



**Southwestern Illinois
Flood Prevention District Council**

104 United Drive, Collinsville, Illinois

September 2018

PRAIRIE DU PONT LEVEE AND SANITARY DISTRICT
FEMA LEVEL IMPROVEMENTS – LIFE CYCLE COSTS

Table of Contents

1.0	Introduction	3
2.0	Sluice Gates.....	3
3.0	Relief Wells	4
3.1	Maintenance	4
3.1.1	Existing Relief Wells	4
3.1.2	New Relief Wells	4
3.1.3	Relief Well Type	4
3.2	Replacement.....	6
4.0	Piezometers	8
4.1	Maintenance	8
4.2	Replacement.....	8
4.2.1	Transducer Replacement	9
5.0	Seepage Berms	9
6.0	Clay Caps.....	12
7.0	Relief Well Conveyance System Piping, Structures, and Check Valves	13
7.1	Maintenance	13
7.2	Replacement.....	14
8.0	Gummersheimer (Site 05) Pump Station	15
8.1	Maintenance	15
8.2	Replacement.....	16
8.3	Operation	17
9.0	Summary.....	19

List of Tables

Table 2-1 – Sluice Gates – Replacement Costs	3
Table 3-1 – Relief Wells – Maintenance Costs	5
Table 3-2 – Relief Wells – Replacement Costs.....	6
Table 4-1 – Piezometers – Replacement Costs.....	8
Table 4-2 – Piezometers – Transducer Replacement Costs	9
Table 5-1 – Seepage Berms – Maintenance Costs.....	9
Table 7-1 – Pipe Systems – Maintenance Costs	13
Table 7-2 – Pipe Systems – Replacement Costs (Pipe).....	14
Table 7-3 – Pipe Systems – Replacement Costs (Structures)	14
Table 7-4 – Pipe Systems – Replacement Costs (Check Valves)	14
Table 8-1 – Pump Stations – Maintenance Costs	15
Table 8-2 – Pump Stations – Replacement Costs.....	17
Table 8-3 – Pump Stations Operation Costs	17
Table 8-4 – Pump Stations – Total Annual Operation Costs	18
Table 9-1 – Annual Costs	20

1.0 Introduction

In December of 2017, the Southwestern Illinois Flood Prevention District Council (FPD Council) officially turned over the assets constructed as part of the “100-Year” or “FEMA-Level” projects to the Prairie du Pont Levee and Sanitation District (the “District”). The improvements to the Prairie du Pont Levee System of the Prairie du Pont and Fish Lake Flood Risk Reduction Project were constructed as part of the following construction projects:

- Southwestern Illinois Levee Certification Design, Bid Package 2B
- Southwestern Illinois Levee Certification Design, Bid Package 5A
- Southwestern Illinois Levee Certification Design, Bid Package 06

Assets transferred to the District as part of these projects include: sluice gates, relief wells, piezometers, seepage berms, clay caps, relief well conveyance systems, and a pump station. The following paragraphs outline a brief description of maintenance requirements, an estimated cost associated with maintaining the new asset, and an estimated replacement cost.

The costs represented are estimates that were calculated using single payment compound amount factors based on initial installation costs; compound adjustment factors (CAFs) for 3-percent interest rates are shown in each table. The useful life of each feature has been estimated based on manufacturers’ literature and recommendations from the U.S. Army Corps of Engineers (USACE). Maintenance costs are estimated only up to the useful life of the improvement. The useful life is highly dependent upon diligent maintenance by the District as outlined in the System Wide Operation and Maintenance Manual.

2.0 Sluice Gates

Sluice gates are to be examined, greased, and trial-operated through a complete open/close cycle at least once every 90 days. (See the system wide O&M for further information).

The scope of this project included replacing six (6) existing sluice gates at the end of their useful life (two (2) 24”, one (1) 36”, one (1) 48”, and two (2) 60”). These sluice gates at these locations are already in the District’s maintenance program and therefore, do not add additional maintenance costs to the District’s budget.

The manufacturer of these sluice gates estimates a 30-year useful life. Replacement costs have been estimated as shown in the table below.

Table 2-1 – Sluice Gates – Replacement Costs								
Gate Size	Station	Gate Well No.	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
36"	086+50	GW-1	\$ 26,080	2016	30	2046	2.427	\$ 63,296
60"	125+00E	GW-2	\$ 54,000	2016	30	2046	2.427	\$ 131,058
60"	125+00W	GW-2	\$ 54,000	2016	30	2046	2.427	\$ 131,058
24"	130+17	GW-3	\$ 10,000	2017	30	2047	2.427	\$ 24,270

Table 2-1 – Sluice Gates – Replacement Costs

Gate Size	Station	Gate Well No.	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
48"	278+05	GW-4	\$ 34,350	2016	30	2046	2.427	\$ 83,367
24"	300+12	GW-5	\$ 10,000	2017	30	2047	2.427	\$ 24,270
Total:								\$ 457,320

3.0 Relief Wells

3.1 Maintenance

Relief wells should be kept free of sand, silt, organic matter, or any other material that will retard flow. Wells should be inspected once per year, preferably prior to normal high-water season. Particular attention should be directed to inspecting the condition of the neoprene gaskets on the underside of the check valves. Each well should be sounded annually, and after each major high-water event, to see if the well is free of debris or any other obstruction. All wells that require removal of sediment should be pump-tested after cleanout to see if there has been any appreciable loss of efficiency as a result of foreign material entering the well. In addition, all wells should be pump-tested periodically in accordance with a program that will result in at least 10 percent of all the wells being pumped each year. This annual pumping should be rotated so that in a period of five years, all wells will have been pump tested.

3.1.1 Existing Relief Wells

Forty-three (43) existing, wood-stave relief wells are located within the footprint of newly constructed seepage berms. The discharge elevations of these wells were raised to 6” above the new finished grade elevation with a stainless-steel riser and capped with a gasketed, flanged cover.

All 43 wells were existing and consequently already in the District’s maintenance program. Therefore, these assets do not add additional maintenance to the District’s budget.

3.1.2 New Relief Wells

Forty-six (46) new stainless-steel relief wells (10 Type “D”, 36 Type “T”) were installed and thirteen (13) existing relief wells were abandoned as part of these improvements. In theory, there is only a net increase of thirty-three (33) relief wells to the District’s program. However, the costs for adding all 46 wells are shown below.

3.1.3 Relief Well Maintenance

Regardless of the construction material (wood-stave or stainless-steel) or discharge type (Type “D” or Type “T”), the annual inspection and periodic pump testing requirements are the same, with the only exception being that wood stave wells require cleaning/filtering of the standing water within the column of the well prior to pump testing. Relief well rehabilitation, if needed, may include mechanical or chemical treatment of the screen; rehabilitation is estimated to occur at the mid-life of the relief well. Maintenance costs have been estimated as shown in the table below.

Table 3-1 – Relief Wells – Maintenance Costs

Year No.	Year	CAF (3%)	Annual Sounding		10-Year Pump Testing		Mid-Life Rehabilitation		Cost per Year
			Price	No. of RWs	Price	No. of RWs	Price	No. of RWs	
0	2018	1.000	\$ 200	46	\$ 1,500	4	\$ 2,500.00	0	\$15,200
1	2019	1.030	\$ 206	46	\$ 1,545	4	\$ 2,575.00	0	\$15,656
2	2020	1.061	\$ 212	46	\$ 1,592	4	\$ 2,652.50	0	\$16,127
3	2021	1.093	\$ 219	46	\$ 1,640	4	\$ 2,732.50	0	\$16,614
4	2022	1.126	\$ 225	46	\$ 1,689	5	\$ 2,815.00	0	\$18,804
5	2023	1.159	\$ 232	46	\$ 1,739	5	\$ 2,897.50	0	\$19,355
6	2024	1.194	\$ 239	46	\$ 1,791	5	\$ 2,985.00	0	\$19,940
7	2025	1.230	\$ 246	46	\$ 1,845	5	\$ 3,075.00	0	\$20,541
8	2026	1.267	\$ 253	46	\$ 1,901	5	\$ 3,167.50	0	\$21,159
9	2027	1.305	\$ 261	46	\$ 1,958	5	\$ 3,262.50	0	\$21,794
10	2028	1.344	\$ 269	46	\$ 2,016	4	\$ 3,360.00	0	\$20,429
11	2029	1.384	\$ 277	46	\$ 2,076	4	\$ 3,460.00	0	\$21,037
12	2030	1.426	\$ 285	46	\$ 2,139	4	\$ 3,565.00	0	\$21,675
13	2031	1.469	\$ 294	46	\$ 2,204	4	\$ 3,672.50	0	\$22,329
14	2032	1.513	\$ 303	46	\$ 2,270	5	\$ 3,782.50	0	\$25,267
15	2033	1.558	\$ 312	46	\$ 2,337	5	\$ 3,895.00	0	\$26,019
16	2034	1.605	\$ 321	46	\$ 2,408	5	\$ 4,012.50	0	\$26,804
17	2035	1.653	\$ 331	46	\$ 2,480	5	\$ 4,132.50	0	\$27,605
18	2036	1.702	\$ 340	46	\$ 2,553	5	\$ 4,255.00	0	\$28,423
19	2037	1.754	\$ 351	46	\$ 2,631	5	\$ 4,385.00	0	\$29,292
20	2038	1.806	\$ 361	46	\$ 2,709	4	\$ 4,515.00	0	\$27,451
21	2039	1.860	\$ 372	46	\$ 2,790	4	\$ 4,650.00	0	\$28,272
22	2040	1.916	\$ 383	46	\$ 2,874	4	\$ 4,790.00	0	\$29,123
23	2041	1.974	\$ 395	46	\$ 2,961	4	\$ 4,935.00	0	\$30,005
24	2042	2.033	\$ 407	46	\$ 3,050	5	\$ 5,082.50	0	\$33,951
25	2043	2.094	\$ 419	46	\$ 3,141	5	\$ 5,235.00	46	\$275,780
26	2044	2.157	\$ 431	46	\$ 3,236	5	\$ 5,392.50	0	\$36,022
27	2045	2.221	\$ 444	46	\$ 3,332	5	\$ 5,552.50	0	\$37,091
28	2046	2.288	\$ 458	46	\$ 3,432	5	\$ 5,720.00	0	\$38,210
29	2047	2.357	\$ 471	46	\$ 3,536	5	\$ 5,892.50	0	\$39,362
30	2048	2.427	\$ 485	46	\$ 3,641	4	\$ 6,067.50	0	\$36,890
31	2049	2.500	\$ 500	46	\$ 3,750	4	\$ 6,250.00	0	\$38,000
32	2050	2.575	\$ 515	46	\$ 3,863	4	\$ 6,437.50	0	\$39,140
33	2051	2.652	\$ 530	46	\$ 3,978	4	\$ 6,630.00	0	\$40,310
34	2052	2.732	\$ 546	46	\$ 4,098	5	\$ 6,830.00	0	\$45,624

35	2053	2.814	\$ 563	46	\$ 4,221	5	\$ 7,035.00	0	\$46,994
36	2054	2.898	\$ 580	46	\$ 4,347	5	\$ 7,245.70	0	\$48,401
37	2055	2.985	\$ 597	46	\$ 4,478	5	\$ 7,463.07	0	\$49,853
38	2056	3.075	\$ 615	46	\$ 4,612	5	\$ 7,686.96	0	\$51,349
39	2057	3.167	\$ 633	46	\$ 4,751	5	\$ 7,917.57	0	\$52,889
40	2058	3.262	\$ 652	46	\$ 4,893	4	\$ 8,155.09	0	\$49,583
41	2059	3.360	\$ 672	46	\$ 5,040	4	\$ 8,399.75	0	\$51,070
42	2060	3.461	\$ 692	46	\$ 5,191	4	\$ 8,651.74	0	\$52,603
43	2061	3.565	\$ 713	46	\$ 5,347	4	\$ 8,911.29	0	\$54,181
44	2062	3.671	\$ 734	46	\$ 5,507	5	\$ 9,178.63	0	\$61,313
45	2063	3.782	\$ 756	46	\$ 5,672	5	\$ 9,453.99	0	\$63,153
46	2064	3.895	\$ 779	46	\$ 5,843	5	\$ 9,737.61	0	\$65,047
47	2065	4.012	\$ 802	46	\$ 6,018	5	\$ 10,029.74	0	\$66,999
48	2066	4.132	\$ 826	46	\$ 6,198	5	\$ 10,330.63	0	\$69,009
49	2067	4.256	\$ 851	46	\$ 6,384	5	\$ 10,640.55	0	\$71,079
Totals:									\$ 2,062,822

3.2 Replacement

USACE recommends relief well replacement after 50 years; therefore, a 50-year useful life was assumed. Replacement costs have been estimated as shown in the table below.

Table 3-2 – Relief Wells – Replacement Costs

Relief Well No.	Relief Well Type	Station	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
RW-14A	Type "D"	187+25	\$ 52,000	2014	50	2064	4.384	\$ 227,968
RW-14B	Type "D"	187+45	\$ 52,000	2014	50	2064	4.384	\$ 227,968
RW-14C	Type "D"	187+65	\$ 52,000	2014	50	2064	4.384	\$ 227,968
RW-17A	Type "D"	197+25	\$ 52,000	2014	50	2064	4.384	\$ 227,968
RW-18A	Type "D"	198+00	\$ 52,000	2014	50	2064	4.384	\$ 227,968
RW-18B	Type "D"	198+75	\$ 52,000	2014	50	2064	4.384	\$ 227,968
RW-18X	Type "T"	197+67	\$ 50,000	2015	50	2065	4.384	\$ 219,200
RW-19X	Type "T"	199+28	\$ 50,000	2015	50	2065	4.384	\$ 219,200
RW-22A	Type "T"	207+93	\$ 56,000	2015	50	2065	4.384	\$ 245,504
RW-22B	Type "T"	209+43	\$ 65,000	2015	50	2065	4.384	\$ 284,960
RW-22C	Type "T"	211+19	\$ 72,000	2015	50	2065	4.384	\$ 315,648
RW-22D	Type "T"	212+55	\$ 58,000	2015	50	2065	4.384	\$ 254,272
RW-22E	Type "T"	214+32	\$ 53,000	2015	50	2065	4.384	\$ 232,352

Table 3-2 – Relief Wells – Replacement Costs

Relief Well No.	Relief Well Type	Station	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
RW-23X	Type "T"	216+47	\$ 53,000	2015	50	2065	4.384	\$ 232,352
RW-30X	Type "D"	255+64	\$ 64,000	2014	50	2064	4.384	\$ 280,576
RW-41X	Type "T"	299+62	\$ 58,000	2015	50	2065	4.384	\$ 254,272
RW-43A	Type "T"	303+18	\$ 44,000	2015	50	2065	4.384	\$ 192,896
RW-44X	Type "T"	304+29	\$ 44,000	2015	50	2065	4.384	\$ 192,896
RW-45X	Type "T"	306+18	\$ 51,000	2015	50	2065	4.384	\$ 223,584
RW-48X	Type "D"	410+35	\$ 67,000	2014	50	2064	4.384	\$ 293,728
RW-51A	Type "T"	429+90	\$ 60,000	2015	50	2065	4.384	\$ 263,040
RW-51X	Type "D"	428+90	\$ 69,000	2015	50	2065	4.384	\$ 302,496
RW-52A	Type "T"	431+80	\$ 57,000	2015	50	2065	4.384	\$ 249,888
RW-53A	Type "T"	433+45	\$ 63,000	2015	50	2065	4.384	\$ 276,192
RW-55A	Type "T"	436+10	\$ 59,000	2015	50	2065	4.384	\$ 258,656
RW-55B	Type "T"	436+70	\$ 54,000	2015	50	2065	4.384	\$ 236,736
RW-56A	Type "T"	437+75	\$ 54,000	2015	50	2065	4.384	\$ 236,736
RW-60A	Type "D"	444+85	\$ 73,000	2015	50	2065	4.384	\$ 320,032
RW-61A	Type "T"	446+11	\$ 80,000	2015	50	2065	4.384	\$ 350,720
RW-61B	Type "T"	446+61	\$ 67,000	2014	50	2064	4.384	\$ 293,728
RW-61X	Type "T"	445+70	\$ 51,000	2015	50	2065	4.384	\$ 223,584
RW-62A	Type "T"	447+81	\$ 70,000	2014	50	2064	4.384	\$ 306,880
RW-67A	Type "T"	455+24	\$ 61,000	2015	50	2065	4.384	\$ 267,424
RW-68A	Type "T"	456+35	\$ 53,000	2015	50	2065	4.384	\$ 232,352
RW-68B	Type "T"	457+45	\$ 52,000	2015	50	2065	4.384	\$ 227,968
RW-68C	Type "T"	458+66	\$ 48,000	2015	50	2065	4.384	\$ 210,432
RW-68D	Type "T"	459+89	\$ 59,000	2015	50	2065	4.384	\$ 258,656
RW-68E	Type "T"	461+03	\$ 65,000	2015	50	2065	4.384	\$ 284,960
RW-68F	Type "T"	461+69	\$ 63,000	2015	50	2065	4.384	\$ 276,192
RW-68G	Type "T"	462+35	\$ 58,000	2015	50	2065	4.384	\$ 254,272
RW-68H	Type "T"	463+01	\$ 70,000	2015	50	2065	4.384	\$ 306,880
RW-69A	Type "T"	463+66	\$ 66,000	2015	50	2065	4.384	\$ 289,344
RW-69B	Type "T"	464+32	\$ 65,000	2015	50	2065	4.384	\$ 284,960
RW-70A	Type "T"	467+95	\$ 58,000	2015	50	2065	4.384	\$ 254,272
RW-70B	Type "T"	469+35	\$ 60,000	2015	50	2065	4.384	\$ 263,040
RW-70C	Type "T"	470+77	\$ 76,000	2015	50	2065	4.384	\$ 333,184
Total:			\$ 2,708,000					\$ 11,871,872

4.0 Piezometers

4.1 Maintenance

The site of piezometers should be kept clear of weeds and brush and cared for in the same manner as described for relief wells. The District should report any damaged or destroyed piezometers to the Geotechnical Branch, St. Louis District, USACE. General maintenance of piezometers is the responsibility of USACE personnel. Therefore, these assets do not add additional maintenance to the District’s budget.

4.2 Replacement

Twelve (12) new piezometers were installed and two (2) existing piezometers were retrofitted with a transducer. The piezometer itself (stainless steel screen and riser and filter pack) is estimated to have a useful life of 50 years. Replacement costs have been estimated as shown in the table below.

Table 4-1 – Piezometers – Replacement Costs								
PZ No.	PZ Type	Station	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
PZ-178L	Above Grade	178+00	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-178R	Above Grade	178+00	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-207L	Above Grade	207+50	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-207R	Above Grade	207+50	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-214R	Above Grade	213+90	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-215R	Above Grade	215+50	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-229LD	Above Grade	228+67	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-229R	Above Grade	228+72	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-293R	Above Grade	293+10	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-448L	Above Grade	447+67	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-462L	Above Grade	462+60	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-462R	Above Grade	462+60	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-537R	Above Grade	537+20	\$ 12,000	2016	50	2066	4.384	\$ 52,608
PZ-537L	Above Grade	537+36	\$ 12,000	2016	50	2066	4.384	\$ 52,608
Total:			\$ 168,000					\$ 736,512

4.2.1 Transducer Replacement

Each new and retrofitted piezometer was equipped with a transducer. The manufacturer estimates a useful life of 10 years. Replacement costs for the transducers throughout the life of the Piezometer have been estimated as shown in the table below.

Year No.	Year	CAF (3%)	Price	No. of PZs	Cost per Year
0	2016	1.000	\$ 1,000	0	\$ -
10	2026	1.344	\$ 1,344	14	\$ 18,816
20	2036	1.806	\$ 1,806	14	\$ 25,284
30	2046	2.427	\$ 2,427	14	\$ 33,978
40	2056	3.262	\$ 3,262	14	\$ 45,669
50	2066	Cost included in new Piezometer			
Total:					\$ 123,747

5.0 Seepage Berms

Seepage berms shall be maintained in accordance with the system wide operation and maintenance manual. Seepage berms have a relatively indefinite life and do not require replacement. However, they do require periodic maintenance, such as mowing, herbicide application, and rodent abatement. Maintenance costs have been estimated as shown in the table below.

Year No.	Year	CAF (3%)	Rodent/Herbicide			Mowing			Cost per Year
			Price	Area (Ac)	Frequency/Year	Price	Area (Ac)	Frequency/Year	
0	2018	1.000	\$ 20	62.6	1	\$ 60	62.6	4	\$ 16,276
1	2019	1.030	\$ 21	62.6	1	\$ 62	62.6	4	\$ 16,764
2	2020	1.061	\$ 21	62.6	1	\$ 64	62.6	4	\$ 17,269
3	2021	1.093	\$ 22	62.6	1	\$ 66	62.6	4	\$ 17,790
4	2022	1.126	\$ 23	62.6	1	\$ 68	62.6	4	\$ 18,327
5	2023	1.159	\$ 23	62.6	1	\$ 70	62.6	4	\$ 18,864
6	2024	1.194	\$ 24	62.6	1	\$ 72	62.6	4	\$ 19,434
7	2025	1.230	\$ 25	62.6	1	\$ 74	62.6	4	\$ 20,019
8	2026	1.267	\$ 25	62.6	1	\$ 76	62.6	4	\$ 20,622

Table 5-1 – Seepage Berms – Maintenance Costs

Year No.	Year	CAF (3%)	Rodent/Herbicide			Mowing			Cost per Year
			Price	Area (Ac)	Frequency/Year	Price	Area (Ac)	Frequency/Year	
9	2027	1.305	\$ 26	62.6	1	\$ 78	62.6	4	\$ 21,240
10	2028	1.344	\$ 27	62.6	1	\$ 81	62.6	4	\$ 21,875
11	2029	1.384	\$ 28	62.6	1	\$ 83	62.6	4	\$ 22,526
12	2030	1.426	\$ 29	62.6	1	\$ 86	62.6	4	\$ 23,210
13	2031	1.469	\$ 29	62.6	1	\$ 88	62.6	4	\$ 23,909
14	2032	1.513	\$ 30	62.6	1	\$ 91	62.6	4	\$ 24,626
15	2033	1.558	\$ 31	62.6	1	\$ 93	62.6	4	\$ 25,358
16	2034	1.605	\$ 32	62.6	1	\$ 96	62.6	4	\$ 26,123
17	2035	1.653	\$ 33	62.6	1	\$ 99	62.6	4	\$ 26,904
18	2036	1.702	\$ 34	62.6	1	\$ 102	62.6	4	\$ 27,702
19	2037	1.754	\$ 35	62.6	1	\$ 105	62.6	4	\$ 28,548
20	2038	1.806	\$ 36	62.6	1	\$ 108	62.6	4	\$ 29,394
21	2039	1.860	\$ 37	62.6	1	\$ 112	62.6	4	\$ 30,273
22	2040	1.916	\$ 38	62.6	1	\$ 115	62.6	4	\$ 31,185
23	2041	1.974	\$ 39	62.6	1	\$ 118	62.6	4	\$ 32,129
24	2042	2.033	\$ 41	62.6	1	\$ 122	62.6	4	\$ 33,089
25	2043	2.094	\$ 42	62.6	1	\$ 126	62.6	4	\$ 34,082
26	2044	2.157	\$ 43	62.6	1	\$ 129	62.6	4	\$ 35,107
27	2045	2.221	\$ 44	62.6	1	\$ 133	62.6	4	\$ 36,149
28	2046	2.288	\$ 46	62.6	1	\$ 137	62.6	4	\$ 37,239
29	2047	2.357	\$ 47	62.6	1	\$ 141	62.6	4	\$ 38,363
30	2048	2.427	\$ 49	62.6	1	\$ 146	62.6	4	\$ 39,502
31	2049	2.500	\$ 50	62.6	1	\$ 150	62.6	4	\$ 40,690
32	2050	2.575	\$ 52	62.6	1	\$ 155	62.6	4	\$ 41,911
33	2051	2.652	\$ 53	62.6	1	\$ 159	62.6	4	\$ 43,164
34	2052	2.732	\$ 55	62.6	1	\$ 164	62.6	4	\$ 44,466
35	2053	2.814	\$ 56	62.6	1	\$ 169	62.6	4	\$ 45,801
36	2054	2.898	\$ 58	62.6	1	\$ 174	62.6	4	\$ 47,172
37	2055	2.985	\$ 60	62.6	1	\$ 179	62.6	4	\$ 48,588
38	2056	3.075	\$ 61	62.6	1	\$ 184	62.6	4	\$ 50,045
39	2057	3.167	\$ 63	62.6	1	\$ 190	62.6	4	\$ 51,547
40	2058	3.262	\$ 65	62.6	1	\$ 196	62.6	4	\$ 53,093
41	2059	3.360	\$ 67	62.6	1	\$ 202	62.6	4	\$ 54,686
42	2060	3.461	\$ 69	62.6	1	\$ 208	62.6	4	\$ 56,326
43	2061	3.565	\$ 71	62.6	1	\$ 214	62.6	4	\$ 58,016

Table 5-1 – Seepage Berms – Maintenance Costs

Year No.	Year	CAF (3%)	Rodent/Herbicide			Mowing			Cost per Year
			Price	Area (Ac)	Frequency/Year	Price	Area (Ac)	Frequency/Year	
44	2062	3.671	\$ 73	62.6	1	\$ 220	62.6	4	\$ 59,757
45	2063	3.782	\$ 76	62.6	1	\$ 227	62.6	4	\$ 61,549
46	2064	3.895	\$ 78	62.6	1	\$ 234	62.6	4	\$ 63,396
47	2065	4.012	\$ 80	62.6	1	\$ 241	62.6	4	\$ 65,298
48	2066	4.132	\$ 83	62.6	1	\$ 248	62.6	4	\$ 67,257
49	2067	4.256	\$ 85	62.6	1	\$ 255	62.6	4	\$ 69,274
50	2068	4.384	\$ 88	62.6	1	\$ 263	62.6	4	\$ 71,354
51	2069	4.516	\$ 90	62.6	1	\$ 271	62.6	4	\$ 73,495
52	2070	4.651	\$ 93	62.6	1	\$ 279	62.6	4	\$ 75,699
53	2071	4.791	\$ 96	62.6	1	\$ 287	62.6	4	\$ 77,970
54	2072	4.934	\$ 99	62.6	1	\$ 296	62.6	4	\$ 80,310
55	2073	5.082	\$ 102	62.6	1	\$ 305	62.6	4	\$ 82,719
56	2074	5.235	\$ 105	62.6	1	\$ 314	62.6	4	\$ 85,200
57	2075	5.392	\$ 108	62.6	1	\$ 324	62.6	4	\$ 87,756
58	2076	5.554	\$ 111	62.6	1	\$ 333	62.6	4	\$ 90,389
59	2077	5.720	\$ 114	62.6	1	\$ 343	62.6	4	\$ 93,101
60	2078	5.892	\$ 118	62.6	1	\$ 354	62.6	4	\$ 95,894
61	2079	6.068	\$ 121	62.6	1	\$ 364	62.6	4	\$ 98,771
62	2080	6.251	\$ 125	62.6	1	\$ 375	62.6	4	\$ 101,734
63	2081	6.438	\$ 129	62.6	1	\$ 386	62.6	4	\$ 104,786
64	2082	6.631	\$ 133	62.6	1	\$ 398	62.6	4	\$ 107,929
65	2083	6.830	\$ 137	62.6	1	\$ 410	62.6	4	\$ 111,167
66	2084	7.035	\$ 141	62.6	1	\$ 422	62.6	4	\$ 114,502
67	2085	7.246	\$ 145	62.6	1	\$ 435	62.6	4	\$ 117,937
68	2086	7.463	\$ 149	62.6	1	\$ 448	62.6	4	\$ 121,475
69	2087	7.687	\$ 154	62.6	1	\$ 461	62.6	4	\$ 125,120
70	2088	7.918	\$ 158	62.6	1	\$ 475	62.6	4	\$ 128,873
71	2089	8.156	\$ 163	62.6	1	\$ 489	62.6	4	\$ 132,739
72	2090	8.400	\$ 168	62.6	1	\$ 504	62.6	4	\$ 136,722
73	2091	8.652	\$ 173	62.6	1	\$ 519	62.6	4	\$ 140,823
74	2092	8.912	\$ 178	62.6	1	\$ 535	62.6	4	\$ 145,048
75	2093	9.179	\$ 184	62.6	1	\$ 551	62.6	4	\$ 149,399
76	2094	9.454	\$ 189	62.6	1	\$ 567	62.6	4	\$ 153,881
77	2095	9.738	\$ 195	62.6	1	\$ 584	62.6	4	\$ 158,498
78	2096	10.030	\$ 201	62.6	1	\$ 602	62.6	4	\$ 163,253

Table 5-1 – Seepage Berms – Maintenance Costs

Year No.	Year	CAF (3%)	Rodent/Herbicide			Mowing			Cost per Year
			Price	Area (Ac)	Frequency/Year	Price	Area (Ac)	Frequency/Year	
79	2097	10.331	\$ 207	62.6	1	\$ 620	62.6	4	\$ 168,150
80	2098	10.641	\$ 213	62.6	1	\$ 638	62.6	4	\$ 173,195
81	2099	10.960	\$ 219	62.6	1	\$ 658	62.6	4	\$ 178,391
82	2100	11.289	\$ 226	62.6	1	\$ 677	62.6	4	\$ 183,742
83	2101	11.628	\$ 233	62.6	1	\$ 698	62.6	4	\$ 189,255
84	2102	11.977	\$ 240	62.6	1	\$ 719	62.6	4	\$ 194,932
85	2103	12.336	\$ 247	62.6	1	\$ 740	62.6	4	\$ 200,780
86	2104	12.706	\$ 254	62.6	1	\$ 762	62.6	4	\$ 206,804
87	2105	13.087	\$ 262	62.6	1	\$ 785	62.6	4	\$ 213,008
88	2106	13.480	\$ 270	62.6	1	\$ 809	62.6	4	\$ 219,398
89	2107	13.884	\$ 278	62.6	1	\$ 833	62.6	4	\$ 225,980
90	2108	14.301	\$ 286	62.6	1	\$ 858	62.6	4	\$ 232,759
91	2109	14.730	\$ 295	62.6	1	\$ 884	62.6	4	\$ 239,742
92	2110	15.172	\$ 303	62.6	1	\$ 910	62.6	4	\$ 246,934
93	2111	15.627	\$ 313	62.6	1	\$ 938	62.6	4	\$ 254,342
94	2112	16.096	\$ 322	62.6	1	\$ 966	62.6	4	\$ 261,973
95	2113	16.579	\$ 332	62.6	1	\$ 995	62.6	4	\$ 269,832
96	2114	17.076	\$ 342	62.6	1	\$1,025	62.6	4	\$ 277,927
97	2115	17.588	\$ 352	62.6	1	\$1,055	62.6	4	\$ 286,265
98	2116	18.116	\$ 362	62.6	1	\$1,087	62.6	4	\$ 294,853
99	2117	18.659	\$ 373	62.6	1	\$1,120	62.6	4	\$ 303,698
100	2118	19.219	\$ 384	62.6	1	\$1,153	62.6	4	\$ 312,809
Total:									\$ 10,197,247

6.0 Clay Caps

Clay caps shall be maintained in accordance with the system wide operation and maintenance manual. Clay Caps have a relatively indefinite life and do not require replacement.

Four (4) clay cap areas were added on the riverside slope of the levee. These caps maintained a similar cross section to the existing slope and have added a negligible area where general maintenance is required. Therefore, these assets do not add additional maintenance to the District’s budget.

7.0 Relief Well Conveyance System Piping, Structures, and Check Valves

7.1 Maintenance

Relief well conveyance systems are to be inspected periodically to ensure that the pipes, structures, and check valves are in good condition and that there is not an accumulation of silt, trash, and debris in the conveyance pipes, manholes, or at the outfall structures. At a minimum, conveyance systems shall be televised via CCTV every 5 years to ensure that there are no obstructions, rips, tears, or deformations in the pipe and that the structural integrity of the pipe has not been compromised in any way. It is estimated that half way through the useful life, the pipe may require some sort of pipe rehab such as a cured in place liner. Maintenance costs have been estimated as shown in the table below.

Year No.	Year	CAF (3%)	Cleaning/CCTV		Pipe Rehab		Cost per Year
			Price	LF of Pipe	Price	LF of Pipe	
0	2016	1.000	\$ 10	0	\$ 102	0	\$ -
5	2021	1.159	\$ 12	6000	\$ 118	0	\$ 69,540
10	2026	1.344	\$ 13	6000	\$ 137	0	\$ 80,640
15	2031	1.558	\$ 16	6000	\$ 159	0	\$ 93,480
20	2036	1.806	\$ 18	6000	\$ 184	0	\$ 108,360
25	2041	2.094	\$ 21	6000	\$ 214	0	\$ 125,640
30	2046	2.427	\$ 24	6000	\$ 248	0	\$ 145,620
35	2051	2.814	\$ 28	6000	\$ 287	0	\$ 168,840
40	2056	3.262	\$ 33	6000	\$ 333	0	\$ 195,720
45	2061	3.782	\$ 38	6000	\$ 386	0	\$ 226,920
50	2066	4.384	\$ 44	6000	\$ 447	6000	\$ 2,946,048
55	2071	5.082	\$ 51	6000	\$ 518	0	\$ 304,920
60	2076	5.892	\$ 59	6000	\$ 601	0	\$ 353,520
65	2081	6.830	\$ 68	6000	\$ 697	0	\$ 409,800
70	2086	7.918	\$ 79	6000	\$ 808	0	\$ 475,080
75	2091	9.179	\$ 92	6000	\$ 936	0	\$ 550,740
80	2096	10.641	\$ 106	6000	\$1,085	0	\$ 638,460
85	2101	12.336	\$ 123	6000	\$1,258	0	\$ 740,160
90	2106	14.300	\$ 143	6000	\$1,459	0	\$ 858,000
95	2111	16.578	\$ 166	6000	\$1,691	0	\$ 994,680
Total:							\$ 9,486,168

7.2 Replacement

These projects added nearly 6,000 linear feet of high-density polyethylene (HDPE) pipe of varying sizes. These systems are located at the Type “T” relief wells on the north flank, the 5th Street Pump Station, and the Gummersheimer (Site 05) Pump Station.

The manufacturer of the HDPE Pipe publishes a useful life of at least 100 years. The manufacturer of the reinforced concrete structures publishes a useful life of 75 to 100 years. The manufacturer of the rubber check valves publishes a useful life of 35-50 years. Replacement costs have been estimated as shown in the table below.

Table 7-2 – Pipe Systems – Replacement Costs (Pipe)

System	Start Station	End Station	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
Type "T" Relief Well Outlet Works	197+67	216+47	\$ 15,235	2016	100	2116	19.219	\$292,804
5th Street Relief Well Collector	300+00	306+00	\$ 22,928	2016	100	2116	19.219	\$440,649
Site 5 Relief Well Collector	429+90	471+00	\$ 277,759	2016	100	2116	19.219	\$5,338,251
Total:			\$ 315,922					\$6,071,705

Table 7-3 – Pipe Systems – Replacement Costs (Structures)

System	Structure Type	Quantity	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
Type "T" Relief Well Outlet Works	End Section	8	\$ 24,560	2016	75	2091	9.179	\$225,436
5th Street Relief Well Collector	48" MH	1	\$ 2,250	2016	75	2091	9.179	\$20,653
-	End Section	2	\$ 6,140	2016	75	2091	9.179	\$56,359
Site 5 Relief Well Collector	48" MH	9	\$ 20,250	2016	75	2091	9.179	\$185,875
-	60" MH	4	\$ 11,800	2016	75	2091	9.179	\$108,312
-	72" MH	1	\$ 3,860	2016	75	2091	9.179	\$35,431
Total:			\$ 68,860					\$632,066

Table 7-4 – Pipe Systems – Replacement Costs (Check Valves)

System	Type	Quantity	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
Type "T" Relief Well Outlet Works	Duckbill	8	\$ 8,000	2016	35	2051	2.814	\$22,512
5th Street Relief Well Collector	Duckbill	2	\$ 2,000	2016	35	2051	2.814	\$5,628
Total:			\$ 10,000					\$28,140

8.0 Gummersheimer (Site 05) Pump Station

8.1 Maintenance

Periodic inspections of the pump station shall be made to ensure that concrete, miscellaneous metals, riprap, pipes, gates and operating mechanisms are in good condition. Metal parts are to be adequately covered with paint and kept free from rust. Machine-finished surfaces shall be protected from rusting by applying a coating of lubricant. Care is being exercised to prevent the accumulation of silt, trash, and debris near or within the structure. Sluice gates within the wet well are to be maintained as described in the System Wide Operation and Maintenance Manual. Pumps, controls, and other instrumentation are to be maintained per the Operation and Maintenance Manual for each pump station. Over the long term, the pump station may need to be rehabilitated. For example, several mechanical components may be worn or broken, and electronic components may become obsolete. If a major rehabilitation is needed, the sponsor should coordinate with the USACE to discuss the technical plans and the timing of the work. If parts of the pump station or gravity drain structures have been damaged or worn to the point where they should be replaced rather than repaired, the replacement parts should be the same as those shown on the as-built drawings. Maintenance costs have been estimated as shown in the table below.

Table 8-1 – Pump Stations – Maintenance Costs											
Year No.	Year	CAF (3%)	Sluice Gate		Sluice Gate Rehab		Pumps/Controls		Pumps/Controls Rehab		Cost per Year
			Price	QTY	Price	QTY	Price	QTY	Price	QTY	
0	2015	1.000	\$ 50	2	\$ 30,000	0	\$500	0	\$ 50,000	0	\$ 100
1	2016	1.030	\$ 52	2	\$ 30,900	0	\$515	0	\$ 51,500	0	\$ 103
2	2017	1.061	\$ 53	2	\$ 31,830	0	\$531	0	\$ 53,050	0	\$ 106
3	2018	1.093	\$ 55	2	\$ 32,790	0	\$547	0	\$ 54,650	0	\$ 109
4	2019	1.126	\$ 56	2	\$ 33,780	0	\$563	0	\$ 56,300	0	\$ 113
5	2020	1.159	\$ 58	2	\$ 34,770	0	\$580	2	\$ 57,950	0	\$ 1,275
6	2021	1.194	\$ 60	2	\$ 35,820	0	\$597	0	\$ 59,700	0	\$ 119
7	2022	1.230	\$ 62	2	\$ 36,900	0	\$615	0	\$ 61,500	0	\$ 123
8	2023	1.267	\$ 63	2	\$ 38,010	0	\$634	0	\$ 63,350	0	\$ 127
9	2024	1.305	\$ 65	2	\$ 39,150	0	\$653	0	\$ 65,250	0	\$ 131
10	2025	1.344	\$ 67	2	\$ 40,320	0	\$672	2	\$ 67,200	0	\$ 1,478
11	2026	1.384	\$ 69	2	\$ 41,520	0	\$692	0	\$ 69,200	0	\$ 138
12	2027	1.426	\$ 71	2	\$ 42,780	0	\$713	0	\$ 71,300	0	\$ 143
13	2028	1.469	\$ 73	2	\$ 44,070	0	\$735	0	\$ 73,450	0	\$ 147
14	2029	1.513	\$ 76	2	\$ 45,390	0	\$757	0	\$ 75,650	0	\$ 151
15	2030	1.558	\$ 78	2	\$ 46,740	0	\$779	2	\$ 77,900	0	\$ 1,714
16	2031	1.605	\$ 80	2	\$ 48,150	0	\$803	0	\$ 80,250	0	\$ 161
17	2032	1.653	\$ 83	2	\$ 49,590	0	\$827	0	\$ 82,650	0	\$ 165
18	2033	1.702	\$ 85	2	\$ 51,060	0	\$851	0	\$ 85,100	0	\$ 170

Table 8-1 – Pump Stations – Maintenance Costs

Year No.	Year	CAF (3%)	Sluice Gate		Sluice Gate Rehab		Pumps/Controls		Pumps/Controls Rehab		Cost per Year
			Price	QTY	Price	QTY	Price	QTY	Price	QTY	
19	2034	1.754	\$ 88	2	\$ 52,620	0	\$877	0	\$ 87,700	0	\$ 175
20	2035	1.806	\$ 90	2	\$ 54,180	0	\$903	2	\$ 90,300	0	\$ 1,987
21	2036	1.860	\$ 93	2	\$ 55,800	0	\$930	0	\$ 93,000	0	\$ 186
22	2037	1.916	\$ 96	2	\$ 57,480	0	\$958	0	\$ 95,800	0	\$ 192
23	2038	1.974	\$ 99	2	\$ 59,220	0	\$987	0	\$ 98,700	0	\$ 197
24	2039	2.033	\$ 102	2	\$ 60,990	0	\$1,017	0	\$ 101,650	0	\$ 203
25	2040	2.094	\$ 105	2	\$ 62,820	2	\$1,047	2	\$ 104,700	2	\$ 337,343
26	2041	2.157	\$ 108	2	\$ 64,710	0	\$1,079	0	\$107,850	0	\$ 216
27	2042	2.221	\$ 111	2	\$ 66,630	0	\$1,111	0	\$111,050	0	\$ 222
28	2043	2.288	\$ 114	2	\$ 68,640	0	\$1,144	0	\$114,400	0	\$ 229
29	2044	2.357	\$ 118	2	\$ 70,710	0	\$1,179	0	\$117,850	0	\$ 236
30	2045	2.427	\$ 121	2	\$ 72,810	0	\$1,214	2	\$121,350	0	\$ 2,670
31	2046	2.500	\$ 125	2	\$ 75,000	0	\$1,250	0	\$125,000	0	\$ 250
32	2047	2.575	\$ 129	2	\$ 77,250	0	\$1,288	0	\$128,750	0	\$ 258
33	2048	2.652	\$ 133	2	\$ 79,560	0	\$1,326	0	\$132,600	0	\$ 265
34	2049	2.732	\$ 137	2	\$ 81,960	0	\$1,366	0	\$136,600	0	\$ 273
35	2050	2.814	\$ 141	2	\$ 84,420	0	\$1,407	2	\$140,700	0	\$ 3,095
36	2051	2.898	\$ 145	2	\$ 86,948	0	\$1,449	0	\$144,914	0	\$ 290
37	2052	2.985	\$ 149	2	\$ 89,557	0	\$1,493	0	\$149,261	0	\$ 299
38	2053	3.075	\$ 154	2	\$ 92,244	0	\$1,537	0	\$153,739	0	\$ 307
39	2054	3.167	\$ 158	2	\$ 95,011	0	\$1,584	0	\$158,351	0	\$ 317
40	2055	3.262	\$ 163	2	\$ 97,861	0	\$1,631	2	\$163,102	0	\$ 3,588
41	2056	3.360	\$ 168	2	\$ 100,797	0	\$1,680	0	\$167,995	0	\$ 336
42	2057	3.461	\$ 173	2	\$ 103,821	0	\$1,730	0	\$173,035	0	\$ 346
43	2058	3.565	\$ 178	2	\$ 106,936	0	\$1,782	0	\$178,226	0	\$ 356
44	2059	3.671	\$ 184	2	\$ 110,144	0	\$1,836	0	\$183,573	0	\$ 367
45	2060	3.782	\$ 189	2	\$ 113,448	0	\$1,891	2	\$189,080	0	\$ 4,160
46	2061	3.895	\$ 195	2	\$ 116,851	0	\$1,948	0	\$194,752	0	\$ 390
47	2062	4.012	\$ 201	2	\$ 120,357	0	\$2,006	0	\$200,595	0	\$ 401
48	2063	4.132	\$ 207	2	\$ 123,968	0	\$2,066	0	\$206,613	0	\$ 413
49	2064	4.256	\$ 213	2	\$ 127,687	0	\$2,128	0	\$212,811	0	\$ 426
Total:											\$ 366,566

8.2 Replacement

The estimated life of this pump station is approximately 50 years. Performing periodic and annual maintenance as described in the Operation and Maintenance Manual may prolong the useful life,

especially if the sluice gates and pumps are rehabilitated after 25 years as shown above. However, full replacement will undoubtedly be necessary at some point. Replacement costs have been estimated as shown in the table below.

Table 8-2 – Pump Stations – Replacement Costs

System	Station	Initial Cost	Installation	Useful Life	Planned Replacement	CAF (3%)	Replacement Cost
Gummersheimer (Site 05)	454+00	\$1,135,000	2015	50	2065	4.384	\$ 4,975,840
Total:		\$1,135,000					\$ 4,975,840

8.3 Operation

Operation costs have been estimated on a yearly basis. Using available data for the Mississippi River Gage at St. Louis, the number and duration of “activating” events were evaluated to deduce a reasonable pumping duration. It was determined that there is no correlation between an event’s magnitude and its duration (i.e. 2-yr flood events can and tend to last nearly as long as 50-yr and 100-yr flood events, etc.). An operating duration of 85 days was chosen to capture both the average days in operation per year (80) and the maximum duration that can represent 75% of the events (85). The last recorded event that exceeded a 100-yr event was the Flood of 1993, which was an approximately 300-yr event. According to operational levels of the constructed pump station, the Flood of 1993 would have activated the station for 200 consecutive days. While not expected each year, the increased operating costs for flood events of such magnitude should be anticipated.

Costs included in Table 8-3 assume that during an operating event, the duty pump will run simultaneously, and continuously for the event duration. Additionally, the table below includes the cost for 200-day duration. It is recommended that this amount be held on reserve in the event of a high-magnitude flood event or duration. Electrical costs, per kilowatt hour, were obtained from Site 16 invoices in Cahokia, IL between May 2015 and May 2018. The operating costs are listed annually for the useful life of the stations in Table 8-4.

Table 8-3 – Pump Stations Operation Costs

Pump Station Site	Starting River Level (ft)	Ending River Level (ft)	No. of Duty Pumps	Rated Horsepower (per Pump)	Total Kilowatts	Average Days in Operation	Total Kilowatt Hours / Year	Energy Cost Per Kilowatt Hour	Cost Per Year	200-Day Reserve
Site 05	30	20	1	140	104	85	212972	\$ 0.034360	\$ 7,318	\$ 17,218
Total:									\$ 7,318	\$ 17,218

Table 8-4 – Pump Stations – Total Annual Operation Costs

Year No.	Year	CAF (3%)	Installation	Useful Life	Total (All Stations) Operation Cost
0	2018	1.000	2017	50	\$ 7,138
1	2019	1.030	2017	50	\$ 7,352
2	2020	1.061	2017	50	\$ 7,573
3	2021	1.093	2017	50	\$ 7,800
4	2022	1.126	2017	50	\$ 8,034
5	2023	1.159	2017	50	\$ 8,275
6	2024	1.194	2017	50	\$ 8,523
7	2025	1.230	2017	50	\$ 8,779
8	2026	1.267	2017	50	\$ 9,042
9	2027	1.305	2017	50	\$ 9,313
10	2028	1.344	2017	50	\$ 9,593
11	2029	1.384	2017	50	\$ 9,881
12	2030	1.426	2017	50	\$ 10,177
13	2031	1.469	2017	50	\$ 10,482
14	2032	1.513	2017	50	\$ 10,797
15	2033	1.558	2017	50	\$ 11,121
16	2034	1.605	2017	50	\$ 11,454
17	2035	1.653	2017	50	\$ 11,798
18	2036	1.702	2017	50	\$ 12,152
19	2037	1.754	2017	50	\$ 12,517
20	2038	1.806	2017	50	\$ 12,892
21	2039	1.860	2017	50	\$ 13,279
22	2040	1.916	2017	50	\$ 13,677
23	2041	1.974	2017	50	\$ 14,087
24	2042	2.033	2017	50	\$ 14,510
25	2043	2.094	2017	50	\$ 14,945
26	2044	2.157	2017	50	\$ 15,394
27	2045	2.221	2017	50	\$ 15,856
28	2046	2.288	2017	50	\$ 16,331
29	2047	2.357	2017	50	\$ 16,821
30	2048	2.427	2017	50	\$ 17,326
31	2049	2.500	2017	50	\$ 17,846
32	2050	2.575	2017	50	\$ 18,381
33	2051	2.652	2017	50	\$ 18,932
34	2052	2.732	2017	50	\$ 19,500
35	2053	2.814	2017	50	\$ 20,085
36	2054	2.898	2017	50	\$ 20,688

Table 8-4 – Pump Stations – Total Annual Operation Costs					
Year No.	Year	CAF (3%)	Installation	Useful Life	Total (All Stations) Operation Cost
37	2055	2.985	2017	50	\$ 21,309
38	2056	3.075	2017	50	\$ 21,948
39	2057	3.167	2017	50	\$ 22,606
40	2058	3.262	2017	50	\$ 23,284
41	2059	3.360	2017	50	\$ 23,983
42	2060	3.461	2017	50	\$ 24,702
43	2061	3.565	2017	50	\$ 25,444
44	2062	3.671	2017	50	\$ 26,207
45	2063	3.782	2017	50	\$ 26,993
46	2064	3.895	2017	50	\$ 27,803
47	2065	4.012	2017	50	\$ 28,637
48	2066	4.132	2017	50	\$ 29,496
49	2067	4.256	2017	50	\$ 30,381
Total:					\$ 805,144

9.0 Summary

The costs represented above are the best estimate of the engineer at the time of this study. An interest rate of 3-percent was chosen and applied at a constant rate, though it should be expected that this value will fluctuate over the useful life of the improvements. Costs detailed in this study constitute major routine (predictable) costs; any incidental or unpredictable costs shall be considered by the District based on past experience. These estimates do not provide a guarantee of cost values that will be incurred, but shall be used to anticipate the necessity for inevitable and periodic maintenance and replacement. The total cost estimated per year is only inclusive of newly installed features that are still within their useful life (e.g. maintenance costs for piezometers and relief wells, which have estimated useful lives of 50 years, are not included in the year costs behind 2066). The useful life of the improvements is highly dependent upon the diligent maintenance by the District, as outlined in the System Wide Operation and Maintenance Manual. The District is encouraged to engage their financial advisor in any budgetary modifications to ensure that funds are available to maintain the system.

Table 9-1 – Annual Costs

Year	Sluice Gates	Relief Wells Replacement	Relief Well Maintenance	PZ Replacement	PZ Maintenance	Seepage Berm Maintenance	Pipe Systems Replacement	Pipe Systems Maintenance	Pump Station Replacement	Pump Station Maintenance	Pump Station Operation	Total
2015										\$100		\$100
2016										\$103		\$103
2017										\$106		\$106
2018			\$15,200			\$16,276				\$109	\$7,138	\$38,723
2019			\$15,656			\$16,764				\$113	\$7,352	\$39,885
2020			\$16,127			\$17,269				\$1,275	\$7,573	\$42,244
2021			\$16,614			\$17,790		\$69,540		\$119	\$7,800	\$111,863
2022			\$18,804			\$18,327				\$123	\$8,034	\$45,288
2023			\$19,355			\$18,864				\$127	\$8,275	\$46,621
2024			\$19,940			\$19,434				\$131	\$8,523	\$48,027
2025			\$20,541			\$20,019				\$1,478	\$8,779	\$50,818
2026			\$21,159		\$18,816	\$20,622		\$80,640		\$138	\$9,042	\$150,417
2027			\$21,794			\$21,240				\$143	\$9,313	\$52,490
2028			\$20,429			\$21,875				\$147	\$9,593	\$52,044
2029			\$21,037			\$22,526				\$151	\$9,881	\$53,595
2030			\$21,675			\$23,210				\$1,714	\$10,177	\$56,776
2031			\$22,329			\$23,909		\$93,480		\$161	\$10,482	\$150,361
2032			\$25,267			\$24,626				\$165	\$10,797	\$60,855
2033			\$26,019			\$25,358				\$170	\$11,121	\$62,668
2034			\$26,804			\$26,123				\$175	\$11,454	\$64,556
2035			\$27,605			\$26,904				\$1,987	\$11,798	\$68,294
2036			\$28,423		\$25,284	\$27,702		\$108,360		\$186	\$12,152	\$202,107
2037			\$29,292			\$28,548				\$192	\$12,517	\$70,548
2038			\$27,451			\$29,394				\$197	\$12,892	\$69,935
2039			\$28,272			\$30,273				\$203	\$13,279	\$72,027
2040			\$29,123			\$31,185				\$337,343	\$13,677	\$411,329
2041			\$30,005			\$32,129		\$125,640		\$216	\$14,087	\$202,077
2042			\$33,951			\$33,089				\$222	\$14,510	\$81,772
2043			\$275,780			\$34,082				\$229	\$14,945	\$325,036
2044			\$36,022			\$35,107				\$236	\$15,394	\$86,759
2045			\$37,091			\$36,149				\$2,670	\$15,856	\$91,765
2046	\$408,780		\$38,210		\$33,978	\$37,239		\$145,620		\$250	\$16,331	\$680,408
2047	\$48,540		\$39,362			\$38,363				\$258	\$16,821	\$143,343
2048			\$36,890			\$39,502				\$265	\$17,326	\$93,983
2049			\$38,000			\$40,690				\$273	\$17,846	\$96,809
2050			\$39,140			\$41,911				\$3,095	\$18,381	\$102,527

Table 9-1 – Annual Costs

Year	Sluice Gates	Relief Wells Replacement	Relief Well Maintenance	PZ Replacement	PZ Maintenance	Seepage Berm Maintenance	Pipe Systems Replacement	Pipe Systems Maintenance	Pump Station Replacement	Pump Station Maintenance	Pump Station Operation	Total
2051			\$40,310			\$43,164	\$28,140	\$168,840		\$290	\$18,932	\$299,677
2052			\$45,624			\$44,466				\$299	\$19,500	\$109,889
2053			\$46,994			\$45,801				\$307	\$20,085	\$113,187
2054			\$48,401			\$47,172				\$317	\$20,688	\$116,578
2055			\$49,853			\$48,588				\$3,588	\$21,309	\$123,338
2056			\$51,349		\$45,669	\$50,045		\$195,720		\$336	\$21,948	\$365,066
2057			\$52,889			\$51,547				\$346	\$22,606	\$127,388
2058			\$49,583			\$53,093				\$356	\$23,284	\$126,317
2059			\$51,070			\$54,686				\$367	\$23,983	\$130,106
2060			\$52,603			\$56,326				\$4,160	\$24,702	\$137,791
2061			\$54,181			\$58,016		\$226,920		\$390	\$25,444	\$364,950
2062			\$61,313			\$59,757				\$401	\$26,207	\$147,678
2063			\$63,153			\$61,549				\$413	\$26,993	\$152,108
2064		\$2,542,720	\$65,047			\$63,396				\$426	\$27,803	\$2,699,391
2065		\$9,329,152	\$66,999			\$65,298			\$4,975,840		\$28,637	\$14,465,925
2066			\$69,009	\$736,512		\$67,257		\$2,946,048			\$29,496	\$3,848,321
2067			\$71,079			\$69,274					\$30,381	\$170,734
2068						\$71,354					\$805,144	\$876,498
2069						\$73,495						\$73,495
2070						\$75,699						\$75,699
2071						\$77,970		\$304,920				\$382,890
2072						\$80,310						\$80,310
2073						\$82,719						\$82,719
2074						\$85,200						\$85,200
2075						\$87,756						\$87,756
2076						\$90,389		\$353,520				\$443,909
2077						\$93,101						\$93,101
2078						\$95,894						\$95,894
2079						\$98,771						\$98,771
2080						\$101,734						\$101,734
2081						\$104,786		\$409,800				\$514,586
2082						\$107,929						\$107,929
2083						\$111,167						\$111,167
2084						\$114,502						\$114,502
2085						\$117,937						\$117,937
2086						\$121,475		\$475,080				\$596,555

Table 9-1 – Annual Costs

Year	Sluice Gates	Relief Wells Replacement	Relief Well Maintenance	PZ Replacement	PZ Maintenance	Seepage Berm Maintenance	Pipe Systems Replacement	Pipe Systems Maintenance	Pump Station Replacement	Pump Station Maintenance	Pump Station Operation	Total
2087						\$125,120						\$125,120
2088						\$128,873						\$128,873
2089						\$132,739						\$132,739
2090						\$136,722						\$136,722
2091						\$140,823	\$632,066	\$550,740				\$1,323,629
2092						\$145,048						\$145,048
2093						\$149,399						\$149,399
2094						\$153,881						\$153,881
2095						\$158,498						\$158,498
2096						\$163,253		\$638,460				\$801,713
2097						\$168,150						\$168,150
2098						\$173,195						\$173,195
2099						\$178,391						\$178,391
2100						\$183,742						\$183,742
2101						\$189,255		\$740,160				\$929,415
2102						\$194,932						\$194,932
2103						\$200,780						\$200,780
2104						\$206,804						\$206,804
2105						\$213,008						\$213,008
2106						\$219,398		\$858,000				\$1,077,398
2107						\$225,980						\$225,980
2108						\$232,759						\$232,759
2109						\$239,742						\$239,742
2110						\$246,934						\$246,934
2111						\$254,342		\$994,680				\$1,249,022
2112						\$261,973						\$261,973
2113						\$269,832						\$269,832
2114						\$277,927						\$277,927
2115						\$286,265						\$286,265
2116						\$294,853	\$6,071,705					\$6,366,558
2117						\$303,698						\$303,698
2118						\$312,809						\$312,809