Statepoint Engineering
Wastewater Processes
Evaluation & Training

TECHNICAL MEMORANDUM

TO: Wasatch Front Water Quality Council

FROM: Paul Krauth, PE
Statepoint Engineering

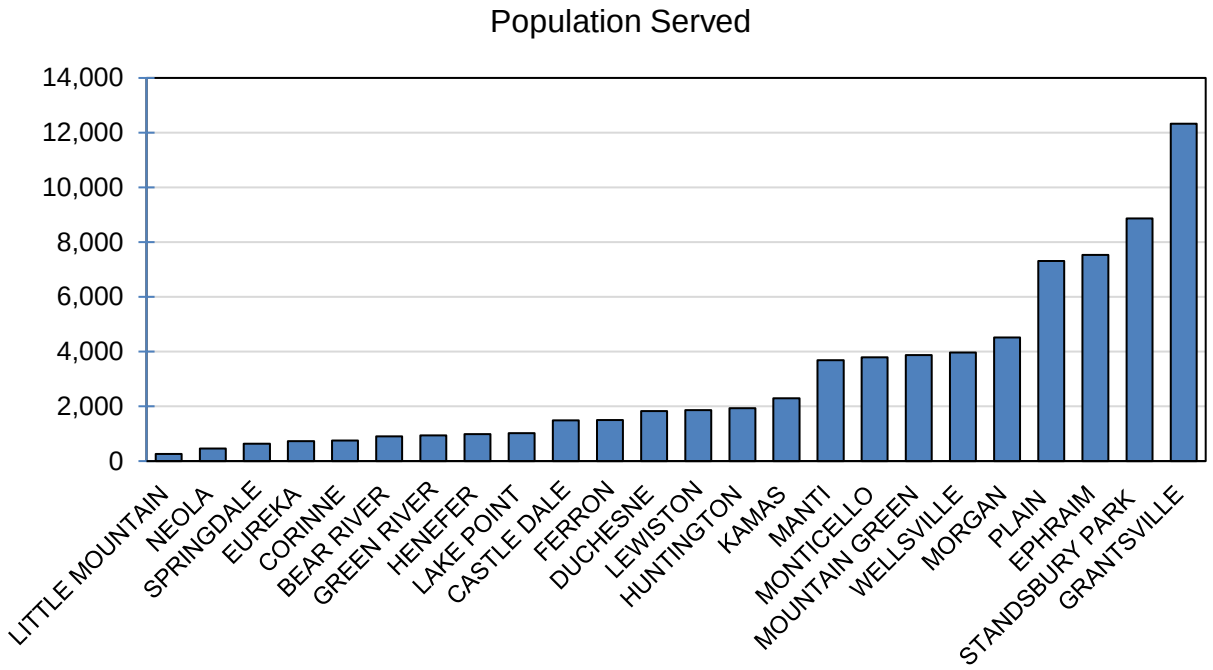
DATE: September 28, 2019

SUBJECT: Municipal Wastewater Lagoons Projected Need Through 2060

Background

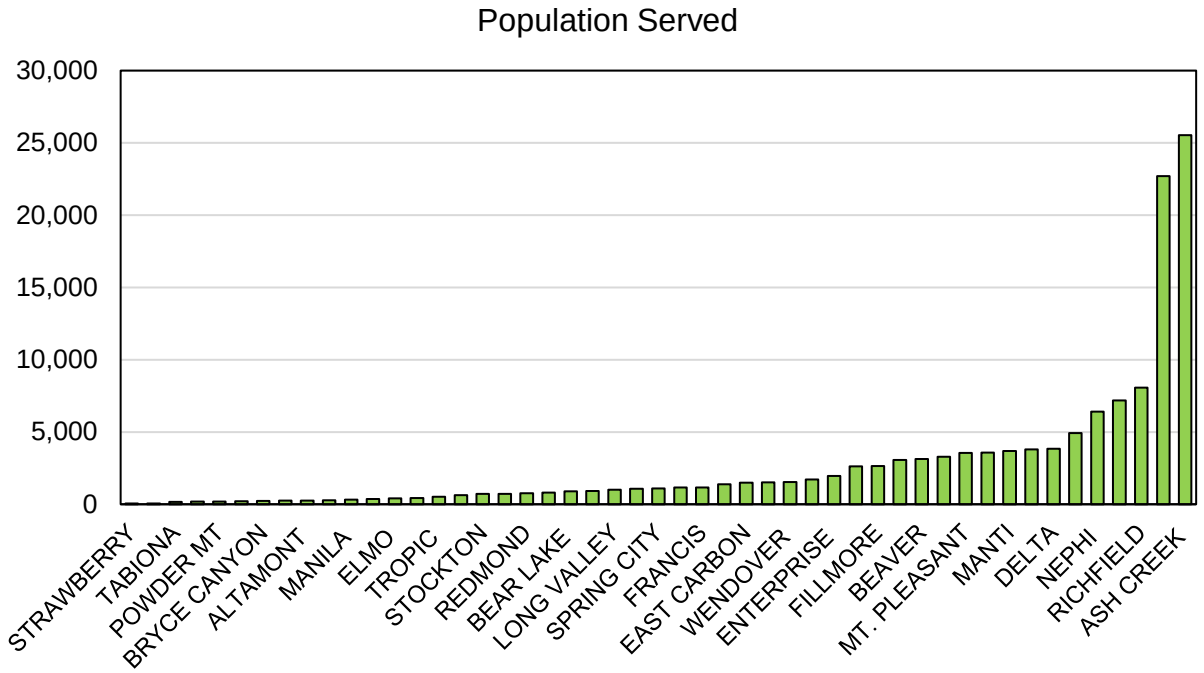
In terms of sheer numbers, the wastewater lagoon system is the predominate treatment process in the State of Utah. Currently there are 75 permitted municipal systems in the State. Of these 26 are discharging to waters of the State. The remaining 49 are percolation/evaporation or land application systems that discharge into the groundwater (which is also a water of the State). Of the 26 discharging systems, two (Logan and Salem) are being replaced by mechanical plants and were not included in this evaluation.

The remaining 24 discharging lagoons serve an estimated population of 73,500.



The 49 non-discharging systems are often called total containment (a misnomer). If a lagoon system does not discharge to surface water, evaporation and percolation are the pathways for disposal. While in Southern Utah evaporations are quite high (net 47.6 inches per year at Lake Powell), most of the water still percolates into the ground. The Utah design standards allow up to 91.25 inches per year of percolation.

Theses 49 “non- discharging” lagoons serve an estimated population of 132,500.



Current Capacities Evaluation Methodology

There are two categories these systems fall into; discharging (UPDES permit) and non-discharging (Operating permit). They were evaluated using a differing method for each classification.

UPDES systems

While the discharging systems are subject to State inspections, this has dropped recently from yearly to twice in a permit cycle (5 years). The only reasonable method given the time constraints on this memo, was a quick hydraulic capacity evaluation using EPA echo website for flow data comparing it to existing populations and design capacity. The current per capita flow was estimated as was used to project flow for 2060. Fortunately, the design capacity of each system is documented within the UPDES permit.

Operating Permits Systems

Initially the non-discharging system were to be inspected annual, lack of resources has caused the State to curtail this program. Since flow records are sporadic at best with these facilities. Population projections were used as a surrogate, with an assumed per capita flow of 100 gallons per person. Unfortunately, the design capacity of these system is not readily available, but I have not hear back from DWQ with this information. Additionally, not all of these systems have a known capacity. Using Google Earth each site was inspected for dry cells during the spring, to provide a "feel" for their existing capacities.

Population Projections for Each Facility

The 2060 populations were estimated using the University of Utah The Kem C. Gardner Policy Institute long-term demographic and economic projections for the state of Utah and its counties. These 50-year state and county projections extend from 2015 to 2065. Each city was estimated using a 2015 know population and the average growth rate per decade for each county, this provided a better estimation the a straight tline growth projection. (appendix A)

Discharging Lagoon Evaluation Results

These lagoons can be sorted into aerated versus non-aerated systems. This is important to the hydraulic capacities and the expansion capabilities of each. Utah design standards require a detention time of 120 days based on winter flow and the maximum operating depth of the entire system for a non-aerated system. If aeration is added then the required detention time becomes 30 days. By adding aeration an existing non-aerated lagoon could expand their hydraulic capacity by a factor of 4, using the existing ponds. Therefore, existing facultative (non-aerated) discharging lagoon have a great amount of expansion capacity without building new cells.

Discharging Facultative Lagoons

Facility	Design Capacity	Current Flow	Percent of Capacity
BEAR RIVER *	360,000	280,000	77.78%
CORINNE	200,000	142,000	71.00%
DUCHESNE *	420,000	210,000	50.00%
EPHRAIM *	500,000	1,120,000	224.00%
HENEFER *	230,000	120,000	52.17%
LEWISTON	210,000	228,000	108.57%
LITTLE MOUNTAIN	250,000	Not Reporting	Est 15%
MANTI *	330,000	525,000	159.09%
MONTICELLO *	320,000	520,000	162.50%
NEOLA	170,000	200,000	117.65%

- Intermittent discharging, not continuous flows

It is quite apparent that there is an existing hydraulic capacity problem with these lagoons. Even more of interest is that system that are exceeding capacity, are not continuously discharging. The only explanation that comes to mind is they a seeping at an excessive rate potentially contaminating the underlying groundwater. Little Mountain was omitted from further calculations due to having such a large capacity available.

Facility	2019 Population	2060 Population	Net Increase
BEAR RIVER *	910	1,262	340
CORINNE	758	1,051	283
DUCHESNE *	1,832	2,517	654
EPHRAIM *	7,532	10,620	3,088
HENEFER *	987	1,479	477
LEWISTON	1,866	2,907	1,012
MANTI *	3,693	5,263	1,531
MONTICELLO *	2,080	2,638	558
NEOLA	466	640	166

But looking at their per capita flow sheds some light of the sources of the high flows. This implies that Neola and Monticello, along with Bear River and Corrine to lesser extent has a high inflow and infiltration problem. So an estimate of 150 per capita was used to estimate Neola and Monticello's future flows. Using the existing per capita flows and the estimated populations for 2060 gives the following results

Facility	Population	Current Flow	Per Capita
BEAR RIVER *	910	280,000	307.7
CORINNE	758	142,000	187.3
DUCHESNE *	1,832	210,000	114.6
EPHRAIM *	7,532	1,120,000	148.7
HENEFER *	987	120,000	121.6
LEWISTON	1,866	228,000	122.2
MANTI *	3,693	525,000	142.2
MONTICELLO *	2,080	520,000	250.0
NEOLA	466	200,000	429.2

Facility	Design Capacity	2060 Est Flow	Percent of Capacity
BEAR RIVER *	360,000	331,000	91.94%
CORINNE	200,000	184,500	92.25%
DUCHESNE *	420,000	288,500	68.69/%
EPHRAIM *	500,000	1,579,000	315.8%
HENEFER *	230,000	180,000	78.26%
LEWISTON	210,000	355,000	169.0%
MANTI *	330,000	748,500	226.8%
MONTICELLO *	320,000	603,500	188.6%
NEOLA	170,000	225,000	132.4%

All these systems will exceed the existing flow by more than 125% before 2060 thus being affected by the phosphorus cap limitations.

Discharging Aerated Lagoons

Facility	Design Capacity	Current Flow	Percent of Capacity
CASTLE DALE	700,000	195,000	27.86%
EUREKA	200,000	200,000	100.00%
FERRON	1,000,000	201,000	20.10%
GRANTSVILLE	760,000	975,000	128.29%
GREEN RIVER	560,000	211,000	37.68%
HUNTINGTON	300,000	225,000	75.00%
KAMAS	1,000,000	296,000	29.60%
LAKE POINT	200,000	161,000	80.50%
MORGAN	450,000	378,000	84.00%
MOUNTAIN GREEN	680,000	394,000	57.94%
PLAIN CITY	760,000	876,000	115.26%
SPRINGDALE	290,000	300,000	103.45%
STANSBURY PARK	2,700,000	893,000	33.07%
WELLSVILLE	800,000	484,000	60.50%

These lagoons system do not appear to have much of an existing hydraulic capacity problem with these lagoons.

Facility	2019 Population	2060 Population	Net Increase
CASTLE DALE	2,824	3,448	624
EUREKA	729	1,337	591
FERRON	1,495	1,827	330
GRANTSVILLE	12,070	19,422	7,094
GREEN RIVER	935	1,142	206
HUNTINGTON	1,934	2,364	427
KAMAS	2,300	3,446	1,112
LAKE POINT	1,025	1,649	602
MORGAN	4,512	7,293	2,649
MOUNTAIN GREEN	3,676	5,941	2,158
PLAIN CITY	7,306	9,963	2,562
SPRINGDALE	641	1,365	707
STANSBURY PARK	8,869	14,271	5,212
WELLSVILLE	3,967	6,179	2,152

As would be expected the facilities surrounds the Wasatch Front metroplex will have the highest population growth.

Looking at their per capita flow sheds some light of the sources of the high flows. Springdale is naturally skewed due to a low resident population being overshadowed by the transient population. There are over 600 hotel rooms in Springdale along with supporting restaurants. So, their per capita flow data is not accurate.

Facility	Population	Current Flow	Per Capita
CASTLE DALE	2,824	195,000	130.6
EUREKA	729	200,000	274.3
FERRON	1,495	201,000	134.4
GRANTSVILLE	12,070	975,000	79.1
GREEN RIVER	935	211,000	225.7
HUNTINGTON	1,934	225,000	116.2
KAMAS	2,300	296,000	128.7
LAKE POINT	1,025	161,000	157.1
MORGAN	4,512	378,000	83.8
MOUNTAIN GREEN	3,676	394,000	101.7
PLAIN CITY	7,306	876,000	119.9
SPRINGDALE	641	300,000	468.0
STANSBURY PARK	8,869	893,000	100.7
WELLSVILLE	3,967	484,000	122.0

Using an estimate of 150 per capita was used to estimate Eureka, Green River and Springdale's future flows. Using the existing per capita flows and the estimated populations for 2060 gives the following results.

Facility	Design Capacity	2060 Est Flow	Percent of Capacity
CASTLE DALE	700,000	450,000	64.29%
EUREKA	200,000	288,500	144.25%
FERRON	1,000,000	245,500	24.55%
GRANTSVILLE	760,000	1,536,000	202.11%
GREEN RIVER	560,000	242,000	43.21%
HUNTINGTON	300,000	274,500	91.50%
KAMAS	1,000,000	443,500	44.35%
LAKE POINT	200,000	259,000	129.50%
MORGAN	450,000	611,000	135.78%
MOUNTAIN GREEN	680,000	604,000	88.82%
PLAIN CITY	760,000	1,194,500	157.17%
SPRINGDALE	290,000	460,000	158.62%
STANSBURY PARK	2,700,000	1,437,000	53.22%
WELLSVILLE	800,000	754,000	94.25%

All these systems will exceed the existing flow by more than 125% before 2060 thus being affected by the phosphorus cap limitations.

Non - Discharging Lagoon Evaluation Results

Since there is a dearth of flow data, and design capacities these facilities will be looked at from a population growth rate only. These systems can be classified as either Evaporation/Percolation or Land Application

Evaporation/Percolation Lagoon Systems

Facility	2019 Population	2060 Population	Net Increase
ALTAMONT	255	350	91
AURORA	1,070	1,418	337
BEAR LAKE	898	1157	259
BEAVER	3,143	4,017	854
BLANDING	3,798	4,883	1,033
CENTERFIELD	1,507	2,148	625
CLAWSON	186	227	41
CLEVELAND	440	537	97
COLUMBIA	376	511	135
DELTA	3,839	4,881	1,008
EAST CARBON	1,484	2,014	512
EAST ZIONS	250	325	75
ELMO	405	494	89
EMERY	268	328	59
ENTERPRISE	1,959	4,172	2,163
ESCALANTE	812	1,022	205
FILLMORE	2,655	3,376	697
FOUNTAIN GREEN	1,174	1,673	487
GUNNISON	3,574	5,150	1,498
HANKSVILLE	218	290	72
HILDALE	3,062	6,521	3,380
HINCKLEY	720	915	189
KANAB	4,922	6,459	1,473
LONG VALLEY	1,015	1333	318

Facility	2019 Population	2060 Population	Net Increase
MANILA	321	437	114
MEXICAN HAT	51	66	14
MILFORD	1,393	1,781	379
MINERSVILLE	918	1,174	250
MT. PLEASANT	3,564	5,080	1,477
MYTON	635	873	227
NEPHI	6,406	11,759	5,200
PANGUITCH	1,712	2,155	432
POWDER MT	200	500	300
REDMOND	756	1,002	238
RICHFIELD	8,065	10,689	2,544
SALINA	2,615	3,466	825
SPRING CITY	1,090	1,554	452
STOCKTON	714	1,148	419
STRAWBERRY	50	65	15
TABIONA	168	230	60
TROPIC	526	662	133
WENDOVER	1,533	2,466	901

Land Disposal Lagoon Systems

Facility	2019 Population	2060 Population	Net Increase
ASH CREEK	25,535	54,386	28,193
BRYCE CANYON	227	286	57
HEBER VALLEY	22,696	43,050	19,778
FRANCIS	1,601	2,364	763
PAROWAN	3,294	4,854	1,560
ROOSEVELT	7,193	10,055	2,611

The Land Disposal systems will experience the largest growth in population. With Ash Creek and Heber Valley will bear the brunt of the increases

Evaporation/Percolation Systems

Facility	Net Increase	# of Ponds	# Dry ponds
ALTAMONT	91	3	1
AURORA	337	3	0
BEAR LAKE	259	5	0
BEAVER	854	6	2
BLANDING	1,033	4	0
CENTERFIELD	625	7	0
CLAWSON	41	4	3
CLEVELAND	97	3	1
COLUMBIA	135	3	2
DELTA	1,008	9	5
EAST CARBON	512	3	2
EAST ZIONS	75	4	0
ELMO	89	3	2
EMERY	59	3	1
ENTERPRISE	2,163	4	0
ESCALANTE	205	4	1
FILLMORE	697	8	2
FOUNTAIN GREEN	487	4	0
GUNNISON	1,498	7	2
HANKSVILLE	72	2	2
HILDALE	3,380	5	0
HINCKLEY	189	2	1
KANAB	1,473	4	2
LONG VALLEY	318	6	2
MANILA	114	5	1
MEXICAN HAT	14	3	2
MILFORD	379	4	3
MINERSVILLE	250	5	1
Facility	Net Increase	# of Ponds	# Dry ponds
MT. PLEASANT	1,477	4	2

MYTON	227	3	2
NEPHI	5,200	3	0
PANGUITCH	432	3	2
POWDER MT	300	4	0
REDMOND	238	2	1
RICHFIELD	2,544	5	4
SALINA	825	3	0
SPRING CITY	452	3	1
STOCKTON	419	3	0
STRAWBERRY	15	3	0
TABIONA	60	3	2
TROPIC	133	4	1
WENDOVER	901	5	2

Estimated Costs for Future Conditions

5 scenarios

1. no nutrient requirements
2. phosphorus limits (1.0 mg/L)
3. phosphorus limits (0.1 mg/L)
4. phosphorus and nitrogen limits (1.0 mg/L , 20 mg/L)
5. phosphorus and nitrogen limits (0.1 mg/L , 10 mg/L)

Scenario 1

Annual O&M costs

Discharging Lagoons

O&M cost will vary greatly from each system and are based upon the following estimates.

Monthly Aeration Costs – $10,000 per MGD (assuming surface aerator – 2 lbs/hp)
Monthly Chlorination Costs - $1,500 per MGD
Monthly UV Costs – $8,000 per MGD (assuming 10¢ kwh)
Monthly Dike/Building Maintenance Costs – 1,000 per MGD

It was assumed that any facultative system that will be above the design capacity will add aeration and upgrade to meet the new demand. These costs were calculated in an annual O&M estimate. I was also assumed that the aerated systems would upgrade to meet demand, and those addition O&M costs were included.

Discharging Facultative Lagoons Annual O&M Cost Estimates

Facility	Aeration	Disinfection	Building	Annual
BEAR RIVER		6,480	4,320	10,800
CORINNE		3,600	2,400	6,000
DUCHESNE		7,560	5,040	12,600
EPHRAIM	192,000	28,800	19,200	240,000
HENEFER		22,080	2,760	24,840
LEWISTON	43,200	6,480	4,320	54,000
LITTLE MT				
MANTI	90,000	13,500	9,000	112,500
MONTICELLO	72,000	10,800	7,200	90,000
NEOLA	27,000	4,050	2,700	33,750
			Total	591,990

Discharging Aerated Lagoons O&M Annual Cost Estimates

Facility	Aeration	Disinfection	Building	Annual
CASTLE DALE	84,000	12,600	8,400	105,000
EUREKA	36,000	5,400	3,600	45,000
FERRON	120,000	18,000	12,000	150,000
GRANTSVILLE	192,000	28,800	19,200	240,000
GREEN RIVER	67,200	10,080	6,720	84,000
HUNTINGTON	36,000	5,400	3,600	45,000
KAMAS	120,000	18,000	12,000	150,000
LAKE POINT	36,000	5,400	3,600	45,000
MORGAN	74,400	11,160	7,440	93,000
MT GREEN	81,600	12,240	8,160	102,000
PLAIN CITY	180,000	27,000	18,000	225,000
SPRINGDALE	55,200	8,280	5,520	69,000
STANSBURY	324,000	48,600	32,400	405,000
WELLSVILLE	96,000	14,400	9,600	120,000
			Total	1,878,000

Non-Discharging Lagoons

O&M cost will vary greatly from each system and are based upon the following estimates. Since not all design flow are known, the 2060 populations were used as a surrogate. As a minimum a base annual rate of $1,800 was assumed.

Monthly Dike/Building Maintenance Costs – 1,000 per 8,000 population

Non-Discharging Lagoons O&M Annual Cost Estimates

Facility	O&M Cost	Facility	O&M Cost
ALTAMONT	1,500	HINCKLEY	1,500
AURORA	2,127	KANAB	9,689
BEAR LAKE	1,736	LONG VALLEY	2,000
BEAVER	6,026	MANILA	1,500
BLANDING	7,325	MEXICAN HAT	1,500
CENTERFIELD	3,222	MILFORD	2,672
CLAWSON	1,500	MINERSVILLE	1,761
CLEVELAND	1,500	MT. PLEASANT	7,620
COLUMBIA	1,500	MYTON	1,500
DELTA	7,322	NEPHI	17,639
EAST CARBON	3,021	PANGUITCH	3,233
EAST ZIONS	1,500	POWDER MT	1,500
ELMO	1,500	REDMOND	1,503
EMERY	1,500	RICHFIELD	16,034
ENTERPRISE	6,258	SALINA	5,199
ESCALANTE	1,533	SPRING CITY	2,331
FILLMORE	5,064	STOCKTON	1,722
FOUNTAIN GREEN	2,510	STRAWBERRY	1,500
GUNNISON	7,725	TABIONA	1,500
HANKSVILLE	1,500	TROPIC	1,500
HILDALE	9,782	WENDOVER	3,699
		Total	162,747

Land Application Systems

Monthly Aeration Costs – $10,000 per MGD (assuming surface aerator – 2 lbs/hp)
Monthly Irrigation/Pumping Costs - $10,000 per MGD (assuming 8 month irrigation)
Monthly Chlorination Costs - $1,500 per MGD
Monthly UV Costs – $8,000 per MGD (assuming 10¢ kwh)
Monthly Dike/Building Maintenance Costs – 1,000 per MGD

It was assumed that any land application system that will be above the design capacity will add aeration and upgrade to meet the new demand. These costs were calculated in an annual O&M estimate. I was also assumed that the aerated systems would upgrade to meet demand, and those addition O&M costs were included.

Land Disposal Systems O&M Annual Cost Estimates

Facility	Aeration	Irrigation	Disinfect	Buildings	Annual
ASH CREEK	652,632	435,088	97,895	65,263	1,250,878
BRYCE	24,000	16,000	3,600	2,400	46,000
HEBER VALLEY	516,600	344,400	77,490	51,660	990,150
FRANCIS	28,368	18,912	4,255	2,837	54,372
PAROWAN	58,248	38,832	8,737	5,825	111,642
ROOSEVELT	120,660	80,440	18,099	12,066	231,265
				Total	2,684,307

Scenarios 2 – 5

Annual O&M costs

In 2009 the consulting firm CH_2M Hill prepared a *Statewide Nutrient Removal Cost Impact Study* in this study both capital and O&M costs were estimated for a “0.5 MGD model” lagoon for the four scenarios The following are prorate cost estimates for the discharging lagoons, corrected for flow and 2019 dollars.

Cost were adjusted by a factor of 1.18 (2009 to 2019 dollars)

Discharging Facultative Lagoons Annual O&M Cost Estimates

Facility	TP-1.0	TP-0.1	TP-0.1 TN-20	TP-0.1 TN-10
BEAR RIVER	$34,572	$65,589	$140,320	$176,385
CORINNE	$23,416	$44,423	$95,039	$119,465
DUCHESNE	$31,546	$59,847	$128,036	$160,943
EPHRAIM	$97,971	$185,865	$397,640	$499,840
HENEFER	$23,033	$43,698	$93,487	$117,514
LEWISTON	$36,224	$68,722	$147,024	$184,811
LITTLE MT	$28,289	$53,669	$114,819	$144,329
MANTI	$59,562	$112,998	$241,748	$303,881
MONTICELLO	$51,597	$97,888	$209,421	$263,246
NEOLA	$26,728	$50,707	$108,482	$136,363
Total	$412,937	$783,404	$1,676,016	$2,106,778

Discharging Aerated Lagoons O&M Annual Cost Estimates

Facility	TP-1.0	TP-0.1	TP-0.1 TN-20	TP-0.1 TN-10
CASTLE DALE	$42,428	$80,492	$172,204	$216,463
EUREKA	$31,546	$59,847	$128,036	$160,943
FERRON	$28,289	$53,669	$114,819	$144,329
GRANTSVILLE	$96,184	$182,475	$390,388	$490,724
GREEN RIVER	$28,058	$53,230	$113,880	$143,148
HUNTINGTON	$30,480	$57,824	$123,709	$155,505
KAMAS	$41,987	$79,655	$170,414	$214,213
LAKE POINT	$29,357	$55,694	$119,152	$149,776
MORGAN	$52,024	$98,697	$211,153	$265,422
MT GREEN	$51,626	$97,942	$209,537	$263,391
PLAIN CITY	$81,316	$154,269	$330,044	$414,870
SPRINGDALE	$43,054	$81,680	$174,746	$219,658
STANSBURY	$92,005	$174,548	$373,428	$469,405
WELLSVILLE	$59,853	$113,551	$242,931	$305,368
TOTAL	$708,204	$1,343,572	$2,874,441	$3,613,215

Estimated Capital costs

5 scenarios

1. no nutrient requirements
2. phosphorus limits (1.0 mg/L)
3. phosphorus limits (0.1 mg/L)
4. phosphorus and nitrogen limits (1.0 mg/L , 20 mg/L)
5. phosphorus and nitrogen limits (0.1 mg/L , 10 mg/L)

Scenario 1

Using equations from *Principles of Design and Operations of Wastewater Treatment Pond Systems for Plant Operators, Engineers, and Managers EPA 2011*

Capital Costs Equations and Assumptions

Facultative Lagoon - cost (millions) = 1.6427 x $flow^{0.5092}$ (2006 dollars)

Aerated Lagoons – cost (millions) = 2.7983 x $flow^{0.3583}$ (2006 dollars)

Non-Discharging Lagoon – cost (millions) = 2.847 x $flow^{0.610}$ (2006 dollars)

Land Application Rates

Facility	Aeration
ASH CREEK	6 acre-ft/acre
HEBER VALLEY	3 acre-ft/acre
PAROWAN	6 acre-ft/acre
ROOSEVELT	4 acre-ft/acre

Land purchased costs estimated at $10,000 per acre

Cost were adjusted by a factor of 1.27 (2006 to 2019 dollars)

Five of the existing facultative lagoons will be over their hydraulic capacity by 2060. The option of converting to an aerated system would allow an increase in the design capacity of each of them to comply with Utah design standards.

Discharging Facultative Lagoons Capital Cost Estimates

Facility	Flow	Cost
EPHRAIM	1,120,000	$3,700,000
LEWISTON	228,000	$2,100,000
MANTI	525,000	$2,800,000
MONTICELLO	520,000	$2,800,000
NEOLA	200,000	$2,000,000
	Total	$13,400,000

Six of the existing Aerated Discharging Lagoon Systems will be over their hydraulic capacity by 2060. The costs were calculated on the additional needs only

Discharging Aerated Lagoons Capital Cost Estimates

Facility	Added Flow	Cost
EUREKA	100,000	$1,600,000
GRANTSVILLE	800,000	$3,300,000
LAKE POINT	50,000	$1,200,000
MORGAN	200,000	$2,000,000
PLAIN CITY	450,000	$2,700,000
SPRINGDALE	200,000	$2,000,000
	Total	12,800,000

The non-discharging lagoons estimate are more subjective. any system with a population increases of over 1,000 and no dry cells in existing system was included in the cost estimates

Non-Discharging Lagoons Capital Cost Estimates

Facility	Added Flow	Aeration	Cost
BLANDING	100,000		$646,000
ENTERPRISE *	220,000	$2,070,000	$2,070,000
HILDALE	338,000		$1,200,000
NEPHI	520,000		$1,495,000
		Total	$5,411,000

*Enterprise is an aerated non discharging system

Four of the existing land Application systems will be over their hydraulic capacity by 2060. The costs were calculated on the additional aeration and land needs only

Land Disposal Systems Capital Cost Estimates

Facility	Added Flow	Cost	Land	Costs	Total
ASH CREEK	2,900,000	$5,200,000	550 ac	$5,500,000	$10,700,000
HEBER	2,000,000	$3,600,000	760 ac	$7,600,000	$11,200,000
PAROWAN	160,000	$820,000	30 ac	$300,000	$1,020,000
ROOSEVELT	260,000	$1,050,000	72 ac	$720,000	$1,770,000
				Total	$24,690,000

Scenarios 2 – 5

Estimated Capital costs

Discharging Facultative Lagoons Capital Cost Estimates

Facility	TP-1.0	TP-0.1	TP-0.1 TN-20	TP-0.1 TN-10
BEAR RIVER	$997,130	$4,617,146	$5,088,615	$9,083,638
CORINNE	$712,667	$3,299,957	$3,636,924	$6,492,239
DUCHESNE	$1,168,690	$5,411,544	$5,964,130	$10,646,513
EPHRAIM	$2,825,668	$13,084,076	$14,420,125	$25,741,228
HENEFER	$782,261	$3,622,209	$3,992,082	$7,126,228
LEWISTON	$1,005,147	$4,654,269	$5,129,529	$9,156,673
LITTLE MT	$826,976	$3,829,261	$4,220,277	$7,533,576
MANTI	$1,717,886	$7,954,560	$8,766,821	$15,649,569
MONTICELLO	$1,488,165	$6,890,856	$7,594,499	$13,556,868
NEOLA	$837,966	$3,880,149	$4,276,361	$7,633,692
Total	$12,362,555	$57,244,027	$63,089,363	$112,620,225

Discharging Aerated Lagoons Capital Cost Estimates

Facility	TP-1.0	TP-0.1	TP-0.1 TN-20	TP-0.1 TN-10
CASTLE DALE	$1,223,699	$5,666,262	$6,244,859	$11,147,638
EUREKA	$908,785	$4,208,073	$4,637,771	$8,278,840
FERRON	$815,913	$3,778,032	$4,163,817	$7,432,791
GRANTSVILLE	$2,774,132	$12,845,444	$14,157,125	$25,271,750
GREEN RIVER	$809,239	$3,747,128	$4,129,757	$7,371,990
HUNTINGTON	$879,090	$4,070,571	$4,486,228	$8,008,322
KAMAS	$1,210,976	$5,607,347	$6,179,928	$11,031,731
LAKE POINT	$846,706	$3,920,620	$4,320,965	$7,713,314
MORGAN	$1,500,469	$6,947,829	$7,657,290	$13,668,955
MT GREEN	$1,488,987	$6,894,661	$7,598,693	$13,564,355
PLAIN CITY	$2,345,977	$10,862,899	$11,972,138	$21,371,350
SPRINGDALE	$1,241,762	$5,749,899	$6,337,036	$11,312,182
STANSBURY	$2,653,613	$12,287,385	$13,542,082	$24,173,843
WELLSVILLE	$1,726,291	$7,993,479	$8,809,714	$15,726,138
TOTAL	$20,425,639	$94,579,630	$104,237,401	$186,073,199

Lagoon Cost Summaries

Scenarios	Capital Costs	2020-2060 O&M	Total
No Nutrients	$56,301,000	$106,340,880	$162,164,880
TP – 1.0 mg/l	$62,889,194	$712,704,960	$775,594,154
TP – 0.1 mg/L	$181,924,657	$3,093,414,220	$3,275,338,877
TP – 0.1 TN - 20	$197,427,764	$3,403,476,360	$3,600,904,124
TP – 0.1 TN – 10	$328,794,424	$6,030,809,560	$6,359,603,984

One of the questions that can be asked is what percentage of the annual O&M actual normal repair and replacement is. Based upon my best professional judgement it is around one third of the total budget. For the purpose of this memo a percentage of 35% is used.

Using that Ration gives the following For Capital Costs and Repair and Replacement for the next 40 years.

Scenarios	Capital Costs	2020-2060 R&R	Total
No Nutrients	$56,301,000	$37,219,308	$93,520,308
TP – 1.0 mg/l	$62,889,194	$249,446,736	$312,335,930
TP – 0.1 mg/L	$181,924,657	$1,082,694,977	$1,264,619,634
TP – 0.1 TN - 20	$197,427,764	$1,191,216,726	$1,388,644,490
TP – 0.1 TN – 10	$328,794,424	$2,110,783,346	$2,439,577,770