:

Parameter	Effluent Limitations				
	Maximum Monthly Avg	Maximum Weekly Avg	lbs./Year	Daily Minimum	Daily Maximum
Total Phosphorus, lbs	-	-	3,490	-	-

DISCHARGE

DESCRIPTION OF DISCHARGE

The wastewater treatment plant has one discharge point, known as 001. This 001 outfall has a latitude 37°09'45" and longitude 113°04'17". The discharge is an eight inch green PVC pipe discharging directly to the Virgin River. The average flow over the last thirty six months is 0.284 MGD per day.

Outfall	Description of Discharge Point
001	Located at latitude 37°09'45" and longitude 113°04'17". The discharge is an eight inch green PVC pipe discharging directly to the Virgin River.

RECEIVING WATERS AND STREAM CLASSIFICATION

The Virgin River is classified as a Class 1C, 2B, 3C and 4 according to *Utah Administrative Code (UAC) R317-2-13*:

Class 1C -- Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water

Class 2B -- Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.

Class 3C -- Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.

Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

BASIS FOR EFFLUENT LIMITATIONS

Limitations on total suspended solids (TSS), biochemical oxygen demand (BOD5), *E. coli*, pH and percent removal for BOD5 and TSS are based on current Utah Secondary Treatment Standards, UAC R317-1-3.2. The oil and grease is based on best professional judgment (BPJ). Attached is a Wasteload Analysis for this discharge into the Virgin River. It has been determined that this discharge will not cause a violation of water quality standards. An Antidegradation Level II review is not required since the Level I review shows that water quality impacts are minimal. The permittee is expected to be able to comply with these limitations.

Total dissolved solids (TDS) limitations are based upon Utah Water Quality Standards for concentration values and the Colorado River Basin Salinity Control Forum (CRBSCF) for mass loading values when applicable as authorized in *UAC R317-2-4*. CRBSCF has established a policy for the reasonable increase of salinity for municipal discharges to any portion of the Colorado River stream system that has an impact on the lower main stem. The CRBSCF Policy entitled "NPDES Permit Program Policy for Implementation of Colorado River Salinity Standards" (Policy), with the most current version dated October 2017, states that the incremental increase in salinity shall be 400 mg/L or less, which is considered to be a reasonable incremental increase above the flow weighted average salinity of the intake water supply.

Reasonable Potential Analysis

Since January 1, 2016, DWQ has conducted reasonable potential analysis (RP) on all new and renewal applications received after that date. RP for this permit renewal was conducted following DWQ's September 10, 2015 Reasonable Potential Analysis Guidance (RP Guidance). There are four outcomes defined in the RP Guidance: Outcome A, B, C, or D. These Outcomes provide a frame work for what routine monitoring or effluent limitations are required

Springdale has not monitored for metals in the past. As a result there is no data to evaluate in a RP analysis. Springdale does not have an approved pretreatment program, does not have any industrial users contributing pollutants, and has a discharge that is less than 1 MGD and is therefore not required to sample metals according to the UPDES Pretreatment Guidance for Sampling of POTWs. Therefore there is a low probability of RP for metals to cause a violation of a WQBEL or subsequent downstream water quality standard for the Virgin River as a result of the discharge.

The permit limitations are;

Parameter	Effluent Limitations[1]				
	Maximum Monthly Avg	Maximum Weekly Avg	lbs./Year	Daily Minimum	Daily Maximum
Total Flow	0.29	-	-	-	-
BOD_5, mg/L	45	65	-	-	-
BOD_5 Min. % Removal	85	-	-	-	-
TSS, mg/L	45	65	-	-	-
TSS Min. % Removal	85	-	-	-	-
Dissolved Oxygen, mg/L	-	-	-	4.0	-
E. coli, No./100mL	126	158	-	-	-
Total Phosphorous, lbs/year	-	-	3,490	-	-
pH, Standard Units	-	-	-	6.5	9

[1] See Definitions, Part VIII, for definition of terms.

Parameter	Effluent Limitations[1]				
	Maximum Monthly Avg	Maximum Weekly Avg	lbs./Year	Daily Minimum	Daily Maximum
TDS, mg/L[2]	<400 Increase	-	-	-	-

SELF-MONITORING AND REPORTING REQUIREMENTS

The following self-monitoring requirements have been modified and updated from the previous permit. The frequency of monitoring has been adjusted to reflect the DWQ Guidance. A requirement for influent monitoring for BOD5 and TSS during non-discharging months has been added to the permit. It now includes monitoring requirements for TBPEL and 303d impairment listed (TMDL) parameters. The permit will require reports to be submitted monthly and annually, as applicable, on Discharge Monitoring Report (DMR) forms due 28 days after the end of the monitoring period. Effective January 1, 2017, monitoring results must be submitted using NetDMR unless the permittee has successfully petitioned for an exception. Lab sheets for biomonitoring must be attached to the biomonitoring DMR. Lab sheets for metals and toxic organics must be attached to the DMRs.

Self-Monitoring and Reporting Requirements[1]			
Parameter	Minimum Frequency	Sample Type	Units
Total Flow[3], [4]	Continuous	Recorder	MGD
BOD_5, Influent[5]	2 x Monthly	Composite	mg/L
Effluent	2 x Monthly	Composite	mg/L
TSS, Influent[5]	2 x Monthly	Composite	mg/L
Effluent	2 x Monthly	Composite	mg/L
E. coli	2 x Monthly	Grab	No./100mL
pH	2 x Monthly	Grab	SU
Ammonia	2 x Monthly	Grab	mg/L
DO	2 x Monthly	Grab	mg/L
TDS[6], Effluent	Quarterly	Grab	mg/L
Source Water	Quarterly	Grab	mg/L
Boron[7]	2 x Monthly	Composite	mg/L
Temperature[7]	2 x Monthly	Grab	ºC

TBPEL Rule Monitoring and Reporting Requirements[1, 8]			
Parameter	Minimum Frequency	Sample Type	Units
Total Ammonia (as N)	Monthly	Composite	mg/L

[2] The effluent shall not exceed the culinary source water intake by more than 400 mg/L of TDS or the permittee could request 1 ton/day salt loading, or 366 tons/year.

[3] Flow measurements of influent/effluent volume shall be made in such a manner that the permittee can affirmatively demonstrate that representative values are being.

[4] If the rate of discharge is controlled, the rate and duration of discharge shall be reported.

[5] In addition to monitoring the final discharge, influent samples shall be taken and analyzed for this constituent at the same frequency as required for this constituent in the discharge. During months where a discharge will not occur influent samples shall be taken and analyzed for this constituent at a minimum frequency of once per month.

[6] The effluent shall not exceed the culinary source water intake by more than 400 mg/L of TDS or the permittee could request 1 ton/day salt loading, or 366 tons/year.

[7] Temperature and Boron are being sampled in support of the work being done for the TMDL currently underway for the Virgin River. The Pollutants Of Concern (POC) will be monitored and reported, but will not have a limit associated with them.

[8] These reflect changes required with the adoption of UCA R317-1-3.3, Technology-based Phosphorus Effluent Limits rule.

TBPEL Rule Monitoring and Reporting Requirements[1, 8]			
Parameter	Minimum Frequency	Sample Type	Units
Orthophosphate, (as P) Effluent	Monthly	Composite	mg/L
Phosphorus, Total Influent Effluent	Monthly Monthly	Composite Composite	mg/L mg/L
Total Kjeldahl Nitrogen, TKN (as N) Influent Effluent	Monthly Monthly	Composite Composite	mg/L mg/L
Nitrate, NO3	Monthly	Composite	mg/L
Nitrite, NO2	Monthly	Composite	mg/L

BIOSOLIDS

The State of Utah has adopted the *40 CFR 503* federal regulations for the disposal of sewage sludge (biosolids) by reference. However, since this facility is a lagoon, there is not any regular sludge production. Therefore, *40 CFR 503* does not apply at this time. In the future, if the sludge needs to be removed from the lagoons and is disposed in some way, the Division of Water Quality must be contacted prior to the removal of the sludge to ensure that all applicable state and federal regulations are met.

STORM WATER

STORMWATER REQUIREMENTS

The Utah Administrative Code (UAC) R-317-8-3.9 requires storm water permit provisions to include the development of a storm water pollution prevention plan for waste water treatment facilities if the facility meets one or both of the following criteria.

1. Waste water treatment facilities with a design flow of 1.0 MGD or greater, and/or,
2. Waste water treatment facilities with an approved pretreatment program as described in 40CFR Part 403,

Springdale, does not meet either of the above criteria; therefore this permit does not include storm water provisions. The permit does however include a storm water re-opener provision.

PRETREATMENT REQUIREMENTS

The permittee has not been designated for pretreatment program development because it does not meet conditions which necessitate a full program. The flow through the plant is less than five (5) MGD and there are no categorical industries discharging to the treatment facility. Based on the information provided, by the wastewater operator for the City, the lagoon system has not experienced interference in the last three years. The facility has had violations of permit limits in the last three years for BOD_5, TSS, e-coli and percent removal for BOD_5 and TSS. With the data currently available it is unknown if pass through has occurred. The violations for TSS and the percent removal have been ongoing without a determination of the cause for the violations. With the additional influent sampling and sampling procedures being composite rather than grab a better understanding of loading will be available to the

POTW. If violations of TSS continue the facility must investigate the violations. If it is determine that violations are occurring due to industrial users or dischargers from campgrounds operational changes may need to occur to prevent the violations from continuing.

Although the permittee does not have to develop an approved pretreatment program, any wastewater discharges to the sanitary sewer from industrial users are subject to Federal, State and local regulations. Pursuant to Section 307 of the Clean Water Act, the permittee shall comply with all applicable Federal General Pretreatment Regulations promulgated, found in 40 CFR 403 and the State Pretreatment Requirements found in UAC R317-8-8.

An industrial waste survey (IWS) is required of the permittee as stated in Part II of the permit. The IWS is to assess the needs of the permittee regarding pretreatment assistance. The IWS is required to be submitted within sixty (60) days after the issuance of the permit. If an industrial user begins to discharge or an existing industrial user changes their discharge the permittee must resubmit an IWS no later than sixty days following the introduction or change as stated in Part II of the permit.

Due to the facility's design capacity being less than one MGD sampling for pretreatment requirements will not be required at this time. If the facility determines local limits are needed sampling will be needed at a frequency necessary to determine headworks loadings for the parameter(s) of concern. It is required that the permittee submit for review any local limits that are developed to the Division of Water Quality for review. If local limits are developed it is required that the permittee perform an annual evaluation of the need to revise or develop technically based local limits for pollutants of concern, to implement the general and specific prohibitions *40 CFR, Part 403.5(a)* and *Part 403.5(b)*. This evaluation may indicate that present local limits are sufficiently protective, need to be revised or should be developed.

BIOMONITORING REQUIREMENTS

A nationwide effort to control toxic discharges where effluent toxicity is an existing or potential concern is regulated in accordance with the Utah Pollutant Discharge Elimination System Permit and Enforcement Guidance Document for Whole Effluent Toxicity Control (biomonitoring) dated February 2018. Authority to require effluent biomonitoring is provided in Permit Conditions, UAC R317-8-4.2, Permit Provisions, UAC R317-8-5.3 and Water Quality Standards, UAC R317-2-5 and R317 -2-7.2.

The permittee is a minor municipal facility that will be infrequently discharging a minimal amount of effluent, in which toxicity is neither an existing concern, nor likely to be present Based on these considerations, and the absence of receiving stream water quality monitoring data, there is no reasonable potential for toxicity in the permittee's discharge (per State of Utah Permitting and Enforcement Guidance Document for WET Control). As such, there will be no numerical WET limitations or WET monitoring requirements in this permit. However, the permit will contain a toxicity limitation re-opener provision that allows for modification of the permit should additional information indicate the presence of toxicity in the discharge.

PERMIT DURATION

It is recommended that this permit be effective for a duration of five (5) years.

Drafted by
Daniel Griffin, Discharge, Reasonable Potential Analysis
Jennifer Robinson, Pretreatment
Lonnie Shull, Biomonitoring
Michael George, Storm Water
Nick von Stackelberg, Wasteload Analysis
Utah Division of Water Quality, (801) 536-4300

PUBLIC NOTICE

Began: March 18, 2019
Ended: April 17, 2019

Comments will be received at: 195 North 1950 West
PO Box 144870
Salt Lake City, UT 84114-4870

The Public Noticed of the draft permit was published in the Daily Spectrum-Washington County Edition.

During the public comment period provided under R317-8-6.5, any interested person may submit written comments on the draft permit and may request a public hearing, if no hearing has already been scheduled. A request for a public hearing shall be in writing and shall state the nature of the issues proposed to be raised in the hearing. All comments will be considered in making the final decision and shall be answered as provided in R317-8-6.12.

ADDENDUM TO FSSOB

During finalization of the Permit certain dates, spelling edits and minor language corrections were completed. Due to the nature of these changes they were not considered Major and the permit is not required to be re Public Noticed.

Responsiveness Summary

No Comments were received during the Public Notice Period. Therefore it is recommended that the permit be issued as drafted.

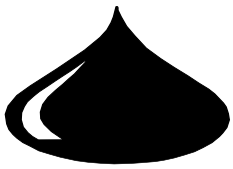
This Page Intentionally Left Blank

ATTACHMENT 1

Industrial Waste Survey

This Page Intentionally Left Blank

Industrial Pretreatment Wastewater Survey



Do you periodically experience any of the following treatment works problems:

foam, floaties or unusual colors
plugged collection lines caused by grease, sand, flour, etc.
discharging excessive suspended solids, even in the winter
smells unusually bad
waste treatment facility doesn't seem to be treating the waste right

Perhaps the solution to a problem like one of these may lie in investigating the types and amounts of wastewater entering the sewer system from industrial users.

An industrial user (IU) is defined as a non-domestic user discharging to the waste treatment facility which meets any of the following criteria:

1. **has a lot of process wastewater (5% of the flow at the waste treatment facility or more than 25,000 gallons per work day.)**

   Examples: Food processor, dairy, slaughterhouse, industrial laundry.

2. **is subject to Federal Categorical Pretreatment Standards**;

   Examples: metal plating, cleaning or coating of metals, bluing of metals, aluminum extruding, circuit board manufacturing, tanning animal skins, pesticide formulating or packaging, and pharmaceutical manufacturing or packaging,

3. **is a concern to the POTW.**

   Examples: septage hauler, restaurant and food service, car wash, hospital, photo lab, carpet cleaner, commercial laundry.

All users of the water treatment facility are **prohibited** from making the following types of discharges:

1. A discharge which creates a fire or explosion hazard in the collection system.

2. A discharge which creates toxic gases, vapor or fumes in the collection system.

3. A discharge of solids or thick liquids which creates flow obstructions in the collection system.

4. An acidic discharge (low pH) which causes corrosive damage to the collection system.

5. Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause problems in the collection system or at the waste treatment facility.

6. Waste haulers are prohibited from discharging without permission. (No midnight dumping!)

When the solution to a sewer system problem may be found by investigating the types and amounts of wastewater entering the sewer system discharged from IUs, it's appropriate to conduct an Industrial Waste Survey.

An Industrial Waste Survey consists of:

Step 1: Identify Industrial Users

Make a list of all the commercial and industrial sewer connections.

Sources for the list:

business license, building permits, water and wastewater billing, Chamber of Commerce, newspaper, telephone book, yellow pages.

Split the list into two groups:

domestic wastewater only--no further information needed
everyone else (IUs)

Step 2: Preliminary Inspection

Go visit each IU identified on the "everybody else" list.

Fill out the **Preliminary Inspection Form** during the site visit.

Step 3: Informing the State

Please fax or send a copy of the Preliminary inspection form (both sides) to:

Jennifer Robinson

Division of Water Quality
288 North 1460 West
PO Box 144870
Salt Lake City, UT 84114-4870

Phone: (801) 536-4383
Fax: (801) 536-4301
E-mail: jenrobinson@utah.gov

PRELIMINARY INSPECTION FORM

INSPECTION DATE ___ / ____ /

Name of Business **Person Contacted** _____
Address _____ **Phone Number** _____

_____

Description of Business _____

Principal product or service: _____

Raw Materials used: _____

_____

Production process is: [ ] Batch [ ] Continuous [ ] Both

Is production subject to seasonal variation? [ ] yes [ ] no
If yes, briefly describe seasonal production cycle.

_____

This facility generates the following types of wastes (check all that apply):

1. [ ] Domestic wastes (Restrooms, employee showers, etc.)
2. [ ] Cooling water, non-contact
3. [ ] Boiler/Tower blowdown
4. [ ] Cooling water, contact
5. [ ] Process
6. [ ] Equipment/Facility wash-down
7. [ ] Air Pollution Control Unit
8. [ ] Storm water runoff to sewer
9. [ ] Other describe

Wastes are discharged to (check all that apply):

[ ] Sanitary sewer **[ ] Storm sewer**
[ ] Surface water **[ ] Ground water**
[ ] Waste haulers **[ ] Evaporation**
[ ] Other (describe)
Name of waste hauler(s), if used

_____

Is a grease trap installed? Yes No
Is it operational? Yes No

Does the business discharge a lot of process wastewater?

- **More than 5% of the flow to the waste treatment facility? Yes No**
- **More than 25,000 gallons per work day? Yes No**

Does the business do any of the following:

[ ] Adhesives
[ ] Aluminum Forming
[ ] Battery Manufacturing
[ ] Copper Forming
[ ] Electric & Electronic Components
[ ] Explosives Manufacturing
[ ] Foundries
[ ] Inorganic Chemicals Mfg. or Packaging
[ ] Industrial Porcelain Ceramic Manufacturing
[ ] Iron & Steel
[ ] Metal Finishing, Coating or Cleaning
[ ] Mining
[ ] Nonferrous Metals Manufacturing
[ ] Organic Chemicals Manufacturing or Packaging
[ ] Paint & Ink Manufacturing
[ ] Pesticides Formulating or Packaging
[ ] Petroleum Refining
[ ] Pharmaceuticals Manufacturing or Packaging
[ ] Plastics Manufacturing
[ ] Rubber Manufacturing
[ ] Soaps & Detergents Manufacturing
[ ] Steam Electric Generation
[ ] Tanning Animal Skins
[ ] Textile Mills

[ ] Car Wash
[ ] Carpet Cleaner
[ ] Dairy
[ ] Food Processor
[ ] Hospital
[ ] Laundries
[ ] Photo Lab
[ ] Restaurant & Food Service
[ ] Septage Hauler
[ ] Slaughter House

Are any process changes or expansions planned during the next three years? Yes No
If yes, attach a separate sheet to this form describing the nature of planned changes or expansions.

_____
Inspector

_____
Waste Treatment Facility

Please send a copy of the preliminary inspection form (both sides) to:

Jennifer Robinson
Division of Water Quality
PO Box 144870
Salt Lake City, Utah 84114-4870

Phone: **(801) 536-4383**
Fax: **(801) 536-4301**
E-Mail: **jenrobinson@utah.gov**

	Industrial User	Jurisdiction	SIC Codes	Categorical Standard Number	Total Average Process Flow (gpd)	Total Average Facility Flow (gpd)	Facility Description
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

This Page Intentionally Left Blank

ATTACHMENT 2

Effluent Monitoring Data

This Page Intentionally Left Blank

Effluent Monitoring Data.

Month	Flow	pH	BOD	TSS	Ammonia	O & G	TDS	DO	E. coli
	MGD	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	#/100mL
Oct-15	ND								
Nov-15	ND								--
Dec-15	ND								--
Jan-16	ND								--
Feb-16	0.45	8.43	14.8	62	5.3	0	1070	5	41.4
Mar-16	ND								--
Apr-16	ND								--
May-16	0.45	8.95	24	74	0	0	1050	5	2419
Jun-16	ND								--
Jul-16	ND								--
Aug-16	ND								--
Sep-16	0.45	8.42	18.5	2.6	4.3	0	1220	5	17.3
Oct-16	ND								--
Nov-16	ND								--
Dec-16	0.4	8.38	22	51	0.4	0	1125	6	41
Jan-17	0.28	8.5	28.1	42	0.4	0	1050	5	2
Feb-17	ND								--
Mar-17	ND								
Apr-17	0.29	9.12	7.71	77	0	0	900	5	4.1
May-17	0.29	8.9	25	77	0.7	0	1040	5	13.2
Jun-17	ND								--
Jul-17	ND								--
Aug-17	0.29	8.34	10.4	18	5.3	0	1070	5	4.1
Sep-17	0.29	8.9	22	59	4.2	0	1060	5	8.6
Oct-17	ND								--
Nov-17	ND								--
Dec-17	0.28	8.61	113.5	41	0.2	0	1100	5	4.1
Jan-18	0.28	8.79	19.7	30	0.2	0	1060	5	3
Feb-18	ND								--
Mar-18	ND								--
Apr-18	0.28	8	28.3	76	0.2	0	1030	5	43.2
May-18	0.28	9.1	24.8	72	0.4	0	1055	5	44.3
Jun-18	ND								--
Jul-18	ND								--
Aug-18	0.29	8.38	12.3	48	2.4	0	1180	5	48
Sep-18	0.29	8.55	34	55	3.3	0	1140	5	2419
Oct-18	ND								--

TBPEL Results

	Influent		Effluent			
Month	TKN	Tot P	NH3 + NO2	Ortho P	TKN	Tot P
Oct-15						
Nov-15						
Dec-15						
Jan-16						
Feb-16	57	8.4	2	5.6	10	6.3
Mar-16						
Apr-16						
May-16	53	5	2.3	3.8	7	5.3
Jun-16						
Jul-16						
Aug-16						
Sep-16	54	4.6	0	2.9	9	3.9
Oct-16						
Nov-16						
Dec-16	45	6	2.4	5.7	8.1	6.1
Jan-17	60.7	6.7	2.5	5.4	6.2	5.8
Feb-17						
Mar-17						
Apr-17	75.3	11	0.4	3	5.1	2.9
May-17	48	5.1	0.9	1.6	4	3.1
Jun-17						
Jul-17						
Aug-17	38.1	4.3	0	3.5	9.5	4.1
Sep-17	60.3	24	0	5.2	10.6	5
Oct-17						
Nov-17						
Dec-17	4.4	6.9	2.6	6.3	6	7
Jan-18						
Feb-18						
Mar-18						
Apr-18						
May-18						
Jun-18						
Jul-18						
Aug-18	7.6	8	0	1.8	70.8	2.6
Sep-18	91.8	8.9	0.2	2.6	8.4	5.1
Oct-18						

ATTACHMENT 3

Wasteload Analysis

Utah Division of Water Quality
Statement of Basis
ADDENDUM
Wasteload Analysis and Antidegradation Level I Review

Date: **January 24, 2019**

Prepared by: **Dave Wham**
Standards and Technical Services

Facility: **Springdale Wastewater Lagoons**
UPDES No. UT-025224

Receiving water: **Virgin River (1C, 2B, 3C, 4)**

This addendum summarizes the wasteload analysis that was performed to determine water quality based effluent limits (WQBEL) for this discharge. Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses (UAC R317-2-8). Projected concentrations are compared to numeric water quality standards to determine acceptability. The numeric criteria in this wasteload analysis may be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

Discharge

Outfall 001: Virgin River

The maximum monthly average design flow for the facility is 0.29 MGD (0.54 cfs).

Receiving Water
The receiving water for Outfall 001 is the Virgin River.

Per UAC R317-2-13.2(a), the designated beneficial uses for the Virgin River and tributaries from the Quail Creek Diversion to headwaters (with exceptions) are 1C, 2B, 3C and 4.

- *Class 1C -- Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water*

- *Class 2B - Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.*

- *Class 3C - Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.*

- *Class 4 - Protected for agricultural uses including irrigation of crops and stock watering.*

Critical Low Flow

Typically, the critical flow for the wasteload analysis is considered the lowest stream flow for seven consecutive days with a ten year return frequency (7Q10). The 7Q10 was calculated using daily average flow values from USGS station #09406000 Virgin River at Virgin, UT for the period 1999-2018. Receiving water quality was characterized using data from DWQ Monitoring Station #4950850, Virgin River 1 Mile East of Virgin for the period 2001-2013.

The calculated annual 7Q10 is 49.5 cfs.

Both of the above monitoring stations are below Springdale's discharge location. However, review of available stations and data led to the conclusion that they are the most appropriate sites to characterize the receiving water. Upstream stations on the Virgin River are upstream of the confluence with major tributaries (East Fork of the Virgin River). Discharge data from Springdale's Lagoons indicate that they discharge on a very intermittent basis (on the order of 4 times per year). Additionally, the lagoon discharge rate (.45 cfs) is very small compared to the receiving water flow (even at critical low flow of 49.5 cfs). Given these factors, it is unlikely that downstream data is significantly influence by the lagoon discharge.

TMDL

According to DWQ's 2016 303(d) Assessment, the Virgin River and tributaries from North Creek confluence to North Fork Virgin River (Assessment Unit UT15010008-012_00), is fully supporting its beneficial uses.

Mixing Zone

The maximum allowable mixing zone is 15 minutes of travel time for acute conditions, not to exceed 50% of stream width, and 2,500 feet for chronic conditions, per UAC R317-2-5. Water quality standards must be met at the end of the mixing zone.

Modeling results show that the effluent was totally mixed with the receiving water within the chronic mixing zone. Acute limits were calculated using 50% of the seasonal critical low flow.

Parameters of Concern

No specific parameters of concern were identified by based on review of the past permit and the impairment status of the receiving water. Addition parameters of concern may become apparent as a result of reasonable potential analysis, technology based standards, or other factors as determined by the UPDES Permit Writer.

WET Limits

The percent of effluent in the receiving water in a fully mixed condition, and acute and chronic dilution in a not fully mixed condition are calculated in the WLA in order to generate WET

limits. The LC_{50} (lethal concentration, 50%) percent effluent for acute toxicity and the IC_{25} (inhibition concentration, 25%) percent effluent for chronic toxicity, as determined by the WET test, needs to be below the WET limits, as determined by the WLA. The WET limit for LC_{50} is typically 100% effluent and does not need to be determined by the WLA.

Table 1: WET Limits for IC_{25}

Outfall	Percent Effluent
Outfall 001	0.9%

Wasteload Allocation Methods

Effluent limits were determined for conservative constituents using a simple mass balance mixing analysis (UDWQ 2012). The mass balance analysis is summarized in the Wasteload Addendum.

The water quality standard for chronic ammonia toxicity is dependent on temperature and pH, and the water quality standard for acute ammonia toxicity is dependent on pH. The AMMTOX Model developed by University of Colorado and adapted by Utah DWQ and EPA Region VIII was used to determine ammonia effluent limits (Lewis et al. 2002). The analysis is summarized in the Wasteload Addendum.

Models and supporting documentation are available for review upon request.

Antidegradation Level I Review

The objective of the Level I ADR is to ensure the protection of existing uses, defined as the beneficial uses attained in the receiving water on or after November 28, 1975. No evidence is known that the existing uses deviate from the designated beneficial uses for the receiving water. Therefore, the beneficial uses will be protected if the discharge remains below the WQBELs presented in this wasteload.

A Level II Antidegradation Review (ADR) is not required for this facility. The proposed permit is a simple renewal, with no increase in flow or concentration over that which was approved in the existing permit.

Documents:

WLA Document: *Springdale_WLADoc_1-24-19.docx*
Wasteload Analysis and Addendum: *Springdale_WLA_1-25-19.xls*

References:

Utah Division of Water Quality. 2012. *Utah Wasteload Analysis Procedures Version 1.0.*

Lewis, B., J. Saunders, and M. Murphy. 2002. *Ammonia Toxicity Model (AMMTOX, Version2): A Tool for Determining Effluent Ammonia Limits.* University of Colorado, Center for Limnology.

WASTELOAD ANALYSIS [WLA]
Addendum: Statement of Basis
SUMMARY

Discharging Facility:	**Springdale Lagoons**			
UPDES No:	UT-025224			
Design Flow	0.29	MGD		

Receiving Water:	**Springdale_WLA_1-25-19.xls**		
Stream Classification:	1C, 2B, 3C, 4		
Stream Flows [cfs]:	49.50	Summer (July-Sept)	7Q10
	49.50	Fall (Oct-Dec)	7Q10
	49.50	Winter (Jan-Mar)	7Q10
	49.50	Spring (Apr-June)	7Q10
	0.0	Average	
Stream TDS Values:	480.8	Summer (July-Sept)	Average
	492.2	Fall (Oct-Dec)	Average
	457.3	Winter (Jan-Mar)	Average
	512.2	Spring (Apr-June)	Average

Effluent Limits:				**WQ Standard:**
Flow, MGD:	0.29	MGD	Design Flow	
BOD, mg/l:	35.0	Summer	5.0	Indicator
Dissolved Oxygen, mg/l	4.0	Summer	5.0	30 Day Average
TNH3, Chronic, mg/l:	108.0	Summer	Varies	Function of pH and Temperature
TDS, mg/l:	80553.6	Summer	1200.0	

Modeling Parameters:	
Acute River Width:	50.0%
Chronic River Width:	100.0%

Level 1 Antidegradation Level Completed: Level II Review not required.

Date: 1/25/2019

WASTELOAD ANALYSIS [WLA]
Addendum: Statement of Basis

25-Jan-19
4:00 PM

Facilities: **Springdale Lagoons** **UPDES No: UT-025224**
Discharging to: **Springdale_WLA_1-25-19.xls**

THIS IS A DRAFT DOCUMENT

I. Introduction

Wasteload analyses are performed to determine point source effluent limitations necessary to maintain designated beneficial uses by evaluating projected effects of discharge concentrations on in-stream water quality. The wasteload analysis also takes into account downstream designated uses [R317-2-8, UAC]. Projected concentrations are compared to numeric water quality standards to determine acceptability. The anti-degradation policy and procedures are also considered. The primary in-stream parameters of concern may include metals (as a function of hardness), total dissolved solids (TDS), total residual chlorine (TRC), un-ionized ammonia (as a function of pH and temperature, measured and evaluated interms of total ammonia), and dissolved oxygen.

Mathematical water quality modeling is employed to determine stream quality response to point source discharges. Models aid in the effort of anticipating stream quality at future effluent flows at critical environmental conditions (e.g., low stream flow, high temperature, high pH, etc).

The numeric criteria in this wasteload analysis may always be modified by narrative criteria and other conditions determined by staff of the Division of Water Quality.

II. Receiving Water and Stream Classification

Virgin River:	1C, 2B, 3C, 4
Antidegradation Review:	Level I review completed. Level II review not required.

III. Numeric Stream Standards for Protection of Aquatic Wildlife

Total Ammonia (TNH3)	Varies as a function of Temperature and pH Rebound. See Water Quality Standards
Chronic Total Residual Chlorine (TRC)	0.011 mg/l (4 Day Average) 0.019 mg/l (1 Hour Average)
Chronic Dissolved Oxygen (DO)	5.00 mg/l (30 Day Average) N/A mg/l (7Day Average) 3.00 mg/l (1 Day Average
Maximum Total Dissolved Solids	1200.0 mg/l

Acute and Chronic Heavy Metals (Dissolved)

Parameter	4 Day Average (Chronic) Standard Concentration	Load*	1 Hour Average (Acute) Standard Concentration		Load*
Aluminum	87.00 ug/l**	0.211 lbs/day	750.00	ug/l	1.817 lbs/day
Arsenic	190.00 ug/l	0.460 lbs/day	340.00	ug/l	0.824 lbs/day
Cadmium	2.01 ug/l	0.005 lbs/day	5.40	ug/l	0.013 lbs/day
Chromium III	215.32 ug/l	0.522 lbs/day	4504.99	ug/l	10.915 lbs/day
ChromiumVI	11.00 ug/l	0.027 lbs/day	16.00	ug/l	0.039 lbs/day
Copper	24.25 ug/l	0.059 lbs/day	40.14	ug/l	0.097 lbs/day
Iron			1000.00	ug/l	2.423 lbs/day
Lead	13.21 ug/l	0.032 lbs/day	338.90	ug/l	0.821 lbs/day
Mercury	0.0120 ug/l	0.000 lbs/day	2.40	ug/l	0.006 lbs/day
Nickel	134.33 ug/l	0.325 lbs/day	1208.18	ug/l	2.927 lbs/day
Selenium	4.60 ug/l	0.011 lbs/day	20.00	ug/l	0.048 lbs/day
Silver	N/A ug/l	N/A lbs/day	25.89	ug/l	0.063 lbs/day
Zinc	308.99 ug/l	0.749 lbs/day	308.99	ug/l	0.749 lbs/day

* Allowed below discharge

**Chronic Aluminum standard applies only to waters with a pH < 7.0 and a Hardness < 50 mg/l as CaCO3

Metals Standards Based upon a Hardness of 305.9 mg/l as CaCO3

Organics [Pesticides]

Parameter	4 Day Average (Chronic) Standard Concentration	Load*	1 Hour Average (Acute) Standard Concentration		Load*
Aldrin			1.500	ug/l	0.004 lbs/day
Chlordane	0.004 ug/l	1.158 lbs/day	1.200	ug/l	0.003 lbs/day
DDT, DDE	0.001 ug/l	0.269 lbs/day	0.550	ug/l	0.001 lbs/day
Dieldrin	0.002 ug/l	0.512 lbs/day	1.250	ug/l	0.003 lbs/day
Endosulfan	0.056 ug/l	15.076 lbs/day	0.110	ug/l	0.000 lbs/day
Endrin	0.002 ug/l	0.619 lbs/day	0.090	ug/l	0.000 lbs/day
Guthion			0.010	ug/l	0.000 lbs/day
Heptachlor	0.004 ug/l	1.023 lbs/day	0.260	ug/l	0.001 lbs/day
Lindane	0.080 ug/l	21.538 lbs/day	1.000	ug/l	0.002 lbs/day
Methoxychlor			0.030	ug/l	0.000 lbs/day
Mirex			0.010	ug/l	0.000 lbs/day
Parathion			0.040	ug/l	0.000 lbs/day
PCB's	0.014 ug/l	3.769 lbs/day	2.000	ug/l	0.005 lbs/day
Pentachlorophenol	13.00 ug/l	3499.901 lbs/day	20.000	ug/l	0.048 lbs/day
Toxephene	0.0002 ug/l	0.054 lbs/day	0.7300	ug/l	0.002 lbs/day

IV. Numeric Stream Standards for Protection of Agriculture

	4 Day Average (Chronic) Standard		1 Hour Average (Acute) Standard	
	Concentration	**Load***	**Concentration**	**Load***
Arsenic			100.0 ug/l	lbs/day
Boron			750.0 ug/l	0.91 lbs/day
Cadmium			10.0 ug/l	0.01 lbs/day
Chromium			100.0 ug/l	lbs/day
Copper			200.0 ug/l	lbs/day
Lead			100.0 ug/l	lbs/day
Selenium			50.0 ug/l	lbs/day
TDS, Summer			1200.0 mg/l	1.45 tons/day

V. Numeric Stream Standards for Protection of Human Health (Class 1C Waters)

	4 Day Average (Chronic) Standard		1 Hour Average (Acute) Standard	
Metals	**Concentration**	**Load***	**Concentration**	**Load***
Arsenic			50.0 ug/l	13.461 lbs/day
Barium			1000.0 ug/l	269.223 lbs/day
Cadmium			10.0 ug/l	2.692 lbs/day
Chromium			50.0 ug/l	13.461 lbs/day
Lead			50.0 ug/l	13.461 lbs/day
Mercury			2.0 ug/l	0.538 lbs/day
Selenium			10.0 ug/l	2.692 lbs/day
Silver			50.0 ug/l	13.461 lbs/day
Fluoride (3)			1.4 ug/l	0.377 lbs/day
to			2.4 ug/l	0.646 lbs/day
Nitrates as N			10.0 ug/l	2.692 lbs/day
Chlorophenoxy Herbicides				
2,4-D			100.0 ug/l	26.922 lbs/day
2,4,5-TP			10.0 ug/l	2.692 lbs/day
Endrin			0.2 ug/l	0.054 lbs/day
ocyclohexane (Lindane)			4.0 ug/l	1.077 lbs/day
Methoxychlor			100.0 ug/l	26.922 lbs/day
Toxaphene			5.0 ug/l	1.346 lbs/day

VI. Numeric Stream Standards the Protection of Human Health from Water & Fish Consumption [Toxics]

	Maximum Conc., ug/l - Acute Standards			
	Class 1C		**Class 3A, 3B**	
Toxic Organics	[2 Liters/Day for 70 Kg Person over 70 Yr.]		[6.5 g for 70 Kg Person over 70 Yr.]	
Acenaphthene	1200.00 ug/l	323.07 lbs/day	2700.0 ug/l	726.90 lbs/day
Acrolein	320.00 ug/l	86.15 lbs/day	780.0 ug/l	209.99 lbs/day
Acrylonitrile	0.06 ug/l	0.02 lbs/day	0.7 ug/l	0.18 lbs/day
Benzene	1.20 ug/l	0.32 lbs/day	71.0 ug/l	19.11 lbs/day
Benzidine	0.00012 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Carbon tetrachloride	0.25 ug/l	0.07 lbs/day	4.4 ug/l	1.18 lbs/day
Chlorobenzene	680.00 ug/l	183.07 lbs/day	21000.0 ug/l	5653.69 lbs/day
1,2,4-Trichlorobenzene				
Hexachlorobenzene	0.00075 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
1,2-Dichloroethane	0.38 ug/l	0.10 lbs/day	99.0 ug/l	26.65 lbs/day

1,1,1-Trichloroethane				
Hexachloroethane	1.90 ug/l	0.51 lbs/day	8.9 ug/l	2.40 lbs/day
1,1-Dichloroethane				
1,1,2-Trichloroethane	0.61 ug/l	0.16 lbs/day	42.0 ug/l	11.31 lbs/day
1,1,2,2-Tetrachloroethai	0.17 ug/l	0.05 lbs/day	11.0 ug/l	2.96 lbs/day
Chloroethane			0.0 ug/l	0.00 lbs/day
Bis(2-chloroethyl) ether	0.03 ug/l	0.01 lbs/day	1.4 ug/l	0.38 lbs/day
2-Chloroethyl vinyl ether	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
2-Chloronaphthalene	1700.00 ug/l	457.68 lbs/day	4300.0 ug/l	1157.66 lbs/day
2,4,6-Trichlorophenol	2.10 ug/l	0.57 lbs/day	6.5 ug/l	1.75 lbs/day
p-Chloro-m-cresol			0.0 ug/l	0.00 lbs/day
Chloroform (HM)	5.70 ug/l	1.53 lbs/day	470.0 ug/l	126.53 lbs/day
2-Chlorophenol	120.00 ug/l	32.31 lbs/day	400.0 ug/l	107.69 lbs/day
1,2-Dichlorobenzene	2700.00 ug/l	726.90 lbs/day	17000.0 ug/l	4576.79 lbs/day
1,3-Dichlorobenzene	400.00 ug/l	107.69 lbs/day	2600.0 ug/l	699.98 lbs/day
1,4-Dichlorobenzene	400.00 ug/l	107.69 lbs/day	2600.0 ug/l	699.98 lbs/day
3,3'-Dichlorobenzidine	0.04 ug/l	0.01 lbs/day	0.1 ug/l	0.02 lbs/day
1,1-Dichloroethylene	0.06 ug/l	0.02 lbs/day	3.2 ug/l	0.86 lbs/day
1,2-trans-Dichloroethyle	700.00 ug/l	188.46 lbs/day	0.0 ug/l	0.00 lbs/day
2,4-Dichlorophenol	93.00 ug/l	25.04 lbs/day	790.0 ug/l	212.69 lbs/day
1,2-Dichloropropane	0.52 ug/l	0.14 lbs/day	39.0 ug/l	10.50 lbs/day
1,3-Dichloropropylene	10.00 ug/l	2.69 lbs/day	1700.0 ug/l	457.68 lbs/day
2,4-Dimethylphenol	540.00 ug/l	145.38 lbs/day	2300.0 ug/l	619.21 lbs/day
2,4-Dinitrotoluene	0.11 ug/l	0.03 lbs/day	9.1 ug/l	2.45 lbs/day
2,6-Dinitrotoluene	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
1,2-Diphenylhydrazine	0.04 ug/l	0.01 lbs/day	0.5 ug/l	0.15 lbs/day
Ethylbenzene	3100.00 ug/l	834.59 lbs/day	29000.0 ug/l	7807.47 lbs/day
Fluoranthene	300.00 ug/l	80.77 lbs/day	370.0 ug/l	99.61 lbs/day
4-Chlorophenyl phenyl ether				
4-Bromophenyl phenyl ether				
Bis(2-chloroisopropyl) e	1400.00 ug/l	376.91 lbs/day	170000.0 ug/l	45767.93 lbs/day
Bis(2-chloroethoxy) met	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Methylene chloride (HM	4.70 ug/l	1.27 lbs/day	1600.0 ug/l	430.76 lbs/day
Methyl chloride (HM)	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Methyl bromide (HM)	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Bromoform (HM)	4.30 ug/l	1.16 lbs/day	360.0 ug/l	96.92 lbs/day
Dichlorobromomethane	0.27 ug/l	0.07 lbs/day	22.0 ug/l	5.92 lbs/day
Chlorodibromomethane	0.41 ug/l	0.11 lbs/day	34.0 ug/l	9.15 lbs/day
Hexachlorobutadiene(c)	0.44 ug/l	0.12 lbs/day	50.0 ug/l	13.46 lbs/day
Hexachlorocyclopentadi	240.00 ug/l	64.61 lbs/day	17000.0 ug/l	4576.79 lbs/day
Isophorone	8.40 ug/l	2.26 lbs/day	600.0 ug/l	161.53 lbs/day
Naphthalene				
Nitrobenzene	17.00 ug/l	4.58 lbs/day	1900.0 ug/l	511.52 lbs/day
2-Nitrophenol	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
4-Nitrophenol	0.00 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
2,4-Dinitrophenol	70.00 ug/l	18.85 lbs/day	14000.0 ug/l	3769.12 lbs/day
4,6-Dinitro-o-cresol	13.00 ug/l	3.50 lbs/day	765.0 ug/l	205.96 lbs/day
N-Nitrosodimethylamine	0.00069 ug/l	0.00 lbs/day	8.1 ug/l	2.18 lbs/day
N-Nitrosodiphenylamine	5.00 ug/l	1.35 lbs/day	16.0 ug/l	4.31 lbs/day
N-Nitrosodi-n-propylami	0.01 ug/l	0.00 lbs/day	1.4 ug/l	0.38 lbs/day
Pentachlorophenol	0.28 ug/l	0.08 lbs/day	8.2 ug/l	2.21 lbs/day

Phenol	2.10E+04 ug/l	5.65E+03 lbs/day	4.6E+06 ug/l	1.24E+06 lbs/day
Bis(2-ethylhexyl)phthala	1.80 ug/l	0.48 lbs/day	5.9 ug/l	1.59 lbs/day
Butyl benzyl phthalate	3000.00 ug/l	807.67 lbs/day	5200.0 ug/l	1399.96 lbs/day
Di-n-butyl phthalate	2700.00 ug/l	726.90 lbs/day	12000.0 ug/l	3230.68 lbs/day
Di-n-octyl phthlate				
Diethyl phthalate	23000.00 ug/l	6192.13 lbs/day	120000.0 ug/l	32306.77 lbs/day
Dimethyl phthlate	3.13E+05 ug/l	8.43E+04 lbs/day	2.9E+06 ug/l	7.81E+05 lbs/day
Benzo(a)anthracene (P/	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Benzo(a)pyrene (PAH)	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Benzo(b)fluoranthene (F	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Benzo(k)fluoranthene (F	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Chrysene (PAH)	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Acenaphthylene (PAH)				
Anthracene (PAH)	9600.00 ug/l	2584.54 lbs/day	0.0 ug/l	0.00 lbs/day
Dibenzo(a,h)anthracene	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Indeno(1,2,3-cd)pyrene	0.0028 ug/l	0.00 lbs/day	0.0 ug/l	0.01 lbs/day
Pyrene (PAH)	960.00 ug/l	258.45 lbs/day	11000.0 ug/l	2961.45 lbs/day
Tetrachloroethylene	0.80 ug/l	0.22 lbs/day	8.9 ug/l	2.40 lbs/day
Toluene	6800.00 ug/l	1830.72 lbs/day	200000 ug/l	53844.62 lbs/day
Trichloroethylene	2.70 ug/l	0.73 lbs/day	81.0 ug/l	21.81 lbs/day
Vinyl chloride	2.00 ug/l	0.54 lbs/day	525.0 ug/l	141.34 lbs/day
			0.0	0.00 lbs/day
Pesticides			0.0	0.00 lbs/day
Aldrin	0.0001 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Dieldrin	0.0001 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Chlordane	0.0006 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
4,4'-DDT	0.0006 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
4,4'-DDE	0.0006 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
4,4'-DDD	0.0008 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
alpha-Endosulfan	0.9300 ug/l	0.25 lbs/day	2.0 ug/l	0.54 lbs/day
beta-Endosulfan	0.9300 ug/l	0.25 lbs/day	2.0 ug/l	0.54 lbs/day
Endosulfan sulfate	0.9300 ug/l	0.25 lbs/day	2.0 ug/l	0.54 lbs/day
Endrin	0.7600 ug/l	0.20 lbs/day	0.8 ug/l	0.22 lbs/day
Endrin aldehyde	0.7600 ug/l	0.20 lbs/day	0.8 ug/l	0.22 lbs/day
Heptachlor	0.0002 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Heptachlor epoxide				
PCB's				
PCB 1242 (Arochlor 12	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
PCB-1254 (Arochlor 12	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
PCB-1221 (Arochlor 12	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
PCB-1232 (Arochlor 12	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
PCB-1248 (Arochlor 12	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
PCB-1260 (Arochlor 12	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
PCB-1016 (Arochlor 10	0.000044 ug/l	0.00 lbs/day	0.0 ug/l	0.00 lbs/day
Pesticide				
Toxaphene	0.000750 ug/l	0.00	0.0 ug/l	0.00 lbs/day
Dioxin				
Dioxin (2,3,7,8-TCDD)	1.30E-08 ug/l	0.00 lbs/day	1.40E-08	0.00

Metals				
Antimony	14.0 ug/l	3.77 lbs/day		
Arsenic	50.0 ug/l	13.46 lbs/day	4300.00 ug/l	1157.66 lbs/day
Asbestos	7.00E+06 ug/l	1.88E+06 lbs/day		
Beryllium				
Cadmium				
Chromium (III)				
Chromium (VI)				
Copper				
Cyanide	1.30E+03 ug/l	349.99 lbs/day	2.2E+05 ug/l	59229.09 lbs/day
Lead	700.0 ug/l	188.46 lbs/day		
Mercury			0.15 ug/l	0.04 lbs/day
Nickel			4600.00 ug/l	1238.43 lbs/day
Selenium	0.1 ug/l	0.04 lbs/day		
Silver	610.0 ug/l	164.23 lbs/day		
Thallium			6.30 ug/l	1.70 lbs/day
Zinc				

There are additional standards that apply to this receiving water, but were not considered in this modeling/waste load allocation analysis.

VII. Mathematical Modeling of Stream Quality

Model configuration was accomplished utilizing standard modeling procedures. Data points were plotted and coefficients adjusted as required to match observed data as closely as possible.

The modeling approach used in this analysis included one or a combination of the following models.

(1) The Utah River Model, Utah Division of Water Quality, 1992. Based upon STREAMDO IV (Region VIII) and Supplemental Ammonia Toxicity Models; EPA Region VIII, Sept. 1990 and QUAL2E (EPA, Athens, GA).

(2) Utah Ammonia/Chlorine Model, Utah Division of Water Quality, 1992.

(3) AMMTOX Model, University of Colorado, Center of Limnology, and EPA Region 8

(4) Principles of Surface Water Quality Modeling and Control. Robert V. Thomann, et.al. Harper Collins Publisher, Inc. 1987, pp. 644.

Coefficients used in the model were based, in part, upon the following references:

(1) Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling. Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens Georgia. EPA/600/3-85/040 June 1985.

(2) Principles of Surface Water Quality Modeling and Control. Robert V. Thomann, et.al. Harper Collins Publisher, Inc. 1987, pp. 644.

VIII. Modeling Information

The required information for the model may include the following information for both the upstream conditions at low flow and the effluent conditions:

Flow, Q, (cfs or MGD)	D.O. mg/l
Temperature, Deg. C.	Total Residual Chlorine (TRC), mg/l
pH	Total NH3-N, mg/l
BOD5, mg/l	Total Dissolved Solids (TDS), mg/l
Metals, ug/l	Toxic Organics of Concern, ug/l

Other Conditions

In addition to the upstream and effluent conditions, the models require a variety of physical and biological coefficients and other technical information. In the process of actually establishing the permit limits for an effluent, values are used based upon the available data, model calibration, literature values, site visits and best professional judgement.

Model Inputs

The following is upstream and discharge information that was utilized as inputs for the analysis. Dry washes are considered to have an upstream flow equal to the flow of the discharge.

Current Upstream Information

	Stream Critical Low Flow cfs	Temp. Deg. C	pH	T-NH3 mg/l as N	BOD5 mg/l	DO mg/l	TRC mg/l	TDS mg/l
Summer (Irrig. Season)	49.50	21.7	8.3	0.01	1.00	6.97	0.00	480.8
Fall	49.50	10.1	8.2	0.01	1.00	---	0.00	492.2
Winter	49.50	7.8	8.1	0.01	1.00	---	0.00	457.3
Spring	49.50	15.7	8.1	0.01	1.00	---	0.00	512.2

Dissolved Metals	Al ug/l	As ug/l	Cd ug/l	CrIII ug/l	CrVI ug/l	Copper ug/l	Fe ug/l	Pb ug/l
All Seasons	11.20	1.30	0.20	1.80	3.975*	2.80	12.2	0.60

Dissolved Metals	Hg ug/l	Ni ug/l	Se ug/l	Ag ug/l	Zn ug/l	Boron ug/l	
All Seasons	0.0000	3.00	0.50	0.50	10.50	69.9	* ~80% MDL

Projected Discharge Information

Season	Flow, MGD	Temp.
Summer	0.29000	22.0
Fall	0.29000	12.0
Winter	0.29000	8.0
Spring	0.29000	12.0

All model numerical inputs, intermediate calculations, outputs and graphs are available for discussion, inspection and copy at the Division of Water Quality.

IX. Effluent Limitations

Current State water quality standards are required to be met under a variety of conditions including in-stream flows targeted to the 7-day, 10-year low flow (R317-2-9).

Other conditions used in the modeling effort coincide with the environmental conditions expected at low stream flows.

Effluent Limitation for Flow based upon Water Quality Standards

In-stream criteria of downstream segments will be met with an effluent flow maximum value as follows:

Season	Daily Average	
Summer	0.290 MGD	0.449 cfs
Fall	0.290 MGD	0.449 cfs
Winter	0.290 MGD	0.449 cfs
Spring	0.290 MGD	0.449 cfs

Flow Requirement or Loading Requirement

The calculations in this wasteload analysis utilize the maximum effluent discharge flow of 0.29 MGD. If the discharger is allowed to have a flow greater than 0.29 MGD during 7Q10 conditions, and effluent limit concentrations as indicated, then water quality standards will be violated. In order to prevent this from occuring, the permit writers must include the discharge flow limititation as indicated above; or, include loading effluent limits in the permit.

Effluent Limitation for Whole Effluent Toxicity (WET) based upon WET Policy

Effluent Toxicity will not occur in downstream segements if the values below are met.

WET Requirements	LC50 >	100.0% Effluent	[Acute]
	IC25 >	0.9% Effluent	[Chronic]

Effluent Limitation for Biological Oxygen Demand (BOD) based upon Water Quality Standards or Regulations

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent BOD limitation as follows:

Season	Concentration	
Summer	35.0 mg/l as BOD5	84.6 lbs/day
Fall	35.0 mg/l as BOD5	84.6 lbs/day
Winter	35.0 mg/l as BOD5	84.6 lbs/day
Spring	35.0 mg/l as BOD5	84.6 lbs/day

Effluent Limitation for Dissolved Oxygen (DO) based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Oxygen will be met with an effluent D.O. limitation as follows:

Season	**Concentration**
Summer	4.00
Fall	4.00
Winter	4.00
Spring	4.00

Effluent Limitation for Total Ammonia based upon Water Quality Standards

In-stream criteria of downstream segments for Total Ammonia will be met with an effluent limitation (expressed as Total Ammonia as N) as follows:

Season		**Concentration**	**Load**
Summer	4 Day Avg. - Chronic	107.98 mg/l as N	261.1 lbs/day
	1 Hour Avg. - Acute	182.5 mg/l as N	441.4 lbs/day
Fall	4 Day Avg. - Chronic	218.2 mg/l as N	527.6 lbs/day
	1 Hour Avg. - Acute	266.4 mg/l as N	644.3 lbs/day
Winter	4 Day Avg. - Chronic	220.1 mg/l as N	532.3 lbs/day
	1 Hour Avg. - Acute	264.4 mg/l as N	639.3 lbs/day
Spring	4 Day Avg. - Chronic	187.6 mg/l as N	453.7 lbs/day
	1 Hour Avg. - Acute	218.2 mg/l as N	527.7 lbs/day

Acute limit calculated with an Acute Zone of Initial Dilution (ZID) to be equal to 50.%.

Effluent Limitation for Total Residual Chlorine based upon Water Quality Standards

In-stream criteria of downstream segments for Total Residual Chlorine will be met with an effluent limitation as follows:

Season		Concentration		Load	
Summer	4 Day Avg. - Chronic	1.112	mg/l	2.69	lbs/day
	1 Hour Avg. - Acute	1.010	mg/l	2.44	lbs/day
Fall	4 Day Avg. - Chronic	1.112	mg/l	2.69	lbs/day
	1 Hour Avg. - Acute	1.010	mg/l	2.44	lbs/day
Winter	4 Day Avg. - Chronic	1.112	mg/l	2.69	lbs/day
	1 Hour Avg. - Acute	1.010	mg/l	2.44	lbs/day
Spring	4 Day Avg. - Chronic	1.112	mg/l	2.69	lbs/day
	1 Hour Avg. - Acute	1.010	mg/l	2.44	lbs/day

Effluent Limitations for Total Dissolved Solids based upon Water Quality Standards

Season		Concentration		Load	
Summer	Maximum, Acute	80553.6	mg/l	97.39	tons/day
Fall	Maximum, Acute	79295.8	mg/l	95.87	tons/day
Winter	Maximum, Acute	83146.5	mg/l	100.53	tons/day
Spring	Maximum, Acute	77089.0	mg/l	93.21	tons/day

Colorado Salinity Forum Limits — Determined by Permitting Section

Effluent Limitations for Total Recoverable Metals based upon Water Quality Standards

In-stream criteria of downstream segments for Dissolved Metals will be met with an effluent limitation as follows (based upon a hardness of 305.9 mg/l):

	4 Day Average Concentration		Load	1 Hour Average Concentration		Load
Aluminum*	N/A		N/A	41,508.1	ug/l	100.6 lbs/day
Arsenic*	21,010.39	ug/l	32.8 lbs/day	19,025.4	ug/l	46.1 lbs/day
Cadmium	202.01	ug/l	0.3 lbs/day	292.0	ug/l	0.7 lbs/day
Chromium III	23,774.69	ug/l	37.2 lbs/day	252,937.0	ug/l	612.8 lbs/day
Chromium VI*	786.11	ug/l	1.2 lbs/day	679.4	ug/l	1.6 lbs/day
Copper	2,391.24	ug/l	3.7 lbs/day	2,100.3	ug/l	5.1 lbs/day
Iron*	N/A		N/A	55,494.9	ug/l	134.5 lbs/day
Lead	1,404.15	ug/l	2.2 lbs/day	19,002.2	ug/l	46.0 lbs/day
Mercury*	1.33	ug/l	0.0 lbs/day	134.8	ug/l	0.3 lbs/day
Nickel	14,624.34	ug/l	22.9 lbs/day	67,695.5	ug/l	164.0 lbs/day
Selenium*	456.98	ug/l	0.7 lbs/day	1,095.8	ug/l	2.7 lbs/day
Silver	N/A	ug/l	N/A lbs/day	1,426.8	ug/l	3.5 lbs/day

Zinc	33,243.26	ug/l	52.0	lbs/day	16,776.1	ug/l	40.6 lbs/day
Cyanide*	578.95	ug/l	0.9	lbs/day	1,235.7	ug/l	3.0 lbs/day

*Limits for these metals are based on the dissolved standard.

Effluent Limitations for Heat/Temperature based upon Water Quality Standards

Summer	467.0 Deg. C.	872.7 Deg. F
Fall	455.4 Deg. C.	851.8 Deg. F
Winter	453.1 Deg. C.	847.7 Deg. F
Spring	461.0 Deg. C.	861.9 Deg. F

Effluent Limitations for Organics [Pesticides] Based upon Water Quality Standards

In-stream criteria of downstream segments for Organics [Pesticides] will be met with an effluent limit as follows:

	4 Day Average Concentration		Load		1 Hour Average Concentration		Load	
Aldrin					1.5E+00	ug/l	5.62E-03	lbs/day
Chlordane	4.30E-03	ug/l	1.04E-02	lbs/day	1.2E+00	ug/l	4.50E-03	lbs/day
DDT, DDE	1.00E-03	ug/l	2.42E-03	lbs/day	5.5E-01	ug/l	2.06E-03	lbs/day
Dieldrin	1.90E-03	ug/l	4.59E-03	lbs/day	1.3E+00	ug/l	4.69E-03	lbs/day
Endosulfan	5.60E-02	ug/l	1.35E-01	lbs/day	1.1E-01	ug/l	4.12E-04	lbs/day
Endrin	2.30E-03	ug/l	5.56E-03	lbs/day	9.0E-02	ug/l	3.37E-04	lbs/day
Guthion	0.00E+00	ug/l	0.00E+00	lbs/day	1.0E-02	ug/l	3.75E-05	lbs/day
Heptachlor	3.80E-03	ug/l	9.19E-03	lbs/day	2.6E-01	ug/l	9.75E-04	lbs/day
Lindane	8.00E-02	ug/l	1.93E-01	lbs/day	1.0E+00	ug/l	3.75E-03	lbs/day
Methoxychlor	0.00E+00	ug/l	0.00E+00	lbs/day	3.0E-02	ug/l	1.12E-04	lbs/day
Mirex	0.00E+00	ug/l	0.00E+00	lbs/day	1.0E-02	ug/l	3.75E-05	lbs/day
Parathion	0.00E+00	ug/l	0.00E+00	lbs/day	4.0E-02	ug/l	1.50E-04	lbs/day
PCB's	1.40E-02	ug/l	3.39E-02	lbs/day	2.0E+00	ug/l	7.50E-03	lbs/day
Pentachlorophenol	1.30E+01	ug/l	3.14E+01	lbs/day	2.0E+01	ug/l	7.50E-02	lbs/day
Toxephene	2.00E-04	ug/l	4.84E-04	lbs/day	7.3E-01	ug/l	2.74E-03	lbs/day

Effluent Targets for Pollution Indicators
Based upon Water Quality Standards

In-stream criteria of downstream segments for Pollution Indicators will be met with an effluent limit as follows:

	1 Hour Average	
	Concentration	Loading
Gross Beta (pCi/l)	50.0 pCi/L	
BOD (mg/l)	5.0 mg/l	12.1 lbs/day
Nitrates as N	4.0 mg/l	9.7 lbs/day
Total Phosphorus as P	0.05 mg/l	0.1 lbs/day
Total Suspended Solids	90.0 mg/l	218.1 lbs/day

Note: Pollution indicator targets are for information purposes only.

Effluent Limitations for Protection of Human Health [Toxics Rule]
Based upon Water Quality Standards (Most stringent of 1C or 3A & 3B as appropriate.)

In-stream criteria of downstream segments for Protection of Human Health [Toxics] will be met with an effluent limit as follows:

	Maximum Concentration	
	Concentration	**Load**
Toxic Organics		
Acenaphthene	1.34E+05 ug/l	3.23E+02 lbs/day
Acrolein	3.56E+04 ug/l	8.62E+01 lbs/day
Acrylonitrile	6.57E+00 ug/l	1.59E-02 lbs/day
Benzene	1.34E+02 ug/l	3.23E-01 lbs/day
Benzidine	ug/l	lbs/day
Carbon tetrachloride	2.78E+01 ug/l	6.73E-02 lbs/day
Chlorobenzene	7.57E+04 ug/l	1.83E+02 lbs/day
1,2,4-Trichlorobenzene		
Hexachlorobenzene	8.35E-02 ug/l	2.02E-04 lbs/day
1,2-Dichloroethane	4.23E+01 ug/l	1.02E-01 lbs/day
1,1,1-Trichloroethane		
Hexachloroethane	2.12E+02 ug/l	5.12E-01 lbs/day
1,1-Dichloroethane		
1,1,2-Trichloroethane	6.79E+01 ug/l	1.64E-01 lbs/day
1,1,2,2-Tetrachloroethane	1.89E+01 ug/l	4.58E-02 lbs/day
Chloroethane		
Bis(2-chloroethyl) ether	3.45E+00 ug/l	8.35E-03 lbs/day
2-Chloroethyl vinyl ether		
2-Chloronaphthalene	1.89E+05 ug/l	4.58E+02 lbs/day
2,4,6-Trichlorophenol	2.34E+02 ug/l	5.65E-01 lbs/day
p-Chloro-m-cresol		
Chloroform (HM)	6.35E+02 ug/l	1.53E+00 lbs/day
2-Chlorophenol	1.34E+04 ug/l	3.23E+01 lbs/day
1,2-Dichlorobenzene	3.01E+05 ug/l	7.27E+02 lbs/day
1,3-Dichlorobenzene	4.45E+04 ug/l	1.08E+02 lbs/day

1,4-Dichlorobenzene	4.45E+04 ug/l	1.08E+02 lbs/day
3,3'-Dichlorobenzidine	4.45E+00 ug/l	1.08E-02 lbs/day
1,1-Dichloroethylene	6.35E+00 ug/l	1.53E-02 lbs/day
1,2-trans-Dichloroethylene1		
2,4-Dichlorophenol	1.04E+04 ug/l	2.50E+01 lbs/day
1,2-Dichloropropane	5.79E+01 ug/l	1.40E-01 lbs/day
1,3-Dichloropropylene	1.11E+03 ug/l	2.69E+00 lbs/day
2,4-Dimethylphenol	6.01E+04 ug/l	1.45E+02 lbs/day
2,4-Dinitrotoluene	1.22E+01 ug/l	2.96E-02 lbs/day
2,6-Dinitrotoluene		
1,2-Diphenylhydrazine	4.45E+00 ug/l	1.08E-02 lbs/day
Ethylbenzene	3.45E+05 ug/l	8.35E+02 lbs/day
Fluoranthene	3.34E+04 ug/l	8.08E+01 lbs/day
4-Chlorophenyl phenyl ether		
4-Bromophenyl phenyl ether		
Bis(2-chloroisopropyl) ether	1.56E+05 ug/l	3.77E+02 lbs/day
Bis(2-chloroethoxy) methane		
Methylene chloride (HM)	5.23E+02 ug/l	1.27E+00 lbs/day
Methyl chloride (HM)		
Methyl bromide (HM)		
Bromoform (HM)	4.79E+02 ug/l	1.16E+00 lbs/day
Dichlorobromomethane(HM)	3.01E+01 ug/l	7.27E-02 lbs/day
Chlorodibromomethane (HM)	4.56E+01 ug/l	1.10E-01 lbs/day
Hexachlorocyclopentadiene	2.67E+04 ug/l	6.46E+01 lbs/day
Isophorone	9.35E+02 ug/l	2.26E+00 lbs/day
Naphthalene		
Nitrobenzene	1.89E+03 ug/l	4.58E+00 lbs/day
2-Nitrophenol		
4-Nitrophenol		
2,4-Dinitrophenol	7.79E+03 ug/l	1.88E+01 lbs/day
4,6-Dinitro-o-cresol	1.45E+03 ug/l	3.50E+00 lbs/day
N-Nitrosodimethylamine	7.68E-02 ug/l	1.86E-04 lbs/day
N-Nitrosodiphenylamine	5.57E+02 ug/l	1.35E+00 lbs/day
N-Nitrosodi-n-propylamine	5.57E-01 ug/l	1.35E-03 lbs/day
Pentachlorophenol	3.12E+01 ug/l	7.54E-02 lbs/day
Phenol	2.34E+06 ug/l	5.65E+03 lbs/day
Bis(2-ethylhexyl)phthalate	2.00E+02 ug/l	4.85E-01 lbs/day
Butyl benzyl phthalate	3.34E+05 ug/l	8.08E+02 lbs/day
Di-n-butyl phthalate	3.01E+05 ug/l	7.27E+02 lbs/day
Di-n-octyl phthlate		
Diethyl phthalate	2.56E+06 ug/l	6.19E+03 lbs/day
Dimethyl phthlate	3.48E+07 ug/l	8.43E+04 lbs/day
Benzo(a)anthracene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day
Benzo(a)pyrene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day
Benzo(b)fluoranthene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day
Benzo(k)fluoranthene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day
Chrysene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day
Acenaphthylene (PAH)		
Anthracene (PAH)		
Dibenzo(a,h)anthracene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day
Indeno(1,2,3-cd)pyrene (PAH)	3.12E-01 ug/l	7.54E-04 lbs/day

Pyrene (PAH)	1.07E+05 ug/l	2.58E+02 lbs/day
Tetrachloroethylene	8.91E+01 ug/l	2.15E-01 lbs/day
Toluene	7.57E+05 ug/l	1.83E+03 lbs/day
Trichloroethylene	3.01E+02 ug/l	7.27E-01 lbs/day
Vinyl chloride	2.23E+02 ug/l	5.38E-01 lbs/day
Pesticides		
Aldrin	1.45E-02 ug/l	3.50E-05 lbs/day
Dieldrin	1.56E-02 ug/l	3.77E-05 lbs/day
Chlordane	6.35E-02 ug/l	1.53E-04 lbs/day
4,4'-DDT	6.57E-02 ug/l	1.59E-04 lbs/day
4,4'-DDE	6.57E-02 ug/l	1.59E-04 lbs/day
4,4'-DDD	9.24E-02 ug/l	2.23E-04 lbs/day
alpha-Endosulfan	1.04E+02 ug/l	2.50E-01 lbs/day
beta-Endosulfan	1.04E+02 ug/l	2.50E-01 lbs/day
Endosulfan sulfate	1.04E+02 ug/l	2.50E-01 lbs/day
Endrin	8.46E+01 ug/l	2.05E-01 lbs/day
Endrin aldehyde	8.46E+01 ug/l	2.05E-01 lbs/day
Heptachlor	2.34E-02 ug/l	5.65E-05 lbs/day
Heptachlor epoxide		
PCB's		
PCB 1242 (Arochlor 1242)	4.90E-03 ug/l	1.18E-05 lbs/day
PCB-1254 (Arochlor 1254)	4.90E-03 ug/l	1.18E-05 lbs/day
PCB-1221 (Arochlor 1221)	4.90E-03 ug/l	1.18E-05 lbs/day
PCB-1232 (Arochlor 1232)	4.90E-03 ug/l	1.18E-05 lbs/day
PCB-1248 (Arochlor 1248)	4.90E-03 ug/l	1.18E-05 lbs/day
PCB-1260 (Arochlor 1260)	4.90E-03 ug/l	1.18E-05 lbs/day
PCB-1016 (Arochlor 1016)	4.90E-03 ug/l	1.18E-05 lbs/day
Pesticide		
Toxaphene	8.13E-02 ug/l	1.97E-04 lbs/day
Metals		
Antimony	1558.70 ug/l	3.77 lbs/day
Arsenic	5423.36 ug/l	13.11 lbs/day
Asbestos	7.79E+08 ug/l	1.88E+06 lbs/day
Beryllium		
Cadmium		
Chromium (III)		
Chromium (VI)		
Copper	144736.69 ug/l	349.99 lbs/day
Cyanide	77935.14 ug/l	188.46 lbs/day
Lead	0.00	0.00
Mercury	15.59 ug/l	0.04 lbs/day
Nickel	67914.91 ug/l	164.23 lbs/day
Selenium	0.00	0.00
Silver	0.00	0.00
Thallium	189.27 ug/l	0.46 lbs/day
Zinc		

Dioxin		
Dioxin (2,3,7,8-TCDD)	1.45E-06 ug/l	3.50E-09 lbs/day

Metals Effluent Limitations for Protection of All Beneficial Uses Based upon Water Quality Standards and Toxics Rule

	Class 4 Acute Agricultural ug/l	Class 3 Acute Aquatic Wildlife ug/l	Acute Toxics Drinking Water Source ug/l	Acute Toxics Wildlife ug/l	1C Acute Health Criteria ug/l	Acute Most Stringent ug/l	Class 3 Chronic Aquatic Wildlife ug/l
Aluminum		41508.1				41508.1	N/A
Antimony			1558.7	478744.4		1558.7	
Arsenic	11133.6	19025.4	5423.4			5423.4	21010.4
Barium					111335.9	111335.9	
Beryllium						0.0	
Cadmium	1091.3	292.0				292.0	202.0
Chromium (III)		252937.0				252937.0	23774.7
Chromium (VI)	10935.0	679.4				679.39	786.11
Copper	21958.2	2100.3	144736.7			2100.3	2391.2
Cyanide		1235.7	24493900.5			1235.7	578.9
Iron		55494.9				55494.9	
Lead	11067.4	19002.2				11067.4	1404.1
Mercury		134.80	15.6	16.70		15.59	1.335
Nickel		67695.5	67914.9	512145.2		67695.5	14624.3
Selenium	5511.6	1095.8				1095.8	457.0
Silver		1426.8				1426.8	
Thallium			189.3	701.4		189.3	
Zinc		16776.1				16776.1	33243.3
Boron	75789.5					75789.5	
Sulfate	222671.8					222671.8	

Summary Effluent Limitations for Metals [Wasteload Allocation, TMDL]
[If Acute is more stringent than Chronic, then the Chronic takes on the Acute value.]

	WLA Acute ug/l	WLA Chronic ug/l	
Aluminum	41508.1	N/A	
Antimony	1558.70		
Arsenic	5423.4	21010.4	Acute Controls
Asbestos	7.79E+08		
Barium			
Beryllium			
Cadmium	292.0	202.0	
Chromium (III)	252937.0	23775	
Chromium (VI)	679.4	786.1	Acute Controls
Copper	2100.3	2391.2	Acute Controls

Cyanide	1235.7	578.9	
Iron	55494.9		
Lead	11067.4	1404.1	
Mercury	15.586	1.335	
Nickel	67695.5	14624	
Selenium	1095.8	457.0	
Silver	1426.8	N/A	
Thallium	189.3		
Zinc	16776.1	33243.3	Acute Controls
Boron	75789.45		
Sulfate	222671.8		N/A at this Waterbody

Other Effluent Limitations are based upon R317-1.

E. coli	126.0	organisms per 100 ml

X. Antidegradation Considerations

The Utah Antidegradation Policy allows for degradation of existing quality where it is determined that such lowering of water quality is necessary to accommodate important economic or social development in the area in which the waters are protected [R317-2-3]. It has been determined that certain chemical parameters introduced by this discharge will cause an increase of the concentration of said parameters in the receiving waters. Under no conditions will the increase in concentration be allowed to interfere with existing instream water uses.

An Antidegradation Level I Review was conducted on this discharge and its effect on the receiving water. Based upon that review, it has been determined that an Antidegradation Level II Review is not required. The proposed permit is a simple renewal, with no increase in flow or concentration over that which was approved in the existing permit.

XI. Colorado River Salinity Forum Considerations

Discharges in the Colorado River Basin are required to have their discharge at a TDS loading of less than 1.00 tons/day unless certain exemptions apply. Refer to the Forum's Guidelines for additional information allowing for an exceedence of this value.

XII. Summary Comments

The mathematical modeling and best professional judgement indicate that violations of receiving water beneficial uses with their associated water quality standards, including important down-stream segments, will not occur for the evaluated parameters of concern as discussed above if the effluent limitations indicated above are met.

This Page Intentionally Left Blank

ATTACHMENT 4

Reasonable Potential Analysis

This Page Intentionally Left Blank

REASONABLE POTENTIAL ANALYSIS

Water Quality has worked to improve our reasonable potential analysis (RP) for the inclusion of limits for parameters in the permit by using an EPA provided model. As a result of the model, more parameters may be included in the renewal permit. A Copy of the Reasonable Potential Analysis Guidance (RP Guide) is available at water Quality. There are four outcomes for the RP Analysis[9]. They are;

Outcome A: A new effluent limitation will be placed in the permit.
Outcome B: No new effluent limitation. Routine monitoring requirements will be placed or increased from what they are in the permit,
Outcome C: No new effluent limitation. Routine monitoring requirements maintained as they are in the permit,
Outcome D: No limitation or routine monitoring requirements are in the permit.

As a result of the infrequent discharge and low flow conditions Springdale has not been required to sample for metals in previous permit cycles. This results in no data for an RP. This result is similar to one that would result in Outcome C or D and the monitoring requirements in the permit will not change..

[9] See Reasonable Potential Analysis Guidance for definitions of terms

STATE OF UTAH
DIVISION OF WATER QUALITY
DEPARTMENT OF ENVIRONMENTAL QUALITY
SALT LAKE CITY, UTAH

UTAH POLLUTANT DISCHARGE ELIMINATION SYSTEM (UPDES) PERMITS

Minor Municipal Permit No. **UT0025224**

In compliance with provisions of the Utah *Water Quality Act, Title 19, Chapter 5, Utah Code Annotated ("UCA") 1953, as amended* (the *"Act"*),

THE TOWN OF SPRINGDALE

is hereby authorized to discharge from its wastewater treatment facility to receiving waters named the

VIRGIN RIVER,

in accordance with specific limitations, outfalls, and other conditions set forth herein.

This permit shall become effective on May 1, 2019

This permit expires at midnight on April 30, 2024.

Signed this 1st day of May, 2019.

Erica Brown Gaddis, PhD
Director

DWQ-2019-001104

Table of Contents

Outline **Page Number**

I. DISCHARGE LIMITATIONS AND REPORTING REQUIREMENTS

A. Description of Discharge Points. The authorization to discharge wastewater provided under this part is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under a UPDES permit are violations of the *Act* and may be subject to penalties under the *Act*. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge may be subject to criminal penalties as provided under the *Act*.

Outfall Number	Location of Discharge Outfall
001	An eight inch green PVC pipe discharging directly to the Virgin River located at latitude 37° 09' 45" and longitude 113° 04' 17".

B. Narrative Standard. It shall be unlawful, and a violation of this permit, for the permittee to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum, or other nuisances such as color, odor or taste, or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by a bioassay or other tests performed in accordance with standard procedures.

C. Specific Limitations and Self-Monitoring Requirements.

1. Effective immediately, and lasting through the life of this permit, there shall be no acute or chronic toxicity in Outfall 001as defined in *Part VIII* of this permit.

2.

a. Effective immediately and lasting the duration of this permit, the permittee is authorized to discharge from Outfall 001. Such discharges shall be limited and monitored by the permittee as specified below:

Parameter	Effluent Limitations[1]				
	Maximum Monthly Avg	Maximum Weekly Avg	lbs./Year	Daily Minimum	Daily Maximum
Total Flow	0.29	-	-	-	-
BOD_5, mg/L BOD_5 Min. % Removal	45 85	65 -	- -	- -	- -
TSS, mg/L TSS Min. % Removal	45 85	65 -	- -	- -	- -
Dissolved Oxygen, mg/L	-	-	-	4.0	-
E. coli, No./100mL	126	158	-	-	-
Total Phosphorous, lbs/year	-	-	3,490	-	-
pH, Standard Units	-	-	-	6.5	9
TDS, mg/L[2]	<400 Increase	-	-	-	-

1 See Definitions, Part VIII, for definition of terms.
2 The effluent shall not exceed the culinary source water intake by more than 400 mg/L of TDS or the permittee could request 1 ton/day salt loading, or 366 tons/year.

Self-Monitoring and Reporting Requirements[1]			
Parameter	Minimum Frequency	Sample Type	Units
Total Flow[3, 4]	Continuous	Recorder	MGD
BOD_5, Influent[5] Effluent	2 x Monthly 2 x Monthly	Composite Composite	mg/L mg/L
TSS, Influent[5] Effluent	2 x Monthly 2 x Monthly	Composite Composite	mg/L mg/L
E. coli	2 x Monthly	Grab	No./100mL
pH	2 x Monthly	Grab	SU
Ammonia	2 x Monthly	Grab	mg/L
DO	2 x Monthly	Grab	mg/L
TDS[6], Effluent Source Water	Quarterly Quarterly	Grab Grab	mg/L mg/L
Boron[7]	2 x Monthly	Composite	mg/L
Temperature[7]	2 x Monthly	Grab	ºC

TBPEL Rule Monitoring and Reporting Requirements[1, 8]			
Parameter	Minimum Frequency	Sample Type	Units
Total Ammonia (as N)	Monthly	Composite	mg/L
Orthophosphate, (as P) Effluent	Monthly	Composite	mg/L
Phosphorus, Total Influent Effluent	Monthly Monthly	Composite Composite	mg/L mg/L
Total Kjeldahl Nitrogen, TKN (as N) Influent Effluent	Monthly Monthly	Composite Composite	mg/L mg/L
Nitrate, NO3	Monthly	Composite	mg/L
Nitrite, NO2	Monthly	Composite	mg/L

3. Compliance Schedule

   a. There is no Compliance Schedule included in this renewal permit.

D. Reporting of Monitoring Results.

3 Flow measurements of influent/effluent volume shall be made in such a manner that the permittee can affirmatively demonstrate that representative values are being.
4 If the rate of discharge is controlled, the rate and duration of discharge shall be reported.
5 In addition to monitoring the final discharge, influent samples shall be taken and analyzed for this constituent at the same frequency as required for this constituent in the discharge. During months where a discharge will not occur influent samples shall be taken and analyzed for this constituent at a minimum frequency of once per month.
6 The effluent shall not exceed the culinary source water intake by more than 400 mg/L of TDS or the permittee could request 1 ton/day salt loading, or 366 tons/year.
7 Temperature and Boron are being sampled in support of the work being done for the TMDL currently underway for the Virgin River. The Pollutants Of Concern (POC) will be monitored and reported, but will not have a limit associated with them.
8 These reflect changes required with the adoption of UCA R317-1-3.3, Technology-based Phosphorus Effluent Limits rule.

1. Reporting of Wastewater Monitoring Results Monitoring results obtained during the previous month shall be summarized for each month and reported by NetDMR[9], entered into NetDMR no later than the 28th day of the month following the completed reporting period. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports including whole effluent toxicity (WET) test reports required herein, shall be signed and certified in accordance with the requirements of *Signatory Requirements (see Part VII.G*), and submitted by NetDMR, or to the Division of Water Quality at the following address:

   Department of Environmental Quality
   Division of Water Quality
   PO Box 144870
   Salt Lake City, Utah 84114-4870

9 Starting January 1, 2017 monitoring results must be submitted using NetDMR unless the permittee has successfully petitioned for an exception.

II. INDUSTRIAL PRETREATMENT PROGRAM

A. Definitions. For this section the following definitions shall apply:

1. *Indirect Discharge* means the introduction of pollutants into a publicly-owned treatment works (POTW) from any non-domestic source regulated under section 307 (b), (c) or (d) of the Act.

2. *Interference* means a discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

   a. Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and

   b. Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent State or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including State regulations contained in any State sludge management plan prepared pursuant to subtitle D of the SWDA), the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

3. *Local Limit* is defined as a limit designed to prevent pass through and/or interference. And is developed in accordance with 40 CFR 403.5(c).

4. *Pass Through means* a Discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

5. *Publicly Owned Treatment Works* or *POTW* means a treatment works as defined by section 212 of the Act, which is owned by a State or municipality (as defined by section 502(4) of the Act). This definition includes any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW Treatment Plant. The term also means the municipality as defined in section 502(4) of the Act, which has jurisdiction over the Indirect Discharges to and the discharges from such a treatment works.

6. *Significant industrial user (SIU)* is defined as an industrial user discharging to a POTW that satisfies any of the following:

   a. Has a process wastewater flow of 25,000 gallons or more per average work day;

   b. Has a flow greater than five percent of the flow carried by the municipal system receiving the waste;

   c. Is subject to Categorical Pretreatment Standards, or

d. Has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement.

7. *User or Industrial User (IU)* means a source of Indirect Discharge

B. Pretreatment Reporting Requirements. Because the design capacity of this municipal wastewater treatment facility is less than 5 MGD, the permittee will not be required to develop a State-approved industrial pretreatment program at this time. However, in order to determine if development of an industrial pretreatment program is warranted, the permittee shall conduct an **industrial waste survey**, as described in *Part II.C.1*, and submit it to the Division of Water Quality within **sixty (60) calendar days** of the effective date of this permit.

C. Industrial Wastes.

1. The "Industrial Waste Survey" as required by *Part II.B.1*. consists of;

a. Identifying each industrial user (IU) and determining if the IU is a signification industrial user (SIU),

b. Determination of the qualitative and quantitative characteristics of each discharge, and

c. Appropriate production data.

2. The IWS must be maintained and updated with IU information as necessary, to ensure that all IUs are properly permitted and/or controlled at all times. Updates must be submitted to the Director sixty (60) days following a change to the IWS.

3. Evaluate all significant industrial users at least once every two years to determine if they need to develop a slug prevention plan. If a slug prevention plan is required, the permittee shall notify the Director.

4. Notify all significant industrial users of their obligation to comply with applicable requirements under *Subtitles C and D* of the *Resource* Conservation and Recovery Act (RCRA).

5. The permittee must notify the Director of any new introductions by new or existing SIUs or any substantial change in pollutants from any major industrial source. Such notice must contain the information described in 1. above, and be forwarded no later than sixty (60) days following the introduction or change.

D. General and Specific Prohibitions. The general prohibitions and the specific prohibitions apply to each User introducing pollutants into a POTW whether or not the User is subject to other Pretreatment Standards or any national, State or local Pretreatment Requirements.

1. General prohibition Standards. A User may not introduce into a POTW any pollutant(s) which cause Pass Through or Interference.

2. Specific Prohibited Standards. Developed pursuant to *Section 307* of *The Water Quality Act of 1987* require that under no circumstances shall the permittee allow introduction of the following pollutants into the waste treatment system from any User (*40 CFR 403.5*):

a. Pollutants which create a fire or explosion hazard in the publicly owned treatment works (POTW), including, but not limited to, waste-streams with a closed cup flashpoint of less than 140˚F (60˚C);

b. Pollutants, which will cause corrosive structural damage to the POTW, but in no case, discharges with a pH lower than 5.0;

c. Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;

d. Any pollutant, including oxygen demanding pollutants (BOD, etc.) released in a discharge at such volume or strength as to cause interference in the POTW;

e. Heat in amounts, which will inhibit biological activity in the POTW, resulting in interference, but in no case, heat in such quantities that the influent to the sewage treatment works exceeds 104˚F (40˚C);

f. Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

g. Pollutants which result in the presence of toxic gases, vapor, or fumes within the POTW in a quantity that may cause worker health or safety problems; or,

h. Any trucked or hauled pollutants, except at discharge points designated by the POTW.

i. Any pollutant that causes pass through or interference at the POTW.

3. In addition to the general and specific limitations expressed above, more specific pretreatment limitations have been and will be promulgated for specific industrial categories under *Section 307* of *the Water Quality Act of 1987 as amended (WQA). (See 40 CFR, Subchapter N, Parts 400* through *500*, for specific information).

E. Significant Industrial Users Discharging to the POTW. The permittee shall provide adequate notice to the Director and the Division of Water Quality Industrial Pretreatment Coordinator of;

1. Any new introduction of pollutants into the treatment works from an indirect discharger (i.e., industrial user) which would be subject to *Sections 301* or *306* of the *WQA* if it were directly discharging those pollutants;

2. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit; and

3. For the purposes of this section, adequate notice shall include information on:

a. The quality and quantity of effluent to be introduced into such treatment works; and,

b. Any anticipated impact of the change on the quantity or quality of effluent to be discharged from such publicly owned treatment works.

4. Any SIU that must comply with applicable requirements under Subtitles C and D of the Resource Conservation and Recovery Act (RCRA).

F. Change of Conditions. At such time as a specific pretreatment limitation becomes applicable to an industrial user of the permittee, the Director may, as appropriate, do the following:

1. Amend the permittee's UPDES discharge permit to specify the additional pollutant(s) and corresponding effluent limitation(s) consistent with the applicable national pretreatment limitation;

2. Require the permittee to specify, by ordinance, contract, or other enforceable means, the type of pollutant(s) and the maximum amount which may be discharged to the permittee's facility for treatment. Such requirement shall be imposed in a manner consistent with the POTW program development requirements of the *General Pretreatment Regulations* at *40 CFR 403*; and/or,

3. Require the permittee to monitor its discharge for any pollutant, which may likely be discharged from the permittee's facility, should the industrial user fail to properly pretreat its waste.

4. Require the permittee to develop an approved pretreatment program.

G. Legal Action. The Director retains, at all times, the right to take legal action against the industrial user and/or the treatment works, in those cases where a permit violation has occurred because of the failure of an industrial user to discharge at an acceptable level. If the permittee has failed to properly delineate maximum acceptable industrial contributor levels, the Director will look primarily to the permittee as the responsible party.

H. Local Limits. If local limits are developed per R317-8-8.5(4)(b) to protect the POTW from pass-through or interference, then the POTW must submit limits to DWQ for review and public notice, as required by R317-8-8.5(4)(c).

III. BIOSOLIDS REQUIREMENTS

The State of Utah has adopted the 40 CFR 503 federal regulations for the disposal of sewage sludge (biosolids) by reference. However, since this facility is a lagoon, there is not any regular sludge production. Therefore 40 CFR 503 does not apply at this time. In the future, if the sludge needs to be removed from the lagoons and is disposed in some way, the Division of Water Quality must be contacted prior to the removal of the sludge to ensure that all applicable state and federal regulations are met.

IV. STORM WATER REQUIREMENTS.

A. Coverage of This Section. The requirements listed under this section shall apply to storm water discharges if No Exposure Conditions are not met or a No Exposure Certification is not filed within 30 days of the permit's effective date. Storm water discharges from the following portions of the facility may be eligible for coverage under this permit: biosolids drying beds, haul or access roads on which transportation of biosolids may occur, grit screen cleaning areas, chemical loading, unloading and storage areas, salt or sand storage areas, vehicle or equipment storage and maintenance areas, or any other wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including lands dedicated to the disposal of sewage sludge that are located within the confines of the facility that may have a reasonable expectation to contribute to pollutants in a storm water discharge.

B. Prohibition of Non-Storm Water Discharges. Except for discharges identified in *Part I.*, and discharges described below in this paragraph, non-storm water discharges are prohibited. The following non-storm water discharges may be authorized under this permit provided the non-storm water component of the discharge is in compliance with this section; discharges from firefighting activities; fire hydrant flushing; potable water sources including waterline flushing; drinking fountain water; irrigation drainage and lawn watering; routine external building wash down water where detergents or other compounds have not been used in the process; pavement wash waters where spills or leaks of toxic or hazardous materials (including oils and fuels) have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; uncontaminated compressor condensate; uncontaminated springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents.

C. Storm Water Pollution Prevention Plan Requirements. The permittee must have (on site) and implement a storm water pollution prevention plan as a condition of this permit.

1. Contents of the Plan. The plan shall include, at a minimum, the following items:

a. *Pollution Prevention Team*. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

b. *Description of Potential Pollutant Sources*. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials, which may be reasonably expected to have the potential as a significant pollutant source. Each plan shall include, at a minimum:

(1) *Drainage*. A site map indicating drainage areas and storm water outfalls. For each area of the facility that generates storm water discharges associated with the waste water treatment related activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow and an identification of the types of pollutants that are likely to be present

in storm water discharges associated with the activity. Factors to consider include the toxicity of the pollutant; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified. The site map shall include but not be limited to:

(a) Drainage direction and discharge points from all wastewater associated activities including but not limited to grit screen cleaning, bio-solids drying beds and transport, chemical/material loading, unloading and storage areas, vehicle maintenance areas, salt or sand storage areas.

(b) Location of any erosion and sediment control structure or other control measures utilized for reducing pollutants in storm water runoff.

(c) Location of bio-solids drying beds where exposed to precipitation or where the transportation of bio-solids may be spilled onto internal roadways or tracked off site.

(d) Location where grit screen cleaning or other routinely performed industrial activities are located and are exposed to precipitation.

(e) Location of any handling, loading, unloading or storage of chemicals or potential pollutants such as caustics, hydraulic fluids, lubricants, solvents or other petroleum products, or hazardous wastes and where these may be exposed to precipitation.

(f) Locations where any major spills or leaks of toxic or hazardous materials have occurred.

(g) Location of any sand or salt piles.

(h) Location of fueling stations or vehicle and equipment maintenance and cleaning areas that are exposed to precipitation.

(i) Location of receiving streams or other surface water bodies.

(j) Locations of outfalls and the types of discharges contained in the drainage areas of the outfalls.

(2) *Inventory of Exposed Materials*. An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the effective date of this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the effective date of this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(3) *Spills and Leaks*. A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the effective date of this permit. Such list shall be updated as appropriate during the term of the permit.

(4) *Sampling Data*. A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(5) *Summary of Potential Pollutant Sources and Risk Assessment*. A narrative description of the potential pollutant sources from the following activities associated with treatment works: access roads/rail lines; loading and unloading operations; outdoor storage activities; material handling sites; outdoor vehicle storage or maintenance sites; significant dust or particulate generating processes; and onsite waste disposal practices. Specific potential pollutants shall be identified where known.

c. *Measures and Controls*. The permittee shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(1) *Good Housekeeping*. All areas that may contribute pollutants to storm waters discharges shall be maintained in a clean, orderly manner. These are practices that would minimize the generation of pollutants at the source or before it would be necessary to employ sediment ponds or other control measures at the discharge outlets. Where applicable, such measures or other equivalent measures would include the following: sweepers and covered storage to minimize dust generation and storm runoff; conservation of vegetation where possible to minimize erosion; sweeping of haul roads, bio-solids access points, and exits to reduce or eliminate off site tracking; sweeping of sand or salt storage areas to minimize entrainment in storm water runoff; collection, removal, and proper disposal of waste oils and other fluids resulting from vehicle and equipment maintenance; other equivalent measures to address identified potential sources of pollution.

(2) *Preventive Maintenance*. A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(3) *Spill Prevention and Response Procedures*. Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points, shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures and equipment for

cleaning up spills shall be identified in the plan and made available to the appropriate personnel.

(4) *Inspections*. In addition to the comprehensive site evaluation required under paragraph (*Part IV.C.1.c.(10))* of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a periodic basis. The following areas shall be included in all inspections: access roads/rail lines, equipment storage and maintenance areas (both indoor and outdoor areas); fueling; material handling areas, residual treatment, storage, and disposal areas; and wastewater treatment areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist developed by the facility is encouraged.

(5) *Employee Training*. Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify how often training will take place, but training should be held at least annually (once per calendar year). Employee training must, at a minimum, address the following areas when applicable to a facility: petroleum product management; process chemical management; spill prevention and control; fueling procedures; general good housekeeping practices; proper procedures for using fertilizers, herbicides and pesticides.

(6) *Record keeping and Internal Reporting Procedures*. A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(7) *Non-storm Water Discharges*.

(a) *Certification*. The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with *Part VII.G* of this permit.

(b) *Exceptions*. Except for flows from firefighting activities, sources of non-storm water listed in *Part IV.B.* (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(c) *Failure to Certify*. Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the *Director* within 180 days after the effective date of this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the State, which are not, authorized by a *UPDES* permit are unlawful, and must be terminated.

(8) *Sediment and Erosion Control*. The plan shall identify areas, which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(9) *Management of Runoff*. The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity *Part IV.C.1.b* (Description of Potential Pollutant Sources) of this permit] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices and discharging storm water through the waste water facility for treatment.

(10) *Comprehensive Site Compliance Evaluation*. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with *Part IV.C.1.b* (Description of Potential Pollutant Sources) of this section and pollution prevention measures and controls identified in the plan in accordance with

Part IV.C.1.c. (Measures and Controls) of this section shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph *(b)* (above) shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with *Part VII.G* (Signatory Requirements) of this permit.

(11) *Deadlines for Plan Preparation and Compliance*. The permittee shall prepare and implement a plan in compliance with the provisions of this section within 270 days of the effective date of this permit. If the permittee already has a plan, it shall be revised according to *Part IV.C.1.c.(10)*, Comprehensive Site Evaluation.

(12) *Keeping Plans Current*. The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, that has a significant effect on the potential for the discharge of pollutants to the waters of the state or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified by the plan, or in otherwise achieving the general objective of controlling pollutants in storm water discharges associated with the activities at the facility.

D. Monitoring and Reporting Requirements.

1. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each of the following designated periods during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event: January through March; April through June; July through September; and October through December.

a. *Sample and Data Collection*. Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

b. *Visual Storm Water Discharge Examination Reports*. Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

c. *Representative Discharge*. When the permittee has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

d. *Adverse Conditions*. When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the results of the visual examination. Adverse weather conditions, which may prohibit the collection of samples, include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

e. *Inactive and Unstaffed Site*. When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

V. MONITORING, RECORDING & GENERAL REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under *Part I* shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge. Samples of biosolids shall be collected at a location representative of the quality of biosolids immediately prior to the use-disposal practice.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under *Utah Administrative Code ("UAC") R317-2-10 and 40CFR Part 503*, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The *Act* provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

E. Additional Monitoring by the Permittee. If the permittee monitors any parameter more frequently than required by this permit, using test procedures approved under *UAC R317-2-10* and *40 CFR 503* or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR or the Biosolids Report Form. Such increased frequency shall also be indicated. Only those parameters required by the permit need to be reported.

F. Records Contents. Records of monitoring information shall include:

1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

G. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least five years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time. A copy of this UPDES permit must be maintained on site during the duration of activity at the permitted location

H. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall (orally) report any noncompliance including transportation accidents, spills, and uncontrolled runoff from biosolids transfer or land application sites which may seriously endanger health or environment, as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of circumstances. The report shall be made to the Division of Water Quality, (801) 536-4300, or 24-hour answering service (801) 536-4123.

2. The following occurrences of noncompliance shall be reported by telephone (801) 536-4300 as soon as possible but no later than 24 hours from the time the permittee becomes aware of the circumstances:

   a. Any noncompliance which may endanger health or the environment;

   b. Any unanticipated bypass, which exceeds any effluent limitation in the permit (See *Part VI.G, Bypass of Treatment Facilities.)*;

   c. Any upset which exceeds any effluent limitation in the permit (See *Part VI.H*, *Upset Conditions*.);

   d. Violation of a daily discharge limitation for any of the pollutants listed in the permit; or,

   e. Violation of any of the Table 3 metals limits, the pathogen limits, the vector attraction reduction limits or the management practices for biosolids that have been sold or given away.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected;

   d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance; and,

   e. Steps taken, if any, to mitigate the adverse impacts on the environment and human health during the noncompliance period.

4. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Division of Water Quality, (801) 536-4300.

5. Reports shall be submitted to the addresses in *Part I.D*, *Reporting of Monitoring Results*.

I. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for *Part I.D* are submitted. The reports shall contain the information listed in *Part V.H.3*

J. Inspection and Entry The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, including but not limited to, biosolids treatment, collection, storage facilities or area, transport vehicles and containers, and land application sites;

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the *Act*, any substances or parameters at any location, including, but not limited to, digested biosolids before dewatering, dewatered biosolids, biosolids transfer or staging areas, any ground or surface waters at the land application sites or biosolids, soils, or vegetation on the land application sites; and,

5. The permittee shall make the necessary arrangements with the landowner or leaseholder to obtain permission or clearance, the Director, or authorized representative, upon the presentation of credentials and other documents as may be required by law, will be permitted to enter without delay for the purposes of performing their responsibilities.

VI. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The *Act* provides that any person who violates a permit condition implementing provisions of the *Act* is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions or the Act is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under *UCA 19-5-115(2)* a second time shall be punished by a fine not exceeding $50,000 per day. Except as provided at *Part VI.G*, *Bypass of Treatment Facilities* and *Part VI.H*, *Upset Conditions*, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit, which has a reasonable likelihood of adversely affecting human health or the environment. The permittee shall also take all reasonable steps to minimize or prevent any land application in violation of this permit.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems, which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

F. Removed Substances. Collected screening, grit, solids, sludge, or other pollutants removed in the course of treatment shall be disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge/digester supernatant and filter backwash shall not directly enter either the final effluent or waters of the state by any other direct route.

G. Bypass of Treatment Facilities.

1. Bypass Not Exceeding Limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to paragraph 2 and 3 of this section.

2. Prohibition of Bypass.

   a. Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(1) Bypass was unavoidable to prevent loss of human life, personal injury, or severe property damage;

(2) There were no feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance, and

(3) The permittee submitted notices as required under *section VI.G.3*.

b. The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed in *sections VI.G.2.a (1), (2) and (3)*.

3. Notice.

a. *Anticipated bypass*. Except as provided above in *section VI.G.2* and below in *section VI.G.3.b*, if the permittee knows in advance of the need for a bypass, it shall submit prior notice, at least ninety days before the date of bypass. The prior notice shall include the following unless otherwise waived by the Director:

(1) Evaluation of alternative to bypass, including cost-benefit analysis containing an assessment of anticipated resource damages:

(2) A specific bypass plan describing the work to be performed including scheduled dates and times. The permittee must notify the Director in advance of any changes to the bypass schedule;

(3) Description of specific measures to be taken to minimize environmental and public health impacts;

(4) A notification plan sufficient to alert all downstream users, the public and others reasonably expected to be impacted by the bypass;

(5) A water quality assessment plan to include sufficient monitoring of the receiving water before, during and following the bypass to enable evaluation of public health risks and environmental impacts; and,

(6) Any additional information requested by the Director.

b. *Emergency Bypass*. Where ninety days advance notice is not possible, the permittee must notify the Director, and the Director of the Department of Natural Resources, as soon as it becomes aware of the need to bypass and provide to the Director the information in *section VI.G.3.a.(1) through (6)* to the extent practicable.

c. *Unanticipated bypass*. The permittee shall submit notice of an unanticipated bypass to the Director as required under *Part IV.H*, Twenty Four Hour Reporting. The permittee shall also immediately notify the Director of the Department of Natural

Resources, the public and downstream users and shall implement measures to minimize impacts to public health and environment to the extent practicable.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of paragraph 2 of this section are met. Director's administrative determination regarding a claim of upset cannot be judiciously challenged by the permittee until such time as an action is initiated for noncompliance.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated;

   c. The permittee submitted notice of the upset as required under *Part V.H*, *Twenty-four Hour Notice of Noncompliance Reporting*; and,

   d. The permittee complied with any remedial measures required under *Part VI.D*, *Duty to Mitigate*.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

VII. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when the alteration or addition could significantly change the nature or increase the quantity of parameters discharged or pollutant sold or given away. This notification applies to pollutants, which are not subject to effluent limitations in the permit. In addition, if there are any planned substantial changes to the permittee's existing sludge facilities or their manner of operation or to current sludge management practices of storage and disposal, the permittee shall give notice to the Director of any planned changes at least 30 days prior to their implementation.

B. Anticipated Noncompliance. The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity, which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee shall apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Director, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Director shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Director, and,

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position

having overall responsibility for environmental matters. A duly authorized representative may thus be either a named individual or any individual occupying a named position.

3. Changes to authorization. If an authorization under *paragraph VII.G.2* is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of *paragraph VII.G.2.* must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The *Act* provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000.00 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential under *UAC R317-8-3.2*, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of Director. As required by the *Act*, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the permittee of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under the *Act*.

K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability. The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Director at least 20 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittee's containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Director does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph *2* above.

N. State or Federal Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by *UCA 19-5-117* and *Section 510* of the *Act* or any applicable Federal or State transportation regulations, such as but not limited to the Department of Transportation regulations.

O. Water Quality - Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. Water Quality Standards for the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. A final wasteload allocation is developed and approved by the State and/or EPA for incorporation in this permit.

3. Revisions to the current CWA § 208 areawide treatment management plans or promulgations/revisions to TMDLs (40 CFR 130.7) approved by the EPA and adopted by DWQ which calls for different effluent limitations than contained in this permit.

P. Biosolids – Reopener Provision. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate biosolids limitations (and compliance schedule, if necessary), management practices, other appropriate requirements to protect public health and the environment, or if there have been substantial changes (or such changes are planned) in biosolids use or disposal practices; applicable management practices or numerical limitations for pollutants in biosolids have been promulgated which are more stringent than the requirements in this permit; and/or it has been determined that the permittees biosolids use or land application practices do not comply with existing applicable state of federal regulations.

Q. Toxicity Limitation - Reopener Provision.

This permit may be reopened and modified (following proper administrative procedures) to include WET testing, a WET limitation, a compliance schedule, a compliance date, additional or modified numerical limitations, or any other conditions related to the control of toxicants if toxicity is detected during the life of this permit.

R. Storm Water-Reopener Provision. At any time during the duration (life) of this permit, this permit may be reopened and modified (following proper administrative procedures) as per *UAC R317.8*, to include, any applicable storm water provisions and requirements, a storm

water pollution prevention plan, a compliance schedule, a compliance date, monitoring and/or reporting requirements, or any other conditions related to the control of storm water discharges to "waters-of-State".

VIII. DEFINITIONS

A. Wastewater.

1. The "7-day (and weekly) average", other than for *E. coli* bacteria, fecal coliform bacteria, and total coliform bacteria, is the arithmetic average of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. Geometric means shall be calculated for *E. coli* bacteria, fecal coliform bacteria, and total coliform bacteria. The 7-day and weekly averages are applicable only to those effluent characteristics for which there are 7-day average effluent limitations. The calendar week, which begins on Sunday and ends on Saturday, shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for that calendar week shall be included in the data for the month that contains Saturday.

2. The "30-day (and monthly) average," other than for *E. coli* bacteria, fecal coliform bacteria and total coliform bacteria, is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. Geometric means shall be calculated for *E. coli* bacteria, fecal coliform bacteria and total coliform bacteria. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

3. "Act," means the *Utah Water Quality Act*.

4. "Acute toxicity" occurs when 50 percent or more mortality is observed for either test species at any effluent concentration (lethal concentration or "LC_{50}").

5. "Annual Loading Cap" is the highest allowable phosphorus loading discharged over a calendar year, calculated as the sum of all the monthly loading discharges measured during a calendar year divided by the number of monthly discharges measured during that year.

6. "Bypass," means the diversion of waste streams from any portion of a treatment facility.

7. "Chronic toxicity" occurs when the IC_{25}< XX% effluent. The XX% effluent is the concentration of the effluent in the receiving water, at the end of the mixing zone expressed as per cent effluent.

8. "IC_{25}" is the concentration of toxicant (given in % effluent) that would cause a 25% reduction in mean young per female, or a 25% reduction in overall growth for the test population.

9. "Composite Samples" shall be flow proportioned. The composite sample shall, as a minimum, contain at least four (4) samples collected over the compositing period. Unless otherwise specified, the time between the collection of the first sample and the last sample shall not be less than six (6) hours nor more than 24 hours. Acceptable methods for preparation of composite samples are as follows:

a. Constant time interval between samples, sample volume proportional to flow rate at time of sampling;

b. Constant time interval between samples, sample volume proportional to total flow (volume) since last sample. For the first sample, the flow rate at the time the sample was collected may be used;

c. Constant sample volume, time interval between samples proportional to flow (i.e., sample taken every "X" gallons of flow); and,

d. Continuous sample volume, with sample collection rate proportional to flow rate.

10. "CWA," means *The Federal Water Pollution Control Act*, as amended, by *The Clean Water Act of 1987*.

11. "Daily Maximum" (Daily Max.) is the maximum value allowable in any single sample or instantaneous measurement.

12. "EPA," means the United States Environmental Protection Agency.

13. "Director," means Director of the Division of Water Quality.

14. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

15. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

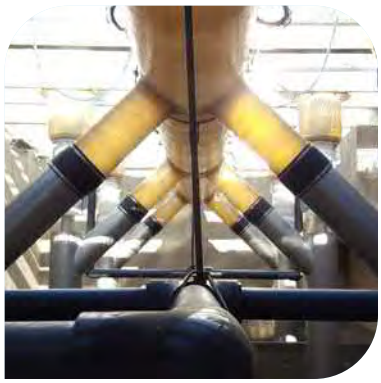
16. "Severe Property Damage," means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

17. "Upset," means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

APPENDIX F

ADDITIONAL INFORMATION ON RECOMMENDED PLANT EQUIPMENT

Parkson™
Treating Water Right



DynaSand®

Continuous Upflow, Granular Media Filter

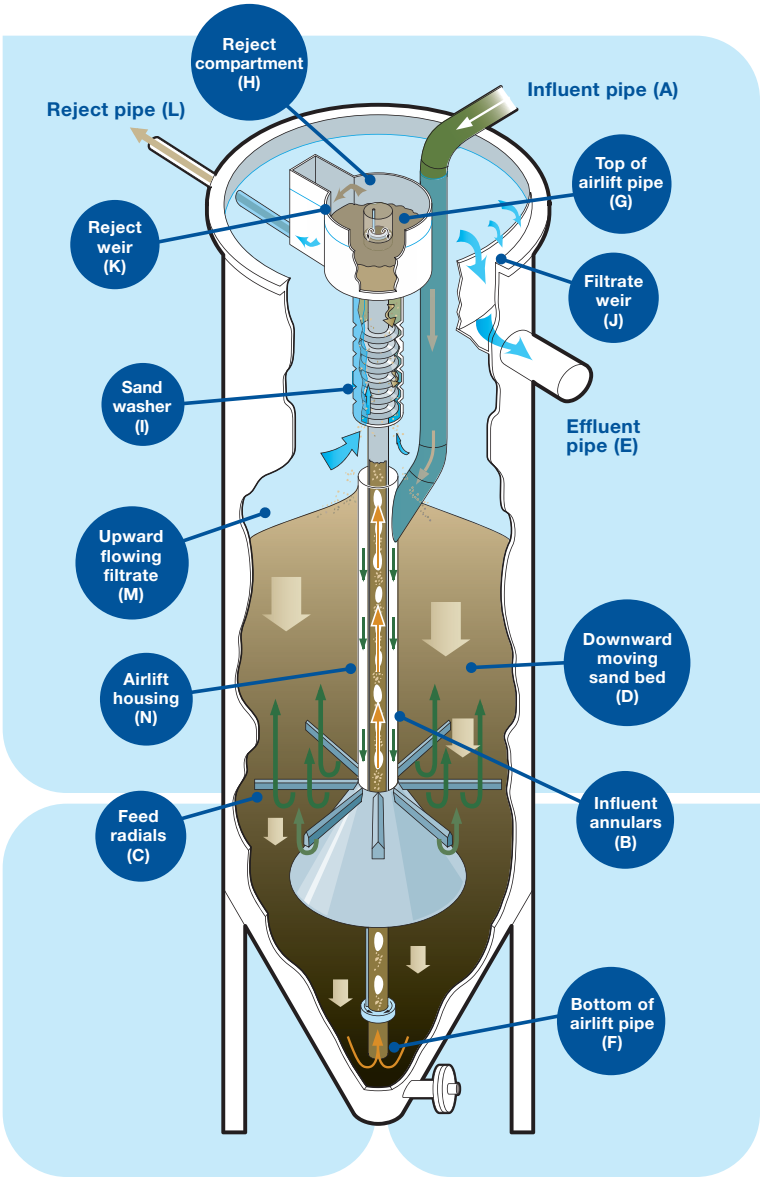
- Continuously cleaned sand bed
- Low power requirement
- Elimination of ancillary backwash equipment
- Reduced operator attention

Great performance, low maintenance

The DynaSand® filter is an upflow, deep bed, granular media filter with continuous backwash. The filter media is cleaned by a simple internal washing system that does not require backwash pumps or storage tanks. The absence of backwash pumps means low energy consumption.

The DynaSand filter's deep media bed allows it to handle high levels of suspended solids. This heavy-duty performance may eliminate the need for pre-sedimentation or flotation steps in the treatment process of some applications.

The DynaSand filter is available in various sizes and configurations. This flexibility allows for customization to fit specific site and application requirements.



DynaSand Filter Principles of Operation

Influent Filtration

Influent feed is introduced at the top of the filter (A) and flows downward through an annular section (B) between the influent feed pipe and airlift housing. The feed is introduced into the bottom of the sand bed through a series of feed radials (C) that are open at the bottom. As the influent flows upward (M) through the downward moving sand bed (D), organic and inorganic impurities are captured by the sand. The clean, polished filtrate continues to move upward and exits at the top of the filter over the filtrate weir (J) and out through the effluent pipe (E).

Sand Self-Cleaning

The sand bed containing captured impurities is drawn downward around the center of the filter where the airlift pipe is located. A small volume of compressed air is shot at the bottom of the airlift (F), drawing the sand into the airlift pipe. The sand is scoured within the airlift pipe at an intensity of 100-150 SCFM/ft^2. The effectiveness of this scouring process is vastly greater than what can be expected in conventional sand filtration backwash. The scouring dislodges any solid particles attached to the sand grains.

The dirty slurry is pushed to the top of the airlift (G) and into the reject compartment (H). From the reject compartment, the sand falls down the sand washer (I) and the lighter reject solids are carried over the reject weir (K) and out the reject pipe (L). As the sand cascades down through the concentric stages of the washer, it encounters a small amount of polished filtrate moving upward, driven by the difference in water level between the filtrate pool and the reject weir. The heavier, coarser sand grains fall through this small countercurrent flow while the remaining contaminants are carried back up to the reject compartment. The clean, recycled sand is deposited on the top of the sand bed where it once again begins the influent cleaning process and its eventual migration to the bottom of the filter where it is recycled and the process repeats.

DynaSand® Filter Configurations

The DynaSand filter is available as either stand alone package units or in a modular concrete design as a 40” standard bed or 80” deep-bed design depending on the nature of the application. Package units are available in 304 stainless steel, fiberglass (FRP) and carbon steel (PCS). Internals for both package units and concrete units are available in stainless steel and/or fiberglass. The new segmented airlift is available in high-density polyethylene (HDPE), stainless steel or PVC and provides ease of assembly, installation, shipping and maintenance.

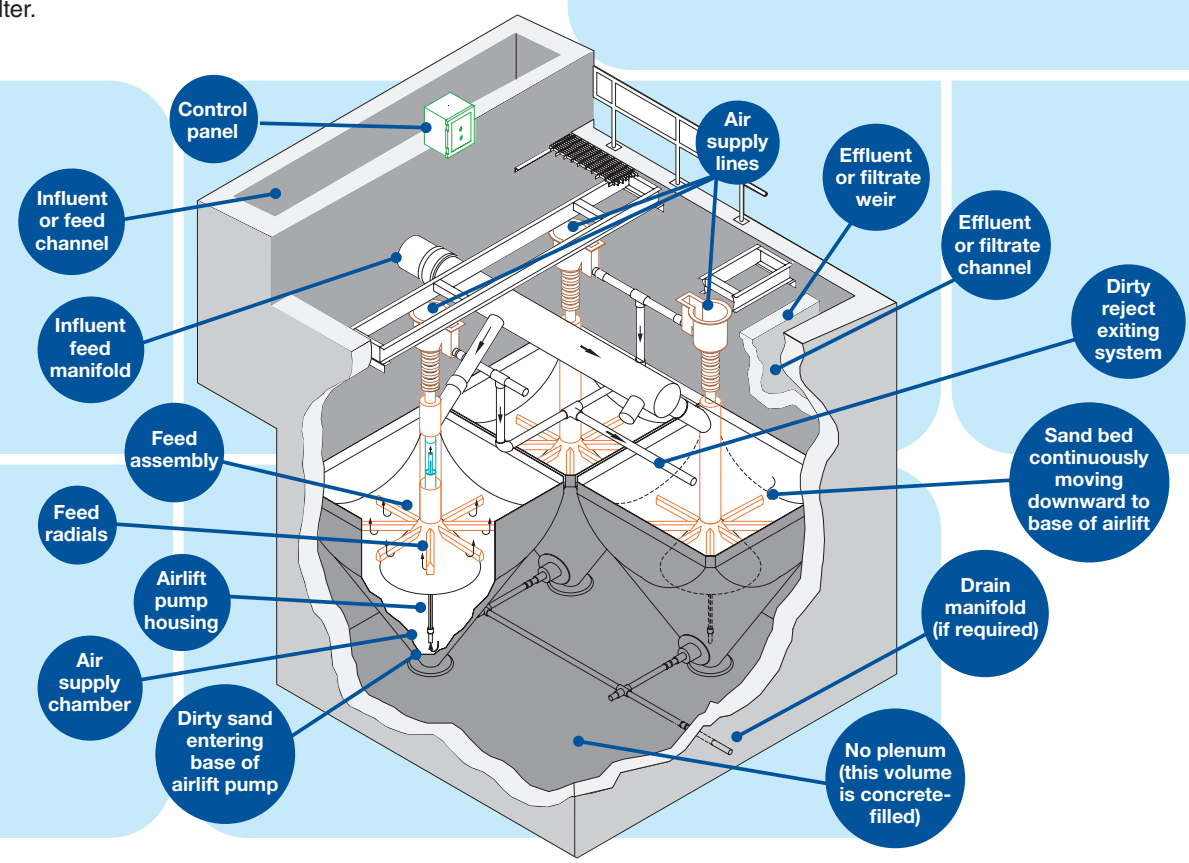
A concrete DynaSand installation can be designed for any size filter area, enabling the technology to be applied to any size water or wastewater treatment plant. Concrete modules are frequently used for high flow capacity systems by placing multiple modules into a common filter cell. The modules in a filter cell share a common filter bed where cones at the bottom of each module distribute sand to their respective airlifts and sand washers. Since all filter beds are being continuously cleaned, the pressure drop remains low and even throughout all the filters. Equal pressure drop ensures even distribution of feed to each filter without the need for splitter boxes or flow controls. Therefore, a typical multiple unit installation can use a common header pipe with feed connections and isolation valves for each filter.

Features

- Continuously cleaned sand bed
- No underdrains or screens
- Sand washed with filtrate
- No level control
- Internal, vertical airlift
- Low power requirements

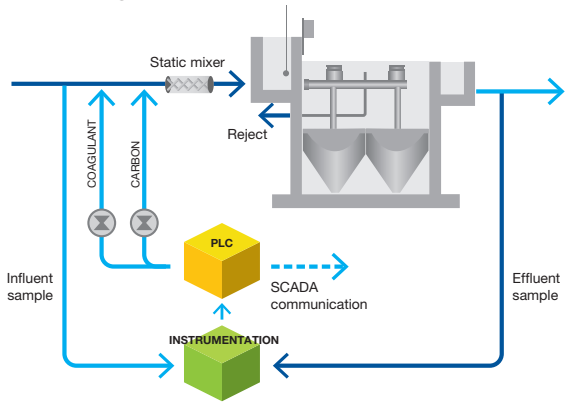
Benefits

- No shutdown for backwash cycles
- Elimination of ancillary backwash equipment
- No flow control valves, splitter boxes, or backwash controls
- No short-circuiting
- Optimum sand-washing efficiency
- Superior filtrate quality
- Reduced operator attention
- Minimizes overall pressure-drop
- Reduces potential for pluggage
- Significantly reduces wear/maintenance
- Can be easily maintained without filter shutdown
- Up to 70% less compressed air vs. other self-cleaning filters



DynaSand® ENR System Overview

Key component of process control and monitoring for meeting low limits



Instrumentation & PLC controls are included in Parkson's scope of supply

DynaSand® Continuous Filtration Process

Water and wastewater treatment in conventional plants typically involves flocculation, clarification and filtration. Direct filtration eliminates clarification, but still requires flocculation. The DynaSand filter utilizes a proprietary process known as Continuous Contact Filtration. The DynaSand filter's 80" media bed depth provides greater hydraulic residence times and more opportunity for floc formation and attachment. Coagulation, flocculation and separation can be performed within the sand bed, eliminating the need for external flocculators and clarifiers. Equipment savings can be substantial, up to 85% compared to conventional treatment and 50% compared to direct filtration. The DynaSand® Continuous Contact Filtration process is best suited to remove small floc, which can help reduce chemical requirements by 20-30% over conventional treatment.

Applications

The DynaSand filter is currently providing exceptional treatment in over 8,600 installations worldwide in a wide variety of applications. Reach out to the Parkson Team for additional information.

DynaSand Filter Applications

- Tertiary filtration
- Algae removal
- Phosphorus removal
- Denitrification
- Cryptosporidium and Giardia removal
- Product recovery
- Potable water (turbidity and color)
- Surface water
- Ground water
- Effluent reuse
- Oil removal
- Process water
- Brine filtration
- Metal finishing
- Cooling tower blowdown
- Steel mill scale
- Chemical processing
- Arsenic removal

Typical Data	Loading Rate (gpm/ft^2)	Influent Solids	Filtrate Solids
Tertiary Filtration	3-5	20-50 ppm SS	5-10 ppm SS
Algae Removal	2-4	100 ppm SS	10-20 ppm SS
Phosphorus Removal	3-5	<1 ppm Total P	<0.1 ppm Total P
Denitrification	3-4	10-15 ppm TN	<3 ppm TN
Potable Water – Turbidity	4-5	10-30 NTU	0.1-0.5 NTU
Potable Water – Color	4-5	10-120 ACU	1-5 ACU
Oil Removal	2-6	<50 ppm O&G	5-10 ppm O&G
Process Water	5	10-30 NTU	0.1-0.5 NTU
Metal Finishing	4-6	20-50 ppm SS	2-5 ppm SS
Steel Mill Scale	8-10	50-300 ppm SS	5-10 ppm SS

Parkson™ Est. 1960

Fort Lauderdale
Chicago
Kansas City
Denver

1.888.PARKSON
technology@parkson.com
www.parkson.com

DSF

Raptor® Fine Screen

Stainless Steel Construction
Efficiently Removes Solids
and Debris

LAKESIDE
EQUIPMENT CORPORATION
Water Purification Since 1928

Cleaner Water for a Brighter Future®

Engineered for Superior Operation and Performance

The Lakeside *Raptor*® Fine Screen is an efficient, proven screening technology for removal of inorganic solids that can be harmful to downstream equipment in municipal and industrial wastewater applications. High removal efficiency and low headloss is achieved with the *Raptor*® Fine Screen's unique inclined cylindrical screenings basket design having varied screen bar heights. The *Raptor*® Fine Screen's rotating rake teeth fully penetrate the screen bars to positively remove captured debris and prevent grease from blinding or plugging the screenings basket, making the *Raptor*® Fine Screen ideal for septage receiving, sludge, scum and grease trap applications. The heavy-duty design provides durability and long life in the most severe conditions. Captured screenings are compacted, dewatered and washed free of most organics to approximately 40 percent solids. Volume is reduced by 50 percent and weight by 67 percent, thereby reducing disposal cost.

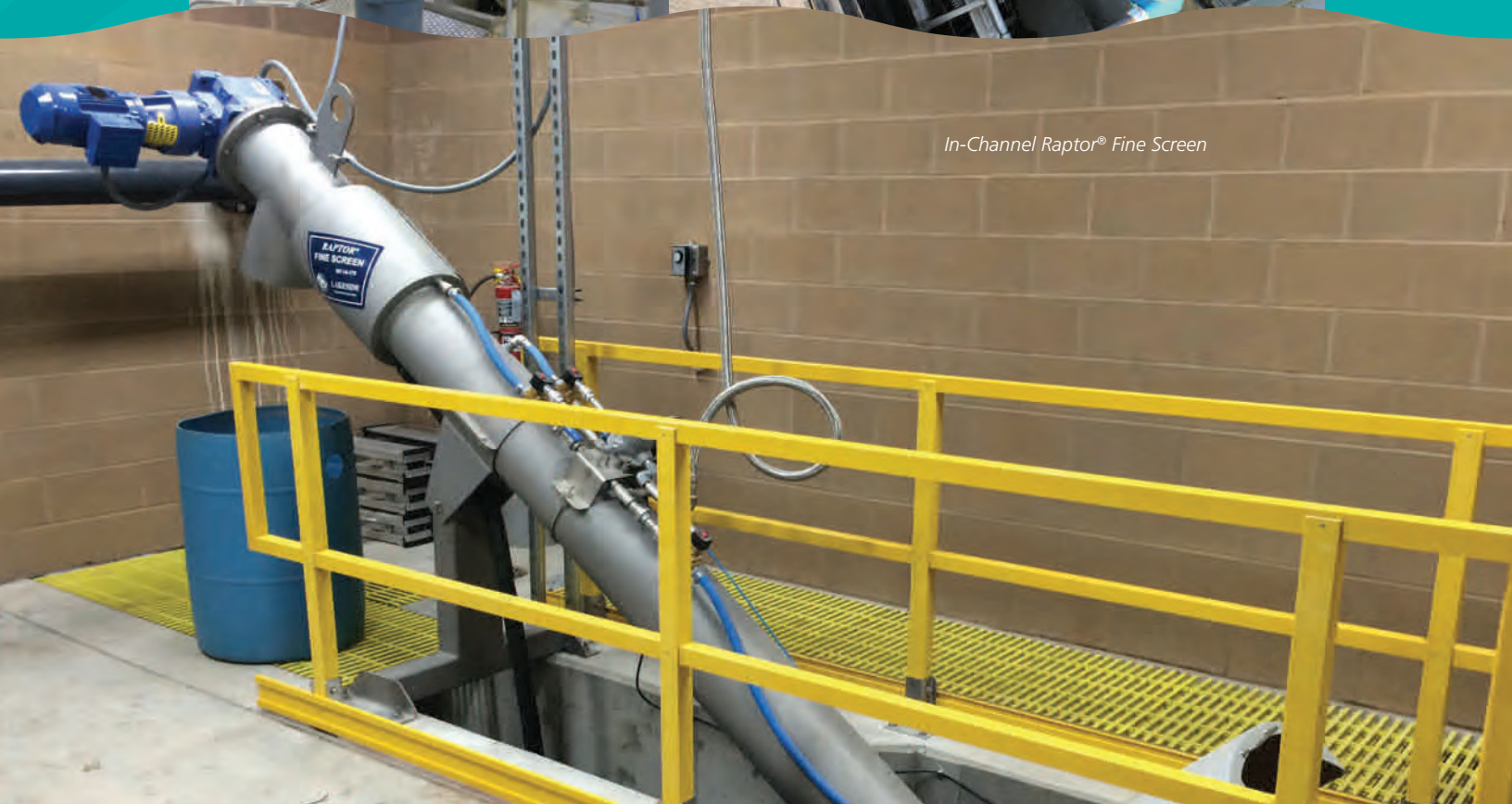
- All stainless steel construction resists corrosion
- Combines 4 processes in one unit (screens, washes, compacts and dewaters)
- Uniquely designed three plane screenings basket minimizes headloss
- Fully penetrating rake teeth prevent screen basket from plugging and blinding
- Dual spray wash system provides cleaner discharge screenings
- Integrated compaction zone reduces volume and weight for reduced disposal cost
- Enclosed transport tube and optional bagger attachment reduce odors

Made in the USA to our quality standards for performance you can trust.

Raptor® Fine Screen with Continuous Bagger

Raptor® Fine Screen with Hinged Access Cover

In-Channel Raptor® Fine Screen



Four Operations in One Unit
Screens, Washes, Compacts and Dewaters

Screen Operation

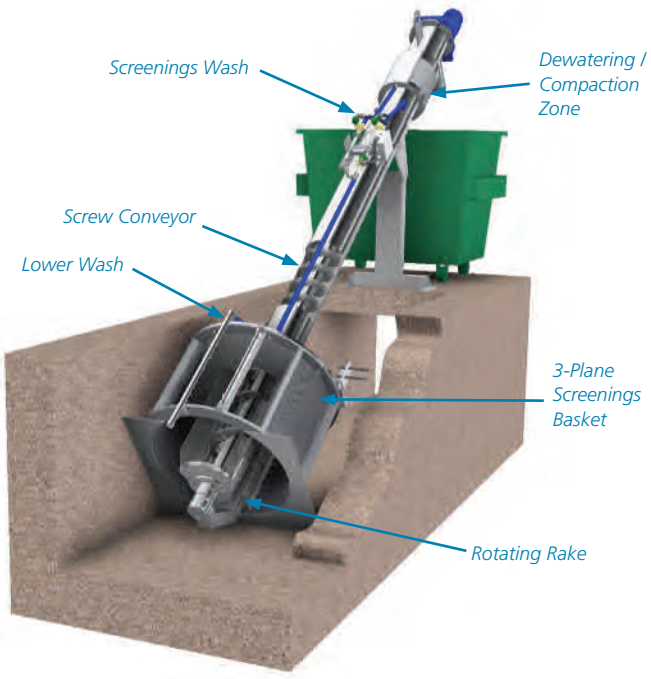
As wastewater flows through the screenings basket, solids are captured by the screen bars that form the unique 3-plane cylindrical basket.

When the upstream water level rises to a high level set point, the rake arm begins to rotate for removal of the captured material. After the rake arm makes a complete revolution, material falls into a collection trough. For complete cleaning, the rake arm reverses direction at the top of the screenings basket and passes through a hinged cleaning comb. The debris is removed from the collection trough by a central screw conveyor. The conveyed material travels up the inclined transport tube where the material is washed, compacted, and dewatered prior to being discharged into a debris container.

Raptor® Fine Screen with Weather Protection

Raptor® Fine Screens with Conveyor

Tank-Mounted Raptor® Fine Screens Handling Sludge



Raptor® Fine Screen

- Hinged structural support allows unit to pivot out of channel for maintenance at floor level
- PLC-equipped control panel for versatile and efficient operation
- Simple drive assembly makes service easy and reduces maintenance costs
- All mating parts are machined to ensure proper fit and operation
- Unit is shipped fully assembled to minimize installation expenses
- Entire unit can be enclosed in a pre-engineered tank for additional protection
- Explosion-proof designs are available
- Optional weather protection system protects to 13° F below zero (minus 25° C)

Stainless steel construction for superior corrosion resistance.

Treatment equipment and process solutions from Lakeside Equipment Corporation

Lakeside offers a wide range of equipment and systems for virtually all stages of wastewater treatment from influent through final discharge. Each process and equipment item that we supply is manufactured with one goal: to reliably improve the quality of our water resources in the most cost-effective way. We have been doing just that since 1928.

Screw Pumps
- Open Screw Pumps
- Enclosed Screw Pumps

***Raptor*® Screening**
- Fine Screen
- Micro Strainer
- Rotating Drum Screen
- Septage Acceptance Plant
- Septage Complete Plant
- Complete Plant
- Multi-Rake Bar Screen
- Wash Press

Screen and Trash Rakes
- Hydronic T Series
- Hydronic K Series
- Hydronic Multifunctional Series
- Hydronic H Series
- Catronic Series
- Monorail Series
- HY-TEC Screen
- CO-TEC Screen
- RO-TEC Screen

Grit Collection
- SpiraGrit
- Aeroductor
- In-Line Grit Collector
- *Raptor*® Grit Washer
- Grit Classifier
- H-PAC®

Clarification and Filtration
- Spiraflo Clarifier
- Spiravac Clarifier
- Full Surface Skimming
- MicroStar® Filter

Biological Treatment
- CLR Process
- Magna Rotor Aerators & Accessories
- Sequencing Batch Reactors
- Package Treatment Plants
- Submersible Mixers & Recirculation Pumps

Hauled Waste Receiving Systems
- *Raptor*® Septage Acceptance Plant
- *Raptor*® Septage Complete Plant

Package Headworks Systems
- *Raptor*® Complete Plant
- H-PAC®

Biological Treatment Systems
- CLR Process
- Package Treatment Plants
- Sequencing Batch Reactors

LAKESIDE EQUIPMENT CORPORATION
Water Purification Since 1928

1022 E. Devon, P.O. Box 8448
Bartlett, IL 60103
630.837.5640 FAX: 630.837.5647
E-mail: sales@lakeside-equipment.com

www.lakeside-equipment.com