TECHNICAL MEMORANDUM

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www.freese.com

TO: Woody Frossard

FROM: Michael McBee, P.E., and Ben Hagood

SUBJECT: Cost Estimates and Permitting Evaluation for the Mary's Creek Water Reuse Alternatives 1-5

PROJECT: TCW20417

DATE: September 3, 2020

CC: Rusty Gibson, P.E.

STATE OF TEXAS
MICHAEL A. MCBEE
130463
LICENSED
PROFESSIONAL ENGINEER

09/03/2020

Contents

1.00 BACKGROUND

Tarrant Regional Water District (TRWD) asked Freese and Nichols, Inc. (FNI) to provide an independent estimate of capital and life cycle costs as well as a review of permit requirements for the Mary's Creek Water Reclamation Facility (MCWRF) Water Reuse Project. The MCWRF is scheduled to be in service in 2026. TRWD identified five reuse alternatives to be evaluated, as follows:

Alternative 1 - Discharge to Lake Worth via straight pipe from MCWRF to Silver Creek

Alternative 2 - Discharge to Benbrook Lake via straight pipe from MCWRF to Dutch Branch Creek (prefer to stay off USACE Property)

Alternative 3 - Discharge to Eagle Mountain Lake via pipe from MCWRF to the Eagle Mountain Pipeline, with a connection just north of the Eagle Mountain Balancing Reservoir (EMBR) and using the existing Eagle Mountain Flow Control and Outlet structure

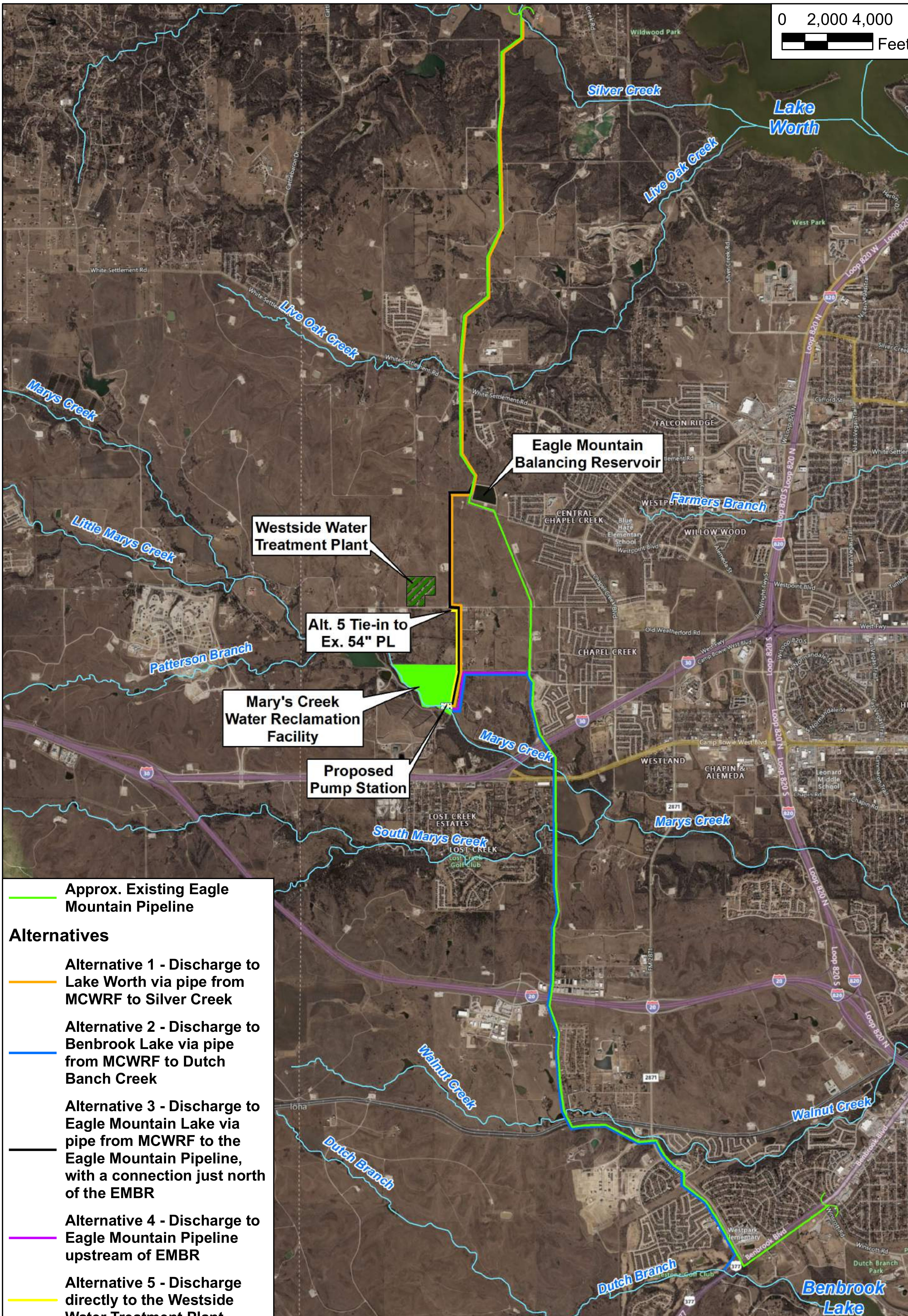
Alternative 4 - Discharge to the Eagle Mountain Pipeline upstream of the EMBR, which would result in some of the water going to the new West Side Water Treatment Plant and some flow going to the Eagle Mountain Flow Control and Outlet

Alternative 5 - Discharge directly to the Westside Water Treatment Plant

The five alternatives are shown in **Figure 1 - Alternative Overview Map.**

It is FNI's understanding that TRWD has studied the water rights permitting and water quality for each alternative, so FNI is not tasked with investigating water rights, water sales, or water quality.

TRWD has self-performed a similar cost analysis for Mary's Creek Water Reclamation Reuse alternatives. TRWD provided FNI some factors such as power rates and a list of output metrics (such as cost/acre foot delivered), but they did not provide their cost estimates for the alternatives so as to preserve the independence of FNI's analysis.



Freese and Nichols
4055 International Plaza Suite 200
Fort Worth, Texas 76109-4895
817-735-7300

N W E S

TARRANT REGIONAL WATER DISTRICT

OVERVIEW MAP

Mary's Creek Water Reclamation Facility Reuse Project: Alternatives 1 – 5

FN JOB NO	TCW20417
FILE	1_Overview_11x17
DATE	9/3/2020
SCALE	1:24,000
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DRAFTED	HHM

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Figure

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2.00 DESIGN CONSIDERATIONS AND ASSUMPTIONS

2.01 HYDRAULIC CAPACITY

A. Flow Projections

TRWD provided FNI with Population and Wastewater Flow Projections for the MCWRF, included in **Table 1** below.

Table 1: Mary's Creek Water Reclamation Facility
Population and Wastewater Flow Projections

Year	Mary's Creek WRF Population	Residential Average Day Flow* (MGD)	Mary's Creek WRF Employment	Nonresidential Average Day Flow ** (MGD)	Benbrook Total Average Flow (MGD)	Total WRF Average Day (MGD)
2020	46,557	4.66	10,345	0.41	0.47	5.54
2021	51,222	5.12	10,535	0.42	0.50	6.04
2022	55,898	5.59	10,728	0.43	0.52	6.54
2023	60,585	6.06	10,925	0.44	0.55	7.05
2024	65,285	6.53	11,125	0.45	0.57	7.55
2025	69,996	7.00	11,329	0.45	0.60	8.05
2026	74,720	7.47	11,533	0.46	0.61	8.54
2027	79,339	7.93	11,741	0.47	0.61	9.01
2028	83,967	8.40	11,952	0.48	0.62	9.50
2029	88,604	8.86	12,167	0.49	0.63	9.98
2030	93,249	9.32	12,386	0.50	0.63	10.45
2031	97,904	9.79	12,609	0.50	0.64	10.93
2032	102,569	10.26	12,836	0.51	0.65	11.42
2033	107,242	10.72	13,067	0.52	0.65	11.89
2034	111,926	11.19	13,302	0.53	0.66	12.38
2035	116,619	11.66	13,524	0.54	0.67	12.87
2036	121,321	12.13	13,785	0.55	0.67	13.35
2037	126,034	12.60	14,033	0.56	0.68	13.84
2038	130,757	13.08	14,224	0.57	0.69	14.34
2039	135,490	13.55	14,458	0.58	0.69	14.82
2040	139,999	14.00	14,674	0.59	0.70	15.29
2050	184,986	18.5	17,030	0.68	0.70	19.88

*Assumes a residential per capita of 100 per capita per day.

**Assumes a nonresidential per capita of 40 gallons per employee per day.

B. Design Flow

To determine design flow for the MCWRF Reuse Pump Station and Pipeline, FNI assumed that the pump station should be designed with a firm capacity capable of conveying the total water reclamation facility average day flow for at least ten years without needing capacity expansion. FNI has assumed that the MCWRF Reuse Pump Station would be in service in 2024. According to **Table 1**, the MCWRF would need to be rated for at least 12.38 MGD to convey the total WRF average day flow in 2034.

For this study, FNI is assuming that the MCWRF Reuse Pump Station would initially be designed to accommodate 15 MGD firm capacity and a 20 MGD total capacity (15 MGD with one pump off-line, and 20 MGD with all pumps running). According to **Table 1**, this design flow/firm capacity would meet projected average day demands until 2040, and the total capacity would meet projected average day demands until the end of the 30-year bond period in 2050.

C. Peak Flow

Peak Flow for the MCWRF would occur during a heavy rain event. During such an event, Inflow & Infiltration could result in a peaking factor of 2.0 times average day flows for a short duration (sometimes assumed to be 2 hours). The Reuse Pump Station and Pipeline are not being designed to accommodate Peak Flow for this study. This study assumes that flow greater than the total capacity of the MCWRF Reuse Pump Station would go directly to Mary's Creek.

2.02 PIPELINE ASSUMPTIONS

A. Diameter

Pipeline diameter impacts the amount of energy required to move water. Smaller pipelines result in higher operational energy costs, whereas larger pipelines result in higher capital costs. For an average day flow of 15 MGD, FNI recommends that the pipeline from the MCWRF to its delivery point (varies depending on alternative, see **Section 3.00**) be 36-inch diameter. **Table 2** below shows flow velocity and head loss (HL) associated with pipe diameter for the design average day flow and total capacity flow of the MCWRF.

B. Friction/Roughness Coefficient

The Hazen Williams C-Factors are used to estimate friction losses, or head losses, in pipes. Pipe lining material and age impact the C-Factor. Newer, smoother pipe have high C-Values corresponding with less friction loss. Older, rougher pipe have lower C-Values and more friction loss. For this study, it was assumed that any proposed piping would be mortar lined, and that over the course of the life cycle assessment, would have an average C-Factor of 120.

Table 2: Pipe Diameter Flow Velocity and Friction Loss Comparison

		Diameter of Pipe (in.)					
		30"		36"		42"	
		Velocity	HL per 1,000 LF	Velocity	HL per 1,000 LF	Velocity	HL per 1,000 LF
Design Average Day Flow (and Firm Capacity)	15 MGD	4.73 ft/s	2.60	3.28 ft/s	1.07	2.41 ft/s	0.51
Design Total Capacity	20 MGD	6.30 ft/s	4.44	4.38 ft/s	1.82	3.22 ft/s	0.86

2.03 PUMP STATION ASSUMPTIONS

A. Site Location

For all the alternative analyses detailed in **Section 3.00**, it has been assumed that a pump station will be located at the southeastern corner of the MCWRF site. The pump station's purpose would be to pump reuse water from the reclamation facility to its delivery point, which would vary depending on alternative constructed. Pump station location impacts the length of pipe from the MCWRF site to the delivery point.

B. Number of Pumps and Type of Operator

The number of pumps included in the MCWRF pump station will impact capital cost (footprint of structure, sizing of electrical equipment) and operational cost (ability to operate pumps near their best efficiency point).

The pump station should operate efficiently at the most common operational conditions while also being capable of operating at peak flow conditions. **Table 1** shows the Average Day flow projections will vary between 5.54 MGD in 2020 to 19.88 MGD by 2050. The MCWRF pump station design should be capable of operating at a range of flows from 0.6x the lowest Average Day flow to 1.0x the highest Average Day flow, a range of roughly 3 MGD to 20 MGD.

To accommodate the wide range of flow demands, the pump station can be designed with multiple pumps operating in parallel and controlled with variable frequency drives. For the MCWRF pump station, FNI is assuming the pump station will be designed to include four pumps (three duty and one stand-by) operated with variable frequency drives.

C. Associated Appurtenances

The capital costs associated with the pump station include assumptions about equipment and appurtenances that will be included. The major assumptions are as follows:

a. Four 250 HP pumps
    1) Assumed to be Vertical Turbine pumps taking suction from a wet well
b. Four variable frequency drives and venturi flow meters
c. Bridge crane
d. Motor operated pump control and isolation valves

For a further breakdown of what is included in the pump station capital costs, see the Opinion of Probable Construction Costs, included on the next three pages.

D. Structure

It assumed that the pump station will be in a steel frame building with concrete wall panels and a metal roof. The building dimensions have been conceptually estimated from recently designed similar pump stations. The pump station footprint has been assumed as 115 feet long by 65 feet wide, and the height has been assumed as 25-foot-tall walls with a gable roof sloped at 1:3.

OPINION OF PROBABLE CONSTRUCTION COST

PROJECT NAME	Mary's Creek Water Reclamation Facility PS	DATE	7/31/2020
CLIENT	TRWD	GROUP	1112
% SUBMITTAL	Conceptual	PM	Ben Hagood

ESTIMATATED BY	QC CHECKED BY	FNI Project Number
Michael McBee	Rusty Gibson	TCW20417

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
PUMP STATION SITEWORK					**$1,330,310.00**
1	CLEARING AND GRUBBING	2.00	AC	$4,500.00	$9,000.00
2	STRUCTURAL EXCAVATION	5,600	CY	$18.10	$101,360.00
3	FLOWABLE FILL BACKFILL (PUMP STATION)	2,500	CY	$120.00	$300,000.00
4	SELECT BACKFILL	3,100	CY	$30.00	$93,000.00
5	SIDEWALK AROUND BUILDING	230	SY	$60.00	$13,800.00
6	HVAC PAD	140	SY	$110.00	$15,400.00
7	EROSION CONTROL	1	LS	$10,000.00	$10,000.00
8	GRADING	1,800	SY	$3.50	$6,300.00
9	24-INCH YARD PIPING	600	LF	$375.00	$225,000.00
10	PIPELINE CONNECTIONS	1	LS	$20,000.00	$20,000.00
11	24-INCH MANUALLY OPERATED ISOLCATION VALVES	4	EA	$12,500.00	$50,000.00
12	24" RESTRAINED FLEXIBLE COUPLING	4	EA	$8,000.00	$32,000.00
13	84-INCH DIAMETER MANHOLES	4	EA	$25,000.00	$100,000.00
14	SOD WITH IRRIGATION	60,000	SF	$1.50	$90,000.00
15	ASPHALT PAVEMENT	1,800	SY	$65.00	$117,000.00
16	CONCRETE CURB AND GUTTER	750	LF	$35.00	$26,250.00
17	SITE DEWATERING	1	LS	$80,000.00	$80,000.00
18	TRENCH SAFETY	600	LF	$2.00	$1,200.00
19	6" CAV ASSEMBLY IN MANHOLE	1	EA	$15,000.00	$15,000.00
20	SANITARY SEWER LINE FOR FLOOR DRAINS (6" PVC)	500	LF	$50.00	$25,000.00
PUMP STATION BUILDING					**$2,535,115.00**
	STRUCTURAL				
21	DRILLED SHAFT FOUNDATION	1,400	VLF	$100.00	$140,000.00
22	GRADE BEAMS	180	CY	$800.00	$144,000.00
23	WET WELL FOOTING	700	CY	$800.00	$560,000.00
24	SLAB	400	CY	$700.00	$280,000.00
25	ROOF BEAM	13	TN	$4,000.00	$52,000.00
26	PURLINS	50	TN	$3,600.00	$180,000.00
27	DECK	11,000	SF	$4.00	$44,000.00
28	BUILDING COLUMNS	20	TN	$4,000.00	$80,000.00
29	GIRTS	10	TN	$3,600.00	$36,000.00
30	BRIDGE CRANE	1	LS	$120,000.00	$120,000.00
	ARCHITECTURAL				
31	PRECAST CONCRETE PANEL WALLS	8,800	SF	$25.50	$224,400.00
32	KALWALL	2,200	SF	$75.00	$165,000.00
33	STANDING SEAM METAL ROOFING	11,000	SF	$15.00	$165,000.00
34	PAINTING	1	LS	$65,000.00	$65,000.00
	DOORS				
35	3'x7' DOOR & FRAME, HOLLOW METAL	6	EA	$1,800.00	$10,800.00
36	7'x9' DOOR & FRAME, HOLLOW METAL	2	EA	$3,095.00	$6,190.00
37	PANIC DEVICES	8	EA	$750.00	$6,000.00
38	12'x13.5' COILING OVERHEAD DOOR	1	EA	$14,500.00	$14,500.00
39	METAL WALL PANELS ABOVE KALWALL ON ENDS OF PUMP STATION	1	LS	$18,000.00	$18,000.00

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
40	GUTTERS	450	LF	$7.50	$3,375.00
41	DOWNSPOUTS	540	LF	$7.50	$4,050.00
42	PIPE BOLLARDS	24	EA	$700.00	$16,800.00
43	MECHANICAL, HVAC, AND PLUMBING	1	LS	$200,000.00	$200,000.00
PUMP STATION PIPING, VALVES, AND EQUIPMENT					**$1,390,500.00**
44	5 MGD PUMP WITH 250 HP MOTOR	4	EA	$235,000.00	$940,000.00
45	3" PUMP BARREL AIR RELIEF VALVE W/ DRAIN LINE	4	EA	$10,000.00	$40,000.00
46	14" HARNESSED DRESSER COUPLING	4	EA	$10,000.00	$40,000.00
47	4" COMBINATION AIR AND VACCUM VALVE W/ DRAIN LINE	4	EA	$10,000.00	$40,000.00
48	14" CHECK VALVE	4	EA	$15,000.00	$60,000.00
49	14" VENTURI FLOW METER	4	EA	$15,000.00	$60,000.00
50	14" BFV, MOTOR OPERATED	4	EA	$12,000.00	$48,000.00
51	36" BFV, MANUALLY OPERATED	1	EA	$20,000.00	$20,000.00
52	6" COMBINATION AIR/VACUUM VALVE W/ DRAIN LINE	1	EA	$12,500.00	$12,500.00
53	HEADER PIPING IN PUMP STATION (SPOOL PIECES & FITTINGS)	1	LS	$90,000.00	$90,000.00
54	STEEL PIPE SUPPORT ON CONC. BASE	6	EA	$2,000.00	$12,000.00
55	ADJUSTABLE PIPE SUPPORT	28	EA	$1,000.00	$28,000.00
ELECTRICAL AND INSTRUMENTATION					**$3,107,700.00**
56	SCADA/COMMUNICATION	1	LS	$600,000.00	$600,000.00
	ELECTRICAL EQUIPMENT				
57	480V ATO SWITCHBOARD	1	EA	$130,000.00	$130,000.00
58	480V 250HP VFD	4	EA	$250,000.00	$1,000,000.00
59	480Y/277V PANELBOARD	1	EA	$30,000.00	$30,000.00
60	208Y/120V PANELBOARD	1	EA	$20,000.00	$20,000.00
61	SUPPLY FAN STARTERS	4	EA	$4,000.00	$16,000.00
62	480-208Y/120V DRY TYPE TRANSFORMER	1	EA	$15,000.00	$15,000.00
63	30A/3P FUSED DISCONNECT SWITCH	15	EA	$2,000.00	$30,000.00
64	100A / 3P FUSED DISCONNECT SWITCH	4	EA	$6,000.00	$24,000.00
65	LIGHTING CONTACTORS	4	EA	$3,000.00	$12,000.00
66	LEVEL RELAY PANEL	1	EA	$3,000.00	$3,000.00
	EQUIPMENT FOUNDATIONS				
67	TRANSFORMER	1	LS	$3,500.00	$3,500.00
68	LIGHT POLE BASE	6	EA	$3,000.00	$18,000.00
	MISC. ELECTRICAL (GROUNDING, LIGHTS, RECEPTACLES, ETC.)				
69	GROUND RODS	30	EA	$200.00	$6,000.00
70	INTERIOR LOW BAY LIGHTING	15	EA	$1,750.00	$26,250.00
71	INTERIOR HIGH BAY LIGHTING	9	EA	$2,750.00	$24,750.00
72	EXTERIOR BUILDING LIGHTING	7	EA	$2,000.00	$14,000.00
	INSTRUMENTATION				
73	DIFFERENTIAL PRESSURE TRANSMITTER	4	EA	$3,200.00	$12,800.00
74	DISCHARGE HEADER PRESSURE TRANSMITTER	1	EA	$2,500.00	$2,500.00
75	LEVEL SWITCHES	10	EA	$480.00	$4,800.00
76	INTRUSION DETECTION (DOOR CONTACTS)	8	EA	$550.00	$4,400.00
77	TEMPERATURE TRANSMITTERS	4	EA	$650.00	$2,600.00
78	HEAT DETECTORS	6	EA	$450.00	$2,700.00
79	SMOKE DETECTORS	6	EA	$350.00	$2,100.00
80	LIGHTNING PROTECTION SYSTEM	1	LS	$72,000.00	$72,000.00
81	CABLE AND CONDUIT	1	LS	$950,000.00	$950,000.00
82	ELECTRICAL PULLBOXES	4	EA	$3,500.00	$14,000.00
83	ELECTRICAL MANHOLES	4	EA	$9,200.00	$36,800.00
84	POWER SYSTEM STUDIES	1	LS	$18,000.00	$18,000.00
85	START-UP AND TESTING	1	LS	$12,500.00	$12,500.00

SUBTOTAL:		$8,363,630
OH & P	15%	$1,254,550
SUBTOTAL:		$9,618,180
MOBILIZATION	5%	$480,910
SUBTOTAL:		$10,099,090
CONTINGENCY	0%	$0

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL

CONSTRUCTION TOTAL (2020 COSTS)			**$10,100,000**
	INFLATION:	0%	**$0**
PUMP STATION TOTAL (2020 DOLLARS)			**$10,100,000**

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

NOTES:

1 FNI OPCC classified as an AACE Class 1 Estimate with accuracy range or -10 to + 15.
2 FNI OPCC does not include costs associated with engineering fees, permits, surveying, etc.

3.00 ALTERNATIVE DESCRIPTIONS

The five alternatives are best illustrated in **Figure 1**, included in **Section 1.00.**

3.01 ALTERNATIVE 1 - DISCHARGE TO LAKE WORTH VIA PIPE FROM MCWRF TO SILVER CREEK

The Alternative 1 route, also referred to as the Silver Creek route, directs flow from the MCWRF to the Silver Creek tributary of Lake Worth. This route does not cross any highway or railroads. In this alternative a proposed pipeline would be routed as detailed below and illustrated in **Figure 1** in the **Section 1.00**:

Segment	Start	Route	Destination
1	E side of MCWRF	N paralleling Old Weatherford Chapin Rd	Old Weatherford Rd
2	Old Weatherford Rd	W paralleling Old Weatherford Rd	Natural Gas Utility Easement
3	Natural Gas Utility Easement	N paralleling Gas Easement	Utility Easement to the W of EMBR
4	Utility Easement to the W of EMBR	E paralleling utility easement to EMBR	EMBR
5	EMBR	N paralleling Eagle Mountain Pipeline	Silver Creek

A. Thought behind routing to the North: Routing from the MCWRF north paralleling the gas easement results in a shorter route and less pipe capital cost than if the pipeline were routed east from the MCWRF to the Eagle Mountain Pipeline. While this proposed routing would require new easement acquisition, it would avoid having to modify the existing Eagle Mountain Pipeline easement south of the Eagle Mountain Balancing Reservoir (EMBR) and would leave space in the Eagle Mountain Pipeline easement for a future parallel pipeline to be installed.

B. Key Route Elevations:

1. Start: 758’ MSL at the MCWRF
2. Intermediate High Point: 901’ MSL approximately 11,100 LF from the MCWRF, at the EMBR
3. End: 620’ MSL at Silver Creek, approximately 33,000 LF from the start point

C. Discharge Control Structure: Flow south of the high point will be pumped flow and flow to the north of the high point would be gravity flow unless a control structure with throttling capabilities were installed at the discharge location to maintain full pipe flow. Controlling the discharge is advantageous because it would offer control over how much water is released into Silver Creek. The discharge location will require a structure to house a radio and PLC for communication between the SCADA network and the remotely located equipment, a motor operated valve for throttling flow, and a water meter to measure the volume of water delivered to this location.

D. Standpipe at Intermediate High Point: A standpipe at the intermediate high point would help the pipe downstream of the high point to remain full and offer dampening for any hydraulic surges that may occur in the pressurized pipe. FNI anticipates that the standpipe would consist of a 36”x36”x36” tee off of the pipeline with a concrete splashpad surrounding the standpipe.

E. Pumping Requirements Summary:
   1. Static Head: 62 PSI
   2. Dynamic Head Range and HP Requirements:
      a. 5 MGD = 67 PSI, 180 HP
      b. 15 MGD = 72 PSI, 570 HP
      c. 20 MGD = 76 PSI, 810 HP

3.02 ALTERNATIVE 2 - DISCHARGE TO BENBROOK LAKE VIA PIPE FROM MCWRF TO DUTCH BRANCH CREEK

The Alternative 2 route, also referred to as the Dutch Branch route, directs flow from the MCWRF to just upstream of where US 377 crosses a creek named Dutch Branch. This route crosses I-30, I-20, and an active railroad track. In this alternative a proposed pipeline would be routed as detailed below and illustrated in **Figure 1** in **Section 1.00**:

Segment	Start	Route	Destination
1	E side of MCWRF	E paralleling Old Weatherford Rd	Eagle Mountain Pipeline ROW
2	Eagle Mountain Pipeline ROW	S paralleling Eagle Mountain Pipeline	Dutch Branch

A. Key Route Elevations:
   1. Start: 758' MSL at the MCWRF
   2. Intermediate High Point: 901' MSL approximately 19,000 LF from the MCWRF, immediately north of the I-20 crossing.
   3. End: 725' MSL at Dutch Branch Creek, approximately 36,500 LF from the start point

B. Discharge Control Structure: Flow north of the high point will be pumped flow and flow to the south of the high point would be gravity flow unless a control structure with throttling capabilities were installed at the discharge location to maintain full pipe flow. Controlling the discharge is advantageous because it would offer control over how much water is released into Dutch Branch. The discharge location will require a structure to house a radio and PLC for communication between the SCADA network and the remotely located equipment, a motor operated valve for throttling flow, and a water meter to measure the volume of water delivered to this location.

C. Standpipe at Intermediate High Point: A standpipe at the intermediate high point would help the pipe downstream of the high point to remain full and offer dampening for any hydraulic surges that may occur in the pressurized pipe. FNI anticipates that the standpipe would consist of a 36"x36"x36" tee off of the pipeline with a concrete splashpad surrounding the standpipe.

D. Pumping Requirements Summary:
   1. Static Head: 62 PSI
   2. Dynamic Head Range and HP Requirements:
      a. 5 MGD = 67 PSI, 180 HP
      b. 15 MGD = 75 PSI, 600 HP
      c. 20 MGD = 83 PSI, 880 HP

3.03 ALTERNATIVE 3 - DISCHARGE TO EAGLE MOUNTAIN LAKE VIA PIPE FROM MCWRF TO THE EAGLE MOUNTAIN PIPELINE, WITH A CONNECTION JUST NORTH OF THE EMBR

The Alternative 3 route directs flow from the MCWRF to Eagle Mountain Lake by connecting to the Eagle Mountain Pipeline downstream of the existing EMBR valves B128 and B130. Ultimately, flow from the Eagle Mountain Pipeline would discharge into Eagle Mountain Lake. This route does not cross any highway or railroads. In this alternative a proposed pipeline would be routed as detailed below and illustrated in **Figure 1** in **Section 1.00**:

Segment	Start	Route	Destination
1	E side of MCWRF	N paralleling Old Weatherford Chapin Rd	Old Weatherford Rd
2	Old Weatherford Rd	W paralleling Old Weatherford Rd	Natural Gas Utility Easement
3	Natural Gas Utility Easement	N paralleling Gas Easement	Utility Easement to the W of EMBR
4	Utility Easement to the W of EMBR	E paralleling utility easement to EMBR	EMBR

A. Thought behind routing to the North: Routing from the MCWRF north paralleling the gas easement results in a shorter route and less pipe capital cost than if the pipeline were routed east from the MCWRF to the Eagle Mountain Pipeline. While this proposed routing would require new easement acquisition, it would avoid having to modify the existing Eagle Mountain Pipeline easement south of the EMBR and would leave space in the Eagle Mountain Pipeline easement for a future parallel pipeline to be installed.

B. Key Route Elevations:
   1. Start: 758’ MSL at the MCWRF
   2. End & High Point: 901’ MSL approximately 11,100 LF from the MCWRF, at the EMBR

C. Discharge Control Structure/End Connection: This alternative would flow through the existing Eagle Mountain flow control structure. It would not require construction of a new flow control structure. The cost associated with tying into the existing EMPL is estimated as $50,000.

D. Standpipe at Intermediate High Point: A standpipe at the high point would help the pipe downstream of the high point to remain full for the throttling valve to work properly and offer dampening for any hydraulic surges that may occur in the pressurized pipe. This alternative could take advantage of the existing standpipe by the EMBR.

E. Pumping Requirements Summary:
   1. Static Head: 62 PSI
   2. Dynamic Head Range and HP Requirements:
      a. 5 MGD = 67 PSI, 180 HP
      b. 15 MGD = 72 PSI, 570 HP
      c. 20 MGD = 76 PSI, 810 HP

3.04 ALTERNATIVE 4 - DISCHARGE TO EAGLE MOUNTAIN PIPELINE UPSTREAM OF EMBR

The Alternative 4 route directs flow from the MCWRF to Eagle Mountain Lake by connecting to the Eagle Mountain Pipeline upstream of the existing EMBR, due east of the MCWRF. Ultimately, flow from the Eagle Mountain Pipeline would discharge into Eagle Mountain Lake and the Westside Water Treatment Plant. This route does not cross any highway or railroads. In this alternative a proposed pipeline would be routed as detailed below and illustrated in **Figure 1** in **Section 1.00**:

Segment	Start	Route	Destination
1	E side of MCWRF	E paralleling Old Weatherford Rd	Eagle Mountain Pipeline ROW

A. Key Route Elevations:
   1. Start: 758' MSL at the MCWRF
   2. Proposed Pipeline End & High Point: 875' MSL approximately 4,650 LF from the MCWRF, near the Eagle Mountain Pipeline ROW
   3. High Point at EMBR (controls pump head): 901' MSL approximately 11,100 LF from the MCWRF, at the EMBR

B. Discharge Control Structure/End Connection: This alternative would flow through the existing Eagle Mountain flow control structure. It would not require construction of a new flow control structure. The cost associated with tying into the existing EMPL is estimated as $50,000.

C. Standpipe at High Point: This alternative would not require construction of a new standpipe. The existing standpipe at the EMBR could offer the same benefits listed for alternatives 1 and 2.

D. Pumping Requirements Summary:
   1. Static Head: 62 PSI (controlled by the water level in the EMBR)
   2. Dynamic Head Range and HP Requirements:
      a. 5 MGD = 67 PSI, 180 HP
      b. 15 MGD = 69 PSI, 550 HP
      c. 20 MGD = 70 PSI, 750 HP

3.05 ALTERNATIVE 5 - DISCHARGE DIRECTLY TO THE WESTSIDE WATER TREATMENT PLANT

The Alternative 5 route directs flow from the MCWRF directly to the Westside Water Treatment Plant. This route does not cross any highway or railroads. In this alternative a proposed pipeline would be routed as detailed below and illustrated in **Figure 1** in **Section 1.00**:

Segment	Start	Route	Destination
1	E side of MCWRF	N paralleling Old Weatherford Chapin Rd	54" WL paralleling Old Weatherford Rd

A. Key Route Elevations:
   1. Start: 758’ MSL at the MCWRF
   2. Proposed Pipeline End & High Point: 864’ MSL approximately 4,520 LF from the MCWRF, at Old Weatherford Rd
   3. High Point at EMBR (controls pump head): 901’ MSL approximately 11,100 LF from the MCWRF, at the EMBR

B. Connection to 54” Pipeline: Flow to the high point near Old Weatherford Rd and the existing 54” pipeline that connects the Eagle Mountain pipeline with the Westside Water Treatment Plant will be pumped, then would join the 54” pipeline flowing west to the Westside Water Treatment Plant. For this alternative, FNI has assumed that the flow from MCWRF would be metered and that a motor operated valve would be required at the connection. The connection location will require a structure to house a radio and PLC for communication between the SCADA network and the remotely located equipment. Any excess flow that is not taken by the Westside Water Treatment Plant would back-feed to the EMBR, mixing with water from the Eagle Mountain Pipeline.

C. Standpipe at High Point: This alternative would not require construction of a new standpipe. The existing standpipe at the EMBR could offer the same benefits listed for alternatives 1 and 2.

D. Pumping Requirements Summary:
   1. Static Head: 62 PSI (controlled by the water level in the EMBR)
   2. Dynamic Head Range and HP Requirements:
      a. 5 MGD = 67 PSI, 180 HP
      b. 15 MGD = 68 PSI, 550 HP
      c. 20 MGD = 70 PSI, 750 HP

4.00 LIFE CYCLE COST DEVELOPMENT

A detailed life cycle cost analysis of each of the five alternatives has been included in the attachments as **Section 7.02** and is summarized in **Section 5.00** of this memo. This section of the memo explains the components factoring into the Life Cycle Cost. Components of Life Cycle Cost included:

A. Capital Costs

1. Pump Station: Each of the alternatives would include a pump station to convey flow from the MCWRF to its ultimate delivery point. **Section 2.03** of this memo details assumptions about the pump station design. Although the pumping power required for each of the alternatives varies, the capital cost for the pump station facility will vary slightly for each of the five alternatives. A detailed breakdown of the pump station construction cost is included in an OPCC in **Section 2.03**.
2. Power Supply to Site: Each of the alternatives would require distribution voltage electrical power be brought to the pump station site. Power would likely be tapped off of the power supply to the MCWRF. The power supply cost for each of the alternatives would be the same. FNI is assuming a cost of $50,000 for power line to the site for each of the alternatives.
3. Standpipe Structure: Standpipes at the highpoints are recommended for some of the alternatives. The standpipe cost for each of the alternatives would be very similar. FNI is assuming a cost of $50,000 for standpipe structure for each of the alternatives.
4. Outlet Works/End Connection: As discussed in **Section 3.00**, alternatives 1 and 2 are recommended to include a control structure with throttling capabilities at the discharge location to maintain full pipe flow. The cost for the control structure outlet works/end connection of alternatives 1 and 2 is assumed to be $500,000. The cost of end connection for alternatives 3 and 4, connecting to the Eagle Mountain Pipeline, is assumed to be included in the cost of the proposed pipeline. The cost of end connection for alternative 5 is assumed to be $50,000.
5. Pipeline: Each of the alternatives would include a proposed 36-inch pipeline. FNI has assumed the pipeline will be AWWA C303 bar-wrapped pipe or polyurethane coated steel pipe and that the pipeline will average roughly 6 feet of cover.
   a. Open Cut: Unit prices for Open Cut installation are based off recent project bids and recent quotes from manufacturers. The Open Cut unit price is meant to include the pipe material, installation, and appurtenances such as air valves.
   b. Trenchless: Unit prices for Trenchless pipeline are based off recent project bids and recent quotes from manufacturers. The trenchless unit price is meant to include the carrier pipe material, casing pipe material, and installation via tunnel bore.
6. ROW: Each of the alternatives will require some ROW acquisition. FNI has assumed that the full extent of proposed pipeline that is outside the existing Eagle Mountain Pipeline ROW will require ROW acquisition, and that the ROW acquisition will be 80' wide and will cost $30,000 per acre. ROW width and unit cost are consistent with the "Mary's Creek Water Reclamation Reuse Pipeline Alternatives Analysis, November 2018" memorandum provided by TRWD.

7. Engineering, Surveying, Legal, and Contingencies: Each of the alternatives includes an Engineering, Surveying, Legal and Contingencies cost estimated as 35% of the capital cost for Pump Station Items and 30% for Pipeline Items, consistent with the Texas Water Development Board's "Unified Costing Model User's Guide," November 2018.
   a. The Capital Cost of the Pump Station includes line items "Pump Station," "Pumps," and "Power Supply to site."
   b. The Capital Cost of the Pipeline includes line items "Standpipe Structure," "Flow Control Str/Outlet Works/End Connection," "Pipeline," and "ROW Cost."

B. Power Cost to Pump 15 MGD

This section of Table 3 in **Section 5.00** is a snapshot of the operating cost to pump exactly 15 MGD and has been included as a comparison to a table in the "Mary's Creek Water Reclamation Reuse Pipeline Alternatives Analysis, November 2018" memorandum. The Power Cost included in the life cycle assessment is discussed in **Section 4.00.C.2**.

1. Unit Cost per KW-Hr: A unit price of $0.09/Kw-hr has been assumed for electrical power to be consistent with the District's Integrated Water Supply Plan (IWSP) and Region C planning methodology.
2. Electrical Cost for Pumping 15 MGD: The electrical cost for pumping 15 MGD is calculated by first calculating the HP required to pump 15 MGD at the dynamic head range listed in **Section 3.00** for each alternative. In calculating the HP required, pump efficiency is assumed to be 80% and motor efficiency is assumed to be 95%.
3. Operating Cost per 1,000 gallons of water delivered: The Electrical Cost for Pumping 15 MGD divided by 15,000 to convert to cost per 1,000 gallons.

C. Total Present Worth Cost of 30-Year Life Cycle: This value represents a 30-year life cycle cost brought back to present worth. A worksheet titled "30 Year Life Cycle Cost Analysis" breaking down the costs over the 30 years has been included for each alternative in the attachments as **Section 7.02**. A description of the components of the life cycle cost is below:

1. Total Capital Cost/Debt Service: The summation of Pump Station, Power Supply to Site, Standpipe Structure, Outlet Works/End Connection, Pipeline, ROW, Contingency, and Engineering, Surveying, Legal is used for the Total Capital Cost in the Present Worth 30-Year Life Cycle Cost. Capital Cost is distributed over the 30-year life cycle as debt service.
   a. Bond Rate: Assumed as 3.50%, consistent with the Texas Water Development Board's "Unified Costing Model User's Guide," November 2018."
   b. Bond Term: Assumed as 30 years per TRWD policy.
   c. Inflation: Assumed as 3.00%
   d. Discount Rate: 2.75%, as given in the USACE's Economic Guidance Memorandum for Federal Discount Rate for Fiscal Year 2020 on the table "Federal Discount Rates for Project Formulation and Evaluation."
2. Power Costs: Power cost is dependent upon the projected Water Reclamation Facility Average Day flow (see **Table 1**). For this calculation, power cost is the summation of the 30 yearly power costs calculated as the amount of power needed to pump the average day flow for 24 hours a day for one year. The yearly power costs have been calculated in present worth using a unit price of $0.09/Kw-hr to be consistent with the District's Integrated Water Supply Plan

(IWSP) and Region C planning methodology. A breakdown of pumping power cost projected over the 30-year life cycle evaluation period for each alternative is included in the attachments as **Section 7.01**.

3. O&M: 2.5% of Capital Cost for the Pump Station and 1% of Capital Cost for the Pipeline, consistent with the Texas Water Development Board's "Unified Costing Model User's Guide," November 2018.
   a. The Capital Cost of the Pump Station for O&M calculation includes line items "Pump Station (with Channel dam for Alt 6)," "Pumps," "Power Supply to site," and "PS - Engineering, Surveying, Legal, and Contingency (35%)."
   b. The Capital Cost of the Pipeline for O&M calculation includes line items "Standpipe Structure," "Flow Control Str/Outlet Works/End Connection," "Pipeline," "ROW Cost," and "PL - Engineering, Surveying, Legal, and Contingency (30%)."

D. Description of Columns in Table 4: Summary of Life Cycle Cost Comparison

1. Capital Cost: Includes pump station, power supply to site, standpipe structure, outlet works/end connection, pipeline, ROW, and Engineering, Surveying, Legal, and Contingencies as described in **Section 4.00.A**.
2. Average Present Worth Annual Cost without Debt Service: Annual Cost without debt service has been calculated as power cost and O&M cost. Power cost is dependent upon the projected Water Reclamation Facility Average Day flow (see **Table 1**). For this calculation, Power Cost was taken as the average of the Power Costs Present Worth over the 30-year life cycle. O&M cost is calculated as explained in **Section 4.00.C.6**.
3. With Debt Service Unit Cost (per 1,000 gal): Calculated as the total present worth cost of the project after 30 years (capital, debt service, power, and O&M) divided by the projected flow delivered over the 30 year life cycle, divided by 1,000 gallons so as to be comparable to other analysis performed by TRWD in the "Mary's Creek Water Reclamation Reuse Pipeline Alternatives Analysis, November 2018" memorandum.
4. Without Debt Service Unit cost (per 1,000 gal): Calculated as the total present worth cost of the project after 30 years (power and O&M) without debt service, divided by the projected flow delivered over the 30 year life cycle, divided by 1,000 gallons so as to be comparable to other analysis performed by TRWD in the "Mary's Creek Water Reclamation Reuse Pipeline Alternatives Analysis, November 2018" memorandum.
5. Total Present Worth 30 Year Life Cycle Cost: Calculated as the total present worth cost of the project after 30 years (debt service, power, and O&M) as explained in **Section 4.00.C**.

5.00 LIFE CYCLE COST COMPARISON

The life cycle cost comparison, as explained in **Section 4.00**, is shown in detail in **Table 3** (a larger version of the table is included on the next page). **Table 4** highlights the results.

Table 3: Detailed 30-year Life Cycle Cost Comparison

30 Year Life Cycle Cost Analysis Summary	Alternative 1 Discharge to Lake Worth via pipe from MCWRF to Silver Creek	Alternate 2 Discharge to Benbrook Lake via pipe from MCWRF to Dutch Branch Creek	Alternative 3 Discharge to EM Lake via pipe from MCWRF to the EM PL w/ connect N of EMBR	Alternative 4 Discharge to Eagle Mountain Pipeline upstream of EMBR	Alternative 5 Discharge directly to the Westside WTP
Capital Costs	A (36")	B (36")	C (36")	C (36")	C (36")
Pump Station (with channel dam for Alt 6)	$ 9,100,000	$ 9,100,000.00	$ 9,100,000.00	$ 8,950,000.00	$ 8,950,000.00
Pumps	$ 1,000,000	$ 1,000,000.00	$ 1,000,000.00	$ 850,000.00	$ 850,000.00
Power Supply to site	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00
Standpipe Structure	$ 50,000.00	$ 50,000.00	$ -	$ -	$ -
Flow Control Str/Outlet Works/End Connection	$ 500,000	$ 500,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00
Pipeline	$ 13,215,200	$ 17,965,400	$ 4,440,000	$ 1,860,000	$ 1,808,000
Open cut Length (LF)	32,778	32,635	11,100	4,650	4,520
Unit Cost ($/LF)	$ 400	$ 400.00	$ 400.00	$ 400.00	$ 400.00
Open Cut Subtotal	$ 13,111,200	$ 13,054,000	$ 4,440,000	$ 1,860,000	$ 1,808,000
Trenchless length (LF)	80	3,778	-	-	-
Unit Cost ($/LF)	$ 1,300	$ 1,300	$ 1,300	$ 1,300	$ 1,300
Trenchless Subtotal	$ 104,000	$ 4,911,400	$ -	$ -	$ -
ROW ($/ac) ($30k low end - $50k high end)	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
ROW length	10,750	4,650	10,750	4,650	6,600
ROW width	80	80	80	80	80
ROW Cost	$ 592,287	$ 256,198	$ 592,287	$ 256,198	$ 363,636
PL - Engineering, Surveying, Legal, and Contingency (30%)	$ 4,307,246	$ 5,631,480	$ 1,524,686	$ 649,860	$ 666,491
PS - Engineering, Surveying, Legal, and Contingency (35%)	$ 3,552,500	$ 3,552,500	$ 3,552,500	$ 3,447,500	$ 3,447,500
Total Capital Cost	**$ 32,367,232**	**$ 38,105,578**	**$ 20,309,472**	**$ 16,113,558**	**$ 16,185,627**
Capital Cost per 1,000 gallons of water delivered (based off of 15 mgd)	$ 2,158	$ 2,540	$ 1,354	$ 1,074	$ 1,079
Operating Costs					
Hp (to pump 15 MGD)	570	600	570	550	550
Pumping Power (kW, to pump 15 MGD)	425	447	425	410	410
Unit cost per KW-Hr	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.09
Electrical Cost for pumping 15 MGD ($/day)	$ 919.00	$ 967.00	$ 919.00	$ 886.00	$ 886.00
Total Present Worth 30 Year Life Cycle Cost	$63,680,000.00	$72,620,000.00	$45,870,000.00	$39,100,000.00	$39,200,000.00

Table 4: Summary of Life Cycle Cost Comparison

Alt.	Short Description	Capital Cost	Avg. Present Worth Annual Cost w/o Debt Service	w/ Debt Service Unit Cost (per 1,000 gal)	w/o Debt Service Unit Cost (per 1,000 gal)	Total Present Worth 30 Year Life Cycle Cost
1	Silver Creek	$32,367,232	$814,907	$0.44	$0.17	$63,680,000
2	Dutch Branch	$38,105,578	$886,526	$0.50	$0.19	$72,620,000
3	Tie-in N of EMBR	$20,309,472	$694,330	$0.32	$0.15	$45,870,000
4#	Tie-in S of EMBR	$16,113,558	$634,673	$0.27	$0.14	$39,100,000
5#	Direct to WTP	$16,185,627	$635,159	$0.27	$0.14	$39,200,000

- Alts 4 and 5 do not include modifications to the treatment plant that would likely be required for direct reuse. Plant upgrade costs would likely be substantial.

30 Year Life Cycle Cost Analysis Summary	Alternative 1 Discharge to Lake Worth via pipe from MCWRF to Silver Creek	Alternate 2 Discharge to Benbrook Lake via pipe from MCWRF to Dutch Branch Creek	Alternative 3 Discharge to EM Lake via pipe from MCWRF to the EM PL w/ connect N of EMBR	Alternative 4 Discharge to Eagle Mountain Pipeline upstream of EMBR	Alternative 5 Discharge directly to the Westside WTP
Capital Costs	A (36")	B (36")	C (36")	C (36")	C (36")
Pump Station	$ 9,100,000	$ 9,100,000.00	$ 9,100,000.00	$ 8,950,000.00	$ 8,950,000.00
Pumps	$ 1,000,000	$ 1,000,000.00	$ 1,000,000.00	$ 850,000.00	$ 850,000.00
Power Supply to site	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00
Standpipe Structure	$ 50,000.00	$ 50,000.00	$ -	$ -	$ -
Flow Control Str/Outlet Works/End Connection	$ 500,000	$ 500,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00
Pipeline	$ 13,215,200	$ 17,965,400	$ 4,440,000	$ 1,860,000	$ 1,808,000
Open cut Length (LF)	32,778	32,635	11,100	4,650	4,520
Unit Cost ($/LF)	$ 400	$ 400.00	$ 400.00	$ 400.00	$ 400.00
Open Cut Subtotal	$ 13,111,200	$ 13,054,000	$ 4,440,000	$ 1,860,000	$ 1,808,000
Trenchless length (LF)	80	3,778	-	-	-
Unit Cost ($/LF)	$ 1,300	$ 1,300	$ 1,300	$ 1,300	$ 1,300
Trenchless Subtotal	$ 104,000	$ 4,911,400	$ -	$ -	$ -
ROW ($/ac) ($30k low end - $50k high end)	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000
ROW length	10,750	4,650	10,750	4,650	6,600
ROW width	80	80	80	80	80
ROW Cost	$ 592,287	$ 256,198	$ 592,287	$ 256,198	$ 363,636
PL - Engineering, Surveying, Legal, and Contingency (30%)	$ 4,307,246	$ 5,631,480	$ 1,524,686	$ 649,860	$ 666,491
PS - Engineering, Surveying, Legal, and Contingency (35%)	$ 3,552,500	$ 3,552,500	$ 3,552,500	$ 3,447,500	$ 3,447,500
Total Capital Cost	**$ 32,367,232**	**$ 38,105,578**	**$ 20,309,472**	**$ 16,113,558**	**$ 16,185,627**
Capital Cost per 1,000 gallons of water delivered (based off of 15 mgd)	$ 2,158	$ 2,540	$ 1,354	$ 1,074	$ 1,079
Power Cost to Pump 15 MGD (See Appendix for yearly power cost projections)					
Hp (to pump 15 MGD)	570	600	570	550	550
Pumping Power (kW, to pump 15 MGD)	425	447	425	410	410
Unit cost per KW-Hr	$ 0.09	$ 0.09	$ 0.09	$ 0.09	$ 0.09
Electrical Cost for pumping 15 MGD ($/day)	$ 919.00	$ 967.00	$ 919.00	$ 886.00	$ 886.00
Total Present Worth 30 Year Life Cycle Cost	$63,680,000	$72,620,000	$45,870,000	$39,100,000	$39,200,000

6.00 ENVIRONMENTAL PERMITTING REQUIREMENTS

FNI conducted a high-level desktop analysis to compare the potential environmental permitting requirements of the five alternatives related to Section 404 of the Clean Water Act (Section 404), and the Endangered Species Act. Additionally, FNI considered the general requirements to receive authorization from the Texas Commission on Environmental Quality (TCEQ) for discharging treated domestic wastewater into waters in the state, or if effluent goes directly to a potable water treatment facility, for implementing direct potable reuse. Costs associated with environmental permitting and coordination, including treatment facility improvements required due to implementation of direct potable reuse, are not included in this study.

Overview of Section 404 Permitting

The United States Army Corps of Engineers (USACE) regulates the discharge of dredged and fill material into waters of the U.S. (WOTUS), including wetlands, under Section 404 of the Clean Water Act. Within the context of the project, WOTUS typically include 1) streams that display ordinary high-water marks and have a surface hydrologic connection with traditional navigable waters, 2) wetlands adjacent to these streams, and 3) ponds/impoundments of these streams.

A Section 404 permit would be required by the USACE if construction activities would result in the discharge of dredged or fill material into WOTUS (i.e. a jurisdictional waterbody). Pipeline construction could potentially be authorized by Nationwide Permit (NWP) 12, *Utility Line Activities*, which authorizes activities required for the construction, maintenance, repair, and removal of utility lines in WOTUS. According to the terms and conditions of NWP 12, the pre-construction contours of WOTUS must be restored following construction and permanent adverse impacts must be no more than 0.5 acre at each single and complete crossing of WOTUS. A WOTUS crossing would require the submittal of a PCN to the USACE if any of the following NWP 12 PCN triggers are met:

- There would be mechanized land clearing in a forested or scrub/shrub wetland
- A Section 10 permit would be required
- There would be utility line crossings in WOTUS that would exceed 500 feet
- There would be placement of utility lines within WOTUS that run parallel to or along a stream bed
- There would be discharges that result in the permanent loss of greater than 1/10-acre of WOTUS
- There would be permanent access roads constructed above grade in WOTUS for more than 500 feet
- There would be permanent access roads constructed in WOTUS with impervious materials
- There would be PCN triggers from the State of Texas Regional Conditions
- There would be PCN triggers from the Nationwide Permit General Conditions including potential impacts to threatened or endangered species (General Condition 18, Endangered Species) and/or potential impacts to historic properties (General Condition 20, Historic Properties)

If the project cannot be designed to meet the terms and conditions of NWP 12, the project would potentially require a Section 404 Individual Permit (IP). In contrast to a NWP, an IP would require a much more detailed permit application process consisting of the following key items:

- Project purpose and need statement
- Comprehensive alternatives analysis to identify the least environmentally damaging practicable alternative (LEDPA) that meets the stated need
- USACE consultation with state and federal resource agencies
- USACE public notice to solicit comments on the proposed project
- Compensatory mitigation for unavoidable impacts to aquatic resources

By comparison, NWP's provide immediate authorization for non-PCN projects. Projects that require a PCN may take as little as a 45-day processing time, but commonly take several months if the USACE requests additional information during processing of the PCN. IP's usually take a minimum of four months to a year or more for processing.

Desktop Review of Potential WOTUS

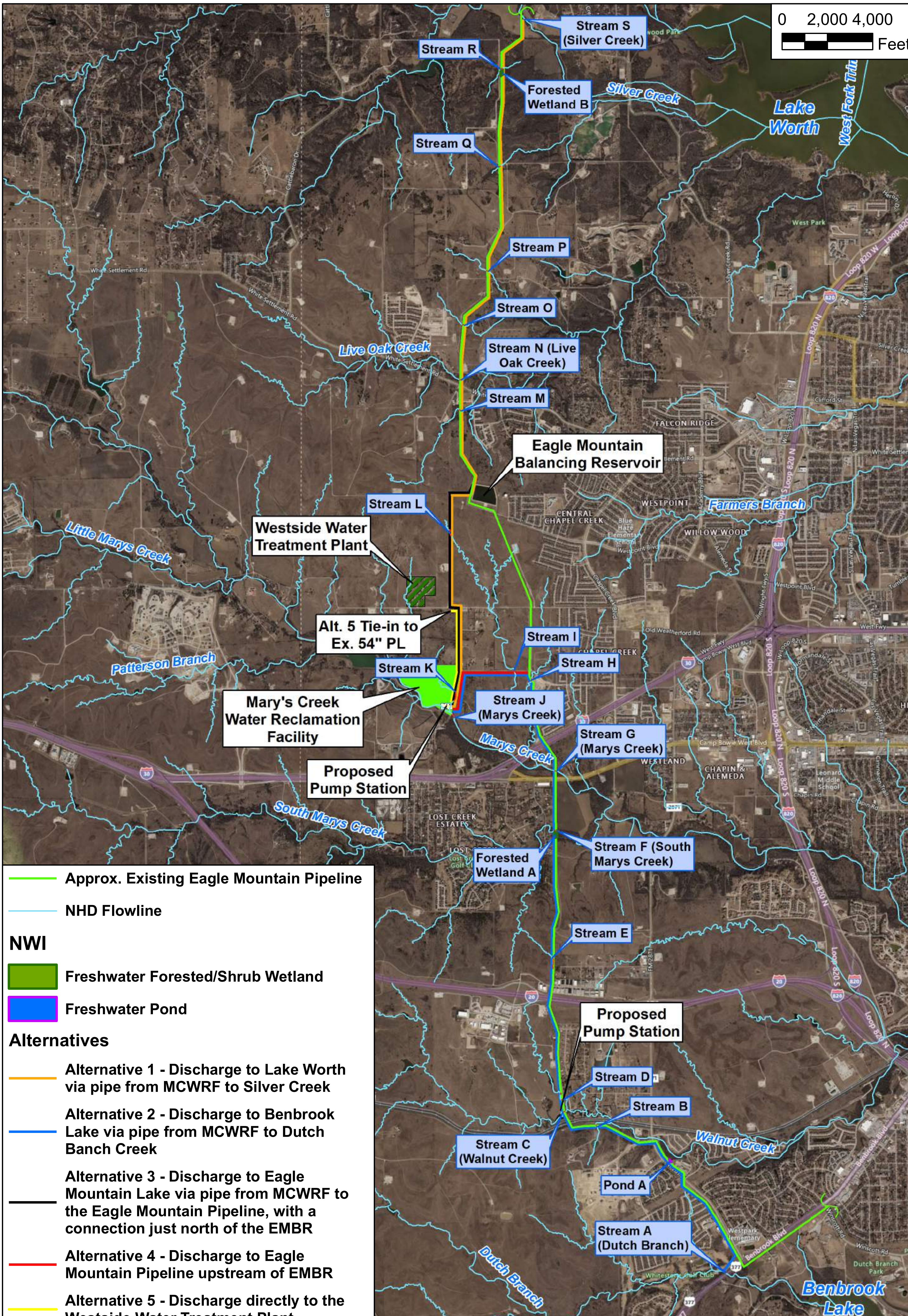
Geographic Information System (GIS) spatial data were used to develop a map of potential WOTUS crossed by the five alternative pipeline routes (**Figure 2**). Data used as part of the desktop analysis includes the following:

- Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO)
- United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) maps
- United States Geological Survey (USGS) 1:24,000 topographic maps
- USGS National Hydrography Dataset (NHD)

It is important to note that official determination of the presence or absence of WOTUS can only be obtained by requesting an approved jurisdictional determination (AJD) from the USACE and that the results of the high-level desktop analysis are only a preliminary identification and mapping of potential WOTUS. The proposed pipeline alignment should be field verified through a pedestrian survey to validate the presence of potential WOTUS.

Overview of Domestic Wastewater Permit

The discharge of treated domestic wastewater into or adjacent to water in the state must be authorized by the TCEQ. Domestic facilities that dispose of treated effluent by discharging into waters in the state are required to obtain a Texas Pollutant Discharge Elimination System (TPDES) permit. Domestic facilities that dispose of treated effluent by land application (surface irrigation, evaporation, drainfields or subsurface land application) are required to obtain a Texas Land Application Permit (TLAP) permit. If a treatment facility has a permitted outfall (typically called "Outfall 001") and an additional outfall location is proposed to discharge effluent into waters in the state, the new outfall (typically called "Outfall 002") must be included as part of the facility's TPDES permit.



Freese and Nichols
4055 International Plaza Suite 200
Fort Worth, Texas 76109-4895
817-735-7300

N W E S

TARRANT REGIONAL WATER DISTRICT
WATERBODY CROSSINGS MAP

Mary's Creek Water Reclamation Facility Reuse Project: Alternatives 1 – 5

FN JOB NO	TCW20417
FILE	2_Waterbody11x17
DATE	9/3/2020
SCALE	1:24,000
DESIGNED	HHM
DRAFTED	HHM

Figure 2

H:\ENVIRONMENTAL\Final_Exhibits\Env_Memo\Alts1-5\2_Waterbody11x17.mxd

Overview of Direct Potable Reuse

The technique of blending effluent with raw water and then treating for potable uses without discharging to water in the state (considered an environmental buffer) is known as raw water blending, and TCEQ classifies raw water blending as direct potable reuse. TCEQ oversees water quality standards and must authorize the treatment processes according to their guidelines for direct potable reuse. TCEQ would require the owner of the treatment facilities (City of Fort Worth) to demonstrate that treatment processes at the treatment facilities would in combination meet specific requirements, like stringent pathogen removal requirements. In order to meet the stringent requirements associated with direct potable reuse, modifications to the treatment facilities would likely be required. Additionally, extensive coordination with both the Water Quality Division and the Water Supply Division at TCEQ would be required for authorization of direct potable reuse. This authorization process typically includes implementation of a pilot study to mimic proposed treatment processes and implementation of a robust testing program.

Endangered Species Act

General Condition 18, Endangered Species, states that a PCN to the USACE is required if any federally listed threatened or endangered species or designated critical habitat might be affected by or is in the vicinity of proposed construction activities. According to the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) resource list from June 2020, the following four federally listed threatened or endangered species were listed as potentially occurring within Tarrant County, Texas: whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), and red knot (*Calidris canutus rufa*). The piping plover and red knot are designated as only needing to be considered in this area for wind energy projects. If any of these species could potentially be impacted by the proposed pipeline, a PCN will be required.

Historic Properties

General Condition 20, Historic Properties, states that a PCN to the USACE is required if construction activities might have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified historic properties and archeological sites. Coordination with the Texas Historical Commission (THC) will be required prior to the commencement of the project per Section 106 of the National Historical Preservation Act and Section 191.0525 (d) of the Antiquities Code of Texas. The THC will evaluate whether known historic properties would be affected by the project and whether an archeological survey may be required. If an archeological survey is required or cultural resources are identified with the proposed pipeline alignment, a PCN will be required for the proposed project. The potential to impact cultural resources, like historic properties, was not part of this desktop analysis.

6.01 ALTERNATIVE 1 - DISCHARGE TO LAKE WORTH VIA PIPE FROM MCWRF TO SILVER CREEK

The Alternative 1 route, also referred to as the Silver Creek route, directs flow from the MCWRF to the Silver Creek tributary of Lake Worth. This route would cross the following ten potential WOTUS identified as part of the desktop analysis:

- Stream K
- Stream L
- Stream M
- Stream N (Live Oak Creek)
- Stream O
- Stream P
- Stream Q
- Forested Wetland B
- Stream R
- Stream S (Silver Creek)

There does not appear to be potential habitat for the whooping crane or the least tern along this route, and therefore, Alternative 1 is not expected to have a potential impact to federally listed threatened or endangered species.

This alternative includes an eventual discharge of treated wastewater (effluent) into Silver Creek, which is considered water in the state, and therefore, it would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

Alternative 1 Environmental Conclusion

Alternative 1 could likely be authorized by NWP 12, and the only PCN trigger identified by this desktop analysis is potential impacts to Forested Wetland B, which could potentially be avoided by shifting the alignment around or boring under the forested wetland, if in fact a forested wetland is present. This alternative would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

6.02 ALTERNATIVE 2 - DISCHARGE TO BENBROOK LAKE VIA PIPE FROM MCWRF TO DUTCH BRANCH CREEK

The Alternative 2 route, also referred to as the Dutch Branch route, directs flow from the MCWRF to just upstream of where US 377 crosses Dutch Branch Creek. This route would cross the following twelve potential WOTUS identified as part of the desktop analysis:

- Pond A
- Stream A (Dutch Branch)
- Stream B
- Stream C (Walnut Creek)
- Stream D

- Stream E
- Forested Wetland A
- Stream F (South Mary's Creek)
- Stream G (Mary's Creek)
- Stream H
- Stream I
- Stream K

There does not appear to be potential habitat for the whooping crane or the least tern along this route, and therefore, Alternative 2 is not expected to have a potential impact to federally listed threatened or endangered species.

This alternative includes an eventual discharge of treated wastewater (effluent) into Dutch Branch, which is considered water in the state, and therefore, it would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

Alternative 2 Environmental Conclusion

Alternative 2 could likely be authorized by NWP 12, and the only PCN trigger identified by the desktop analysis is potential impacts to Forested Wetland A, which could potentially be avoided by shifting the alignment around the forested wetland or boring under the forested wetland, if in fact a forested wetland is present. This alternative would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

6.03 ALTERNATIVE 3 - DISCHARGE TO EAGLE MOUNTAIN LAKE VIA PIPE FROM MCWRF TO THE EAGLE MOUNTAIN PIPELINE, WITH A CONNECTION JUST NORTH OF THE EMBR

The Alternative 3 route directs flow from the MCWRF to Eagle Mountain Lake by connecting to the Eagle Mountain Pipeline downstream of the existing EMBR valves B128 and B130. This route would cross the following two potential WOTUS identified as part of the desktop analysis:

- Stream K
- Stream L

There does not appear to be potential habitat for the whooping crane or the least tern along this route, and therefore, Alternative 3 is not expected to have a potential impact to federally listed threatened or endangered species.

This alternative includes an eventual discharge of treated wastewater (effluent) into Eagle Mountain Lake, which is considered water in the state, and therefore, it would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

Alternative 3 Environmental Conclusion

Alternative 3 could likely be authorized by NWP 12, and no PCN triggers were identified by the desktop analysis. This alternative would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

6.04 ALTERNATIVE 4 - DISCHARGE TO EAGLE MOUNTAIN PIPELINE UPSTREAM OF EMBR

The Alternative 4 route directs flow from the MCWRF to Eagle Mountain Lake by connecting to the Eagle Mountain Pipeline upstream of the existing EMBR, due east of the MCWRF. This route would cross the following two potential WOTUS identified as part of the desktop analysis:

- Stream K
- Stream I

There does not appear to be potential habitat for the whooping crane or the least tern along this route, and therefore, Alternative 4 is not expected to have a potential impact to federally listed threatened or endangered species.

Upstream (i.e., south) of the existing EMBR, the Eagle Mountain Pipeline has a connection to the Westside Water Treatment Plant. Therefore, treated wastewater (effluent) conveyed by the Alternative 4 pipeline would flow into the Eagle Mountain Pipeline and then into either the connection to the Westside Water Treatment Plant or to the EMBR. Because effluent could enter the Westside Water Treatment Plant without first discharging into water in the state, TCEQ would classify Alternative 4 as direct potable reuse. TCEQ would require the City to demonstrate that treatment processes at the MCWRF and Westside Water Treatment Plant would in combination meet specific requirements, which would likely require significant modifications to the treatment processes at a significant financial cost. If MCWRF is not operational during the TCEQ coordination process, then implementation of a testing program would be a challenge because there would be no treated effluent from the MCWRF to test. Because effluent could also flow to the EMBR and eventually discharge into Eagle Mountain Lake, the outfall at Eagle Mountain Lake would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

Costs associated with environmental permitting and coordination, including treatment facility improvements required due to implementation of direct potable reuse, are not included in this study.

Alternative 4 Environmental Conclusion

Alternative 4 could likely be authorized by NWP 12, and no PCN triggers were identified by the desktop analysis. This alternative would be considered by the TCEQ as implementation of direct potable reuse, which would require significant coordination with TCEQ and likely result in requirements to significantly modify the MCWRF and/or Westside Water Treatment Plant treatment processes. This alternative would also need to be part of the MCWRF TPDES permit due to effluent also flowing to the EMBR and eventually discharging into Eagle Mountain Lake.

6.05 ALTERNATIVE 5 - DISCHARGE DIRECTLY TO THE WESTSIDE WATER TREATMENT PLANT

The Alternative 5 route directs flow from the MCWRF directly to the Westside Water Treatment Plant. This route would cross the following one potential WOTUS identified as part of the desktop analysis:

- Stream K

There does not appear to be potential habitat for the whooping crane or the least tern along this route, and therefore, Alternative 5 is not expected to have a potential impact to federally listed threatened or endangered species.

Alternative 5 would take treated wastewater (effluent) from the MCWRF to a raw water line that connects directly to the Westside Water Treatment Plant. For this alternative, the effluent would normally not be discharged to a water in the state (considered an environmental buffer) prior to entering a drinking water treatment facility, with exception occurring during high flow events when excess effluent would back-feed to the EMBR and mix with water from the Eagle Mountain Pipeline. Because effluent could enter the Westside Water Treatment Plant without first discharging into water in the state (an environmental buffer), TCEQ would classify Alternative 5 as direct potable reuse. TCEQ would require the City to demonstrate that treatment processes at the MCWRF and Westside Water Treatment Plant would in combination meet specific requirements, which would likely require significant modifications to the treatment processes at a significant financial cost. If MCWRF is not operational during the TCEQ coordination process, then implementation of a testing program would be a challenge because there would be no treated effluent from the MCWRF to test. This alternative assumes excess effluent during high flow events would back-feed to the EMBR, which would eventually discharge into Eagle Mountain Lake. Accordingly, the outfall at Eagle Mountain Lake would need to be authorized by TCEQ as part of the MCWRF TPDES permit.

Costs associated with environmental permitting and coordination, including treatment facility improvements required due to implementation of direct potable reuse, are not included in this study.

Alternative 5 Environmental Conclusion

Alternative 5 could likely be authorized by NWP 12, and no PCN triggers were identified by the desktop analysis. This alternative would be considered by the TCEQ as implementation of direct potable reuse, which would require significant coordination with TCEQ and likely result in requirements to significantly modify the MCWRF and/or Westside Water Treatment Plant treatment processes. This alternative would also need to be part of the MCWRF TPDES permit due to excess effluent back-feeding to the EMBR and eventually discharging into Eagle Mountain Lake.

7.00 ATTACHMENTS

7.01 YEARLY PUMPING POWER COST ESTIMATE FOR EACH ALTERNATIVE

Alternative 1 & Alternative 3 Yearly Pumping Power Cost Estimate

Year	Year Sequence	Total WRF Average Day (MGD)	Flow Velocity (ft/s)	hs (ft)	hf (ft)	ht (ft)	Horsepower Required	kW	Days in Year	Hours	kWh	Pumping Power Cost
2020	0	5.54	1.21	153	1.90	154.90	197.99	147.64	365	8,760	1,293,364	$ 116,402.72
2021	1	6.04	1.32	153	2.23	155.23	216.32	161.31	365	8,760	1,413,086	$ 127,177.73
2022	2	6.54	1.43	153	2.58	155.58	234.76	175.06	365	8,760	1,533,540	$ 138,018.61
2023	3	7.05	1.54	153	2.96	155.96	253.69	189.18	365	8,760	1,657,210	$ 149,148.94
2024	4	7.55	1.65	153	3.36	156.36	272.38	203.12	365	8,760	1,779,299	$ 160,136.87
2025	5	8.05	1.76	153	3.79	156.79	291.21	217.15	365	8,760	1,902,271	$ 171,204.43
2026	6	8.54	1.87	153	4.22	157.22	309.80	231.01	365	8,760	2,023,691	$ 182,132.20
2027	7	9.01	1.97	153	4.66	157.66	327.76	244.41	365	8,760	2,141,041	$ 192,693.67
2028	8	9.50	2.08	153	5.14	158.14	346.64	258.49	365	8,760	2,264,352	$ 203,791.69
2029	9	9.98	2.18	153	5.63	158.63	365.28	272.39	365	8,760	2,386,148	$ 214,753.33
2030	10	10.45	2.29	153	6.14	159.14	383.69	286.12	365	8,760	2,506,408	$ 225,576.72
2031	11	10.93	2.39	153	6.67	159.67	402.66	300.26	365	8,760	2,630,291	$ 236,726.16
2032	12	11.42	2.50	153	7.23	160.23	422.19	314.83	365	8,760	2,757,906	$ 248,211.57
2033	13	11.89	2.60	153	7.79	160.79	441.11	328.93	365	8,760	2,881,448	$ 259,330.29
2034	14	12.38	2.71	153	8.39	161.39	461.01	343.78	365	8,760	3,011,471	$ 271,032.41
2035	15	12.87	2.82	153	9.02	162.02	481.11	358.77	365	8,760	3,142,789	$ 282,850.97
2036	16	13.35	2.92	153	9.65	162.65	501.00	373.60	365	8,760	3,272,722	$ 294,544.99
2037	17	13.84	3.03	153	10.32	163.32	521.52	388.90	365	8,760	3,406,728	$ 306,605.54
2038	18	14.34	3.14	153	11.02	164.02	542.68	404.67	365	8,760	3,544,936	$ 319,044.21
2039	19	14.82	3.24	153	11.71	164.71	563.21	419.98	365	8,760	3,679,050	$ 331,114.52
2040	20	15.29	3.35	153	12.41	165.41	583.52	435.13	365	8,760	3,811,772	$ 343,059.49
2041	21	15.64	3.42	153	12.94	165.94	598.92	446.62	365	8,760	3,912,353	$ 352,111.77
2042	22	16.11	3.53	153	13.66	166.66	619.50	461.96	365	8,760	4,046,786	$ 364,210.74
2043	23	16.58	3.63	153	14.41	167.41	640.31	477.48	365	8,760	4,182,690	$ 376,442.14
2044	24	17.04	3.73	153	15.17	168.17	661.34	493.16	365	8,760	4,320,102	$ 388,809.21
2045	25	17.51	3.83	153	15.94	168.94	682.61	509.02	365	8,760	4,459,058	$ 401,315.19
2046	26	17.98	3.93	153	16.74	169.74	704.13	525.07	365	8,760	4,599,593	$ 413,963.33
2047	27	18.45	4.04	153	17.55	170.55	725.89	541.29	365	8,760	4,741,743	$ 426,756.84
2048	28	18.91	4.14	153	18.39	171.39	747.90	557.71	365	8,760	4,885,543	$ 439,698.91
2049	29	19.38	4.24	153	19.24	172.24	770.17	574.32	365	8,760	5,031,031	$ 452,792.75
2050	30	19.88	4.35	153	20.16	173.16	794.27	592.29	365	8,760	5,188,458	$ 466,961.23

Alternative 2 Yearly Pumping Power Cost Estimate

Year	Year Sequence	Total WRF Average Day (MGD)	Flow Velocity (ft/s)	hs (ft)	hf (ft)	ht (ft)	Horsepower Required	kW	Days in Year	Hours	kWh	Pumping Power Cost
2020	0	5.54	1.21	153	3.25	156.25	199.72	148.93	365	8,760	1,304,634	$ 117,417.06
2021	1	6.04	1.32	153	3.81	156.81	218.53	162.96	365	8,760	1,427,503	$ 128,475.31
2022	2	6.54	1.43	153	4.41	157.41	237.53	177.13	365	8,760	1,551,626	$ 139,646.32
2023	3	7.05	1.54	153	5.07	158.07	257.12	191.74	365	8,760	1,679,612	$ 151,165.07
2024	4	7.55	1.65	153	5.76	158.76	276.55	206.23	365	8,760	1,806,531	$ 162,587.79
2025	5	8.05	1.76	153	6.48	159.48	296.21	220.89	365	8,760	1,934,965	$ 174,146.81
2026	6	8.54	1.87	153	7.23	160.23	315.72	235.43	365	8,760	2,062,381	$ 185,614.25
2027	7	9.01	1.97	153	7.98	160.98	334.66	249.56	365	8,760	2,186,112	$ 196,750.12
2028	8	9.50	2.08	153	8.80	161.80	354.66	264.47	365	8,760	2,316,766	$ 208,508.98
2029	9	9.98	2.18	153	9.64	162.64	374.52	279.28	365	8,760	2,446,468	$ 220,182.11
2030	10	10.45	2.29	153	10.50	163.50	394.22	293.97	365	8,760	2,575,181	$ 231,766.31
2031	11	10.93	2.39	153	11.41	164.41	414.62	309.18	365	8,760	2,708,454	$ 243,760.89
2032	12	11.42	2.50	153	12.38	165.38	435.75	324.94	365	8,760	2,846,476	$ 256,182.86
2033	13	11.89	2.60	153	13.33	166.33	456.32	340.27	365	8,760	2,980,806	$ 268,272.58
2034	14	12.38	2.71	153	14.37	167.37	478.08	356.50	365	8,760	3,122,950	$ 281,065.49
2035	15	12.87	2.82	153	15.44	168.44	500.17	372.98	365	8,760	3,267,308	$ 294,057.71
2036	16	13.35	2.92	153	16.52	169.52	522.16	389.38	365	8,760	3,410,938	$ 306,984.46
2037	17	13.84	3.03	153	17.66	170.66	544.97	406.38	365	8,760	3,559,899	$ 320,390.91
2038	18	14.34	3.14	153	18.86	171.86	568.62	424.02	365	8,760	3,714,410	$ 334,296.87
2039	19	14.82	3.24	153	20.04	173.04	591.70	441.23	365	8,760	3,865,197	$ 347,867.72
2040	20	15.29	3.35	153	21.23	174.23	614.67	458.36	365	8,760	4,015,242	$ 361,371.75
2041	21	15.64	3.42	153	22.15	175.15	632.16	471.40	365	8,760	4,129,493	$ 371,654.38
2042	22	16.11	3.53	153	23.39	176.39	655.65	488.92	365	8,760	4,282,924	$ 385,463.20
2043	23	16.58	3.63	153	24.66	177.66	679.52	506.72	365	8,760	4,438,874	$ 399,498.69
2044	24	17.04	3.73	153	25.96	178.96	703.79	524.82	365	8,760	4,597,405	$ 413,766.42
2045	25	17.51	3.83	153	27.29	180.29	728.47	543.22	365	8,760	4,758,577	$ 428,271.93
2046	26	17.98	3.93	153	28.66	181.66	753.55	561.92	365	8,760	4,922,453	$ 443,020.77
2047	27	18.45	4.04	153	30.05	183.05	779.06	580.95	365	8,760	5,089,094	$ 458,018.43
2048	28	18.91	4.14	153	31.47	184.47	805.01	600.29	365	8,760	5,258,560	$ 473,270.40
2049	29	19.38	4.24	153	32.92	185.92	831.39	619.97	365	8,760	5,430,913	$ 488,782.15
2050	30	19.88	4.35	153	34.51	187.51	860.09	641.37	365	8,760	5,618,415	$ 505,657.32

Alternative 4 Yearly Pumping Power Cost Estimate

Year	Year Sequence	Total WRF Average Day (MGD)	Flow Velocity (ft/s)	hs (ft)	hf (ft)	ht (ft)	Horsepower Required	kW	Days in Year	Hours	kWh	Pumping Power Cost
2020	0	5.54	1.21	153	0.79	153.79	196.59	146.59	365	8,760	1,284,162	$ 115,574.55
2021	1	6.04	1.32	153	0.93	153.93	214.52	159.97	365	8,760	1,401,315	$ 126,118.31
2022	2	6.54	1.43	153	1.08	154.08	232.50	173.38	365	8,760	1,518,774	$ 136,689.65
2023	3	7.05	1.54	153	1.24	154.24	250.89	187.09	365	8,760	1,638,921	$ 147,502.85
2024	4	7.55	1.65	153	1.41	154.41	268.98	200.58	365	8,760	1,757,064	$ 158,135.80
2025	5	8.05	1.76	153	1.59	154.59	287.12	214.11	365	8,760	1,875,579	$ 168,802.11
2026	6	8.54	1.87	153	1.77	154.77	304.96	227.41	365	8,760	1,992,103	$ 179,289.26
2027	7	9.01	1.97	153	1.95	154.95	322.13	240.21	365	8,760	2,104,242	$ 189,381.76
2028	8	9.50	2.08	153	2.15	155.15	340.09	253.60	365	8,760	2,221,558	$ 199,940.23
2029	9	9.98	2.18	153	2.36	155.36	357.74	266.77	365	8,760	2,336,900	$ 210,320.97
2030	10	10.45	2.29	153	2.57	155.57	375.10	279.71	365	8,760	2,450,258	$ 220,523.19
2031	11	10.93	2.39	153	2.79	155.79	392.89	292.98	365	8,760	2,566,473	$ 230,982.60
2032	12	11.42	2.50	153	3.03	156.03	411.12	306.57	365	8,760	2,685,593	$ 241,703.36
2033	13	11.89	2.60	153	3.26	156.26	428.69	319.67	365	8,760	2,800,326	$ 252,029.30
2034	14	12.38	2.71	153	3.52	156.52	447.08	333.39	365	8,760	2,920,454	$ 262,840.84
2035	15	12.87	2.82	153	3.78	156.78	465.55	347.16	365	8,760	3,041,124	$ 273,701.16
2036	16	13.35	2.92	153	4.04	157.04	483.73	360.72	365	8,760	3,159,875	$ 284,388.71
2037	17	13.84	3.03	153	4.32	157.32	502.37	374.62	365	8,760	3,281,671	$ 295,350.40
2038	18	14.34	3.14	153	4.62	157.62	521.49	388.88	365	8,760	3,406,568	$ 306,591.09
2039	19	14.82	3.24	153	4.91	157.91	539.94	402.63	365	8,760	3,527,070	$ 317,436.27
2040	20	15.29	3.35	153	5.20	158.20	558.09	416.17	365	8,760	3,645,648	$ 328,108.35
2041	21	15.64	3.42	153	5.42	158.42	571.78	426.38	365	8,760	3,735,068	$ 336,156.09
2042	22	16.11	3.53	153	5.72	158.72	589.99	439.95	365	8,760	3,853,989	$ 346,859.05
2043	23	16.58	3.63	153	6.04	159.04	608.29	453.60	365	8,760	3,973,528	$ 357,617.48
2044	24	17.04	3.73	153	6.35	159.35	626.68	467.32	365	8,760	4,093,697	$ 368,432.75
2045	25	17.51	3.83	153	6.68	159.68	645.18	481.11	365	8,760	4,214,513	$ 379,306.21
2046	26	17.98	3.93	153	7.01	160.01	663.77	494.98	365	8,760	4,335,991	$ 390,239.22
2047	27	18.45	4.04	153	7.35	160.35	682.47	508.92	365	8,760	4,458,146	$ 401,233.13
2048	28	18.91	4.14	153	7.70	160.70	701.28	522.94	365	8,760	4,580,992	$ 412,289.28
2049	29	19.38	4.24	153	8.06	161.06	720.19	537.05	365	8,760	4,704,545	$ 423,409.01
2050	30	19.88	4.35	153	8.45	161.45	740.53	552.22	365	8,760	4,837,418	$ 435,367.58

Alternative 5 Yearly Pumping Power Cost Estimate

Year	Year Sequence	Total WRF Average Day (MGD)	Flow Velocity (ft/s)	hs (ft)	hf (ft)	ht (ft)	Horsepower Required	kW	Days in Year	Hours	kWh	Pumping Power Cost
2020	0	5.54	1.21	153	0.77	153.77	196.56	146.57	365	8,760	1,283,976	$ 115,557.86
2021	1	6.04	1.32	153	0.91	153.91	214.48	159.94	365	8,760	1,401,077	$ 126,096.95
2022	2	6.54	1.43	153	1.05	154.05	232.46	173.34	365	8,760	1,518,476	$ 136,662.87
2023	3	7.05	1.54	153	1.21	154.21	250.84	187.05	365	8,760	1,638,552	$ 147,469.68
2024	4	7.55	1.65	153	1.37	154.37	268.91	200.53	365	8,760	1,756,616	$ 158,095.47
2025	5	8.05	1.76	153	1.54	154.54	287.04	214.05	365	8,760	1,875,041	$ 168,753.69
2026	6	8.54	1.87	153	1.72	154.72	304.86	227.34	365	8,760	1,991,466	$ 179,231.96
2027	7	9.01	1.97	153	1.90	154.90	322.01	240.13	365	8,760	2,103,500	$ 189,315.01
2028	8	9.50	2.08	153	2.09	155.09	339.95	253.50	365	8,760	2,220,696	$ 199,862.60
2029	9	9.98	2.18	153	2.29	155.29	357.59	266.66	365	8,760	2,335,907	$ 210,231.63
2030	10	10.45	2.29	153	2.50	155.50	374.92	279.58	365	8,760	2,449,126	$ 220,421.34
2031	11	10.93	2.39	153	2.71	155.71	392.69	292.83	365	8,760	2,565,187	$ 230,866.84
2032	12	11.42	2.50	153	2.94	155.94	410.90	306.41	365	8,760	2,684,135	$ 241,572.19
2033	13	11.89	2.60	153	3.17	156.17	428.44	319.49	365	8,760	2,798,691	$ 251,882.15
2034	14	12.38	2.71	153	3.42	156.42	446.80	333.18	365	8,760	2,918,619	$ 262,675.74
2035	15	12.87	2.82	153	3.67	156.67	465.24	346.93	365	8,760	3,039,075	$ 273,516.74
2036	16	13.35	2.92	153	3.93	156.93	483.38	360.46	365	8,760	3,157,600	$ 284,184.01
2037	17	13.84	3.03	153	4.20	157.20	501.99	374.33	365	8,760	3,279,151	$ 295,123.55
2038	18	14.34	3.14	153	4.49	157.49	521.07	388.56	365	8,760	3,403,779	$ 306,340.10
2039	19	14.82	3.24	153	4.77	157.77	539.47	402.28	365	8,760	3,524,006	$ 317,160.58
2040	20	15.29	3.35	153	5.05	158.05	557.58	415.79	365	8,760	3,642,300	$ 327,807.01
2041	21	15.64	3.42	153	5.27	158.27	571.23	425.97	365	8,760	3,731,495	$ 335,834.51
2042	22	16.11	3.53	153	5.56	158.56	589.39	439.51	365	8,760	3,850,104	$ 346,509.33
2043	23	16.58	3.63	153	5.87	158.87	607.64	453.12	365	8,760	3,969,312	$ 357,238.07
2044	24	17.04	3.73	153	6.18	159.18	625.98	466.80	365	8,760	4,089,134	$ 368,022.06
2045	25	17.51	3.83	153	6.49	159.49	644.42	480.55	365	8,760	4,209,585	$ 378,862.62
2046	26	17.98	3.93	153	6.82	159.82	662.96	494.37	365	8,760	4,330,678	$ 389,761.06
2047	27	18.45	4.04	153	7.15	160.15	681.60	508.27	365	8,760	4,452,430	$ 400,718.70
2048	28	18.91	4.14	153	7.49	160.49	700.34	522.24	365	8,760	4,574,854	$ 411,736.84
2049	29	19.38	4.24	153	7.83	160.83	719.19	536.30	365	8,760	4,697,964	$ 422,816.78
2050	30	19.88	4.35	153	8.21	161.21	739.45	551.41	365	8,760	4,830,342	$ 434,730.81

7.02 30 YEAR LIFE CYCLE COST ANALYSIS FOR EACH ALTERNATIVE

Alternative 2 - 30 Year Life Cycle Cost Analysis

Bond Rate	3.50%	Inflation	3.00%	O&M Cost % of Capital Cost (PS)	2.50%	Capital Cost PS	$ 13,702,500.00
Bond Term	30 Years	Discount Rate	2.75%	O&M Cost % of Capital Cost (PL)	1.00%	Capital Cost PL	$ 24,403,077.85

Year	Sequence Year	Capital Cost (PS+PL)	Debt Service	Power Costs Present Worth	Power Costs (Including Inflation)	O&M Costs Present Worth	O&M Costs (Including Inflation)	Total Annual Cost with Debt Service	Total Present Worth Annual Cost with Debt Service	Total Present Worth Annual Cost without Debt Service	Gallons/Year	Total Annual Cost With Debt Service (Unit Cost per 1,000 gal)	Total Annual Cost Without Debt Service (Unit Cost per 1,000 gal)
2020	0	$ 38,105,578	$2,071,851	$117,417	$117,417	$586,593	$586,593	$2,775,861	$2,775,861	$704,010	2,022,100,000	$ 1.37	$ 0.35
2021	1		$2,071,851	$128,475	$132,330	$586,593	$604,191	$2,808,372	$2,733,208	$715,069	2,204,600,000	$ 1.24	$ 0.32
2022	2		$2,071,851	$139,646	$148,151	$586,593	$622,317	$2,842,319	$2,692,211	$726,240	2,387,100,000	$ 1.13	$ 0.30
2023	3		$2,071,851	$151,165	$165,182	$586,593	$640,986	$2,878,019	$2,653,067	$737,758	2,573,250,000	$ 1.03	$ 0.29
2024	4		$2,071,851	$162,588	$182,994	$586,593	$660,216	$2,915,061	$2,615,293	$749,181	2,755,750,000	$ 0.95	$ 0.27
2025	5		$2,071,851	$174,147	$201,884	$586,593	$680,022	$2,953,757	$2,579,085	$760,740	2,938,250,000	$ 0.88	$ 0.26
2026	6		$2,071,851	$185,614	$221,633	$586,593	$700,423	$2,993,907	$2,544,177	$772,208	3,117,100,000	$ 0.82	$ 0.25
2027	7		$2,071,851	$196,750	$241,978	$586,593	$721,436	$3,035,265	$2,510,289	$783,343	3,288,650,000	$ 0.76	$ 0.24
2028	8		$2,071,851	$208,509	$264,133	$586,593	$743,079	$3,079,063	$2,478,357	$795,102	3,467,500,000	$ 0.71	$ 0.23
2029	9		$2,071,851	$220,182	$287,288	$586,593	$765,371	$3,124,510	$2,447,628	$806,775	3,642,700,000	$ 0.67	$ 0.22
2030	10		$2,071,851	$231,766	$311,475	$586,593	$788,332	$3,171,658	$2,418,065	$818,360	3,814,250,000	$ 0.63	$ 0.21
2031	11		$2,071,851	$243,761	$337,422	$586,593	$811,982	$3,221,255	$2,390,149	$830,354	3,989,450,000	$ 0.60	$ 0.21
2032	12		$2,071,851	$256,183	$365,256	$586,593	$836,342	$3,273,448	$2,363,870	$842,776	4,168,300,000	$ 0.57	$ 0.20
2033	13		$2,071,851	$268,273	$393,967	$586,593	$861,432	$3,327,250	$2,338,415	$854,866	4,339,850,000	$ 0.54	$ 0.20
2034	14		$2,071,851	$281,065	$425,137	$586,593	$887,275	$3,384,263	$2,314,826	$867,659	4,518,700,000	$ 0.51	$ 0.19
2035	15		$2,071,851	$294,058	$458,132	$586,593	$913,893	$3,443,877	$2,292,557	$880,651	4,697,550,000	$ 0.49	$ 0.19
2036	16		$2,071,851	$306,984	$492,620	$586,593	$941,310	$3,505,781	$2,271,305	$893,578	4,872,750,000	$ 0.47	$ 0.18
2037	17		$2,071,851	$320,391	$529,557	$586,593	$969,549	$3,570,958	$2,251,612	$906,984	5,051,600,000	$ 0.45	$ 0.18
2038	18		$2,071,851	$334,297	$569,118	$586,593	$998,636	$3,639,605	$2,233,476	$920,890	5,234,100,000	$ 0.43	$ 0.18
2039	19		$2,071,851	$347,868	$609,988	$586,593	$1,028,595	$3,710,434	$2,216,001	$934,461	5,409,300,000	$ 0.41	$ 0.17
2040	20		$2,071,851	$361,372	$652,678	$586,593	$1,059,453	$3,783,981	$2,199,441	$947,965	5,580,850,000	$ 0.39	$ 0.17
2041	21		$2,071,851	$371,654	$691,387	$586,593	$1,091,236	$3,854,474	$2,180,453	$958,248	5,709,648,645	$ 0.38	$ 0.17
2042	22		$2,071,851	$385,463	$738,587	$586,593	$1,123,973	$3,934,412	$2,166,105	$972,056	5,880,180,660	$ 0.37	$ 0.17
2043	23		$2,071,851	$399,499	$788,445	$586,593	$1,157,693	$4,017,989	$2,152,914	$986,092	6,050,712,675	$ 0.36	$ 0.16
2044	24		$2,071,851	$413,766	$841,102	$586,593	$1,192,423	$4,105,376	$2,140,864	$1,000,360	6,221,244,690	$ 0.34	$ 0.16
2045	25		$2,071,851	$428,272	$896,706	$586,593	$1,228,196	$4,196,753	$2,129,942	$1,014,865	6,391,776,705	$ 0.33	$ 0.16
2046	26		$2,071,851	$443,021	$955,415	$586,593	$1,265,042	$4,292,308	$2,120,134	$1,029,614	6,562,308,720	$ 0.32	$ 0.16
2047	27		$2,071,851	$458,018	$1,017,391	$586,593	$1,302,993	$4,392,235	$2,111,428	$1,044,612	6,732,840,735	$ 0.31	$ 0.16
2048	28		$2,071,851	$473,270	$1,082,808	$586,593	$1,342,083	$4,496,742	$2,103,811	$1,059,864	6,903,372,750	$ 0.30	$ 0.15
2049	29		$2,071,851	$488,782	$1,151,847	$586,593	$1,382,345	$4,606,044	$2,097,273	$1,075,375	7,073,904,765	$ 0.30	$ 0.15
2050	30		$2,071,851	$505,657	$1,227,363	$586,593	$1,423,816	$4,723,030	$2,092,983	$1,092,251	7,256,200,000	$ 0.29	$ 0.15
							Total	$110,058,007	$72,614,801	$27,482,307	144,855,890,345	$ 0.50	$ 0.19

Alternative 3 - 30 Year Life Cycle Cost Analysis

Bond Rate	3.50%	Inflation	3.00%	O&M Cost % of Capital Cost (PS)	2.50%	Capital Cost PS	$ 13,702,500.00
Bond Term	30 Years	Discount Rate	2.75%	O&M Cost % of Capital Cost (PL)	1.00%	Capital Cost PL	$ 6,606,972.45

Year	Sequence Year	Capital Cost (PS+PL)	Debt Service	Power Costs Present Worth	Power Costs (Including Inflation)	O&M Costs Present Worth	O&M Costs (Including Inflation)	Total Annual Cost with Debt Service	Total Present Worth Annual Cost with Debt Service	Total Present Worth Annual Cost without Debt Service	Gallons/Year	Total Annual Cost With Debt Service (Unit Cost per 1,000 gal)	Total Annual Cost Without Debt Service (Unit Cost per 1,000 gal)
2020	0	$ 20,309,472	$1,104,253	$116,403	$116,403	$408,632	$408,632	$1,629,288	$1,629,288	$525,035	2,022,100,000	$ 0.81	$ 0.26
2021	1		$1,104,253	$127,178	$130,993	$408,632	$420,891	$1,656,137	$1,611,812	$535,810	2,204,600,000	$ 0.73	$ 0.24
2022	2		$1,104,253	$138,019	$146,424	$408,632	$433,518	$1,684,195	$1,595,250	$546,651	2,387,100,000	$ 0.67	$ 0.23
2023	3		$1,104,253	$149,149	$162,979	$408,632	$446,523	$1,713,756	$1,579,805	$557,781	2,573,250,000	$ 0.61	$ 0.22
2024	4		$1,104,253	$160,137	$180,235	$408,632	$459,919	$1,744,408	$1,565,023	$568,769	2,755,750,000	$ 0.57	$ 0.21
2025	5		$1,104,253	$171,204	$198,473	$408,632	$473,717	$1,776,443	$1,551,108	$579,837	2,938,250,000	$ 0.53	$ 0.20
2026	6		$1,104,253	$182,132	$217,475	$408,632	$487,928	$1,809,657	$1,537,819	$590,764	3,117,100,000	$ 0.49	$ 0.19
2027	7		$1,104,253	$192,694	$236,989	$408,632	$502,566	$1,843,808	$1,524,905	$601,326	3,288,650,000	$ 0.46	$ 0.18
2028	8		$1,104,253	$203,792	$258,157	$408,632	$517,643	$1,880,053	$1,513,267	$612,424	3,467,500,000	$ 0.44	$ 0.18
2029	9		$1,104,253	$214,753	$280,204	$408,632	$533,172	$1,917,630	$1,502,202	$623,386	3,642,700,000	$ 0.41	$ 0.17
2030	10		$1,104,253	$225,577	$303,156	$408,632	$549,168	$1,956,577	$1,491,690	$634,209	3,814,250,000	$ 0.39	$ 0.17
2031	11		$1,104,253	$236,726	$327,684	$408,632	$565,643	$1,997,580	$1,482,191	$645,358	3,989,450,000	$ 0.37	$ 0.16
2032	12		$1,104,253	$248,212	$353,890	$408,632	$582,612	$2,040,755	$1,473,700	$656,844	4,168,300,000	$ 0.35	$ 0.16
2033	13		$1,104,253	$259,330	$380,835	$408,632	$600,090	$2,085,178	$1,465,478	$667,963	4,339,850,000	$ 0.34	$ 0.15
2034	14		$1,104,253	$271,032	$409,961	$408,632	$618,093	$2,132,307	$1,458,492	$679,665	4,518,700,000	$ 0.32	$ 0.15
2035	15		$1,104,253	$282,851	$440,673	$408,632	$636,636	$2,181,561	$1,452,245	$691,483	4,697,550,000	$ 0.31	$ 0.15
2036	16		$1,104,253	$294,545	$472,658	$408,632	$655,735	$2,232,646	$1,446,474	$703,177	4,872,750,000	$ 0.30	$ 0.14
2037	17		$1,104,253	$306,606	$506,772	$408,632	$675,407	$2,286,432	$1,441,674	$715,238	5,051,600,000	$ 0.29	$ 0.14
2038	18		$1,104,253	$319,044	$543,151	$408,632	$695,669	$2,343,073	$1,437,848	$727,676	5,234,100,000	$ 0.27	$ 0.14
2039	19		$1,104,253	$331,115	$580,611	$408,632	$716,539	$2,401,403	$1,434,202	$739,747	5,409,300,000	$ 0.27	$ 0.14
2040	20		$1,104,253	$343,059	$619,604	$408,632	$738,035	$2,461,892	$1,430,976	$751,692	5,580,850,000	$ 0.26	$ 0.13
2041	21		$1,104,253	$352,112	$655,032	$408,632	$760,176	$2,519,461	$1,425,244	$760,744	5,709,648,645	$ 0.25	$ 0.13
2042	22		$1,104,253	$364,211	$697,865	$408,632	$782,982	$2,585,100	$1,423,237	$772,843	5,880,180,660	$ 0.24	$ 0.13
2043	23		$1,104,253	$376,442	$742,941	$408,632	$806,471	$2,653,665	$1,421,884	$785,074	6,050,712,675	$ 0.23	$ 0.13
2044	24		$1,104,253	$388,809	$790,369	$408,632	$830,665	$2,725,287	$1,421,178	$797,441	6,221,244,690	$ 0.23	$ 0.13
2045	25		$1,104,253	$401,315	$840,265	$408,632	$855,585	$2,800,103	$1,421,112	$809,947	6,391,776,705	$ 0.22	$ 0.13
2046	26		$1,104,253	$413,963	$892,750	$408,632	$881,253	$2,878,255	$1,421,680	$822,596	6,562,308,720	$ 0.22	$ 0.13
2047	27		$1,104,253	$426,757	$947,950	$408,632	$907,690	$2,959,894	$1,422,875	$835,389	6,732,840,735	$ 0.21	$ 0.12
2048	28		$1,104,253	$439,699	$1,005,999	$408,632	$934,921	$3,045,173	$1,424,691	$848,331	6,903,372,750	$ 0.21	$ 0.12
2049	29		$1,104,253	$452,793	$1,067,036	$408,632	$962,969	$3,134,257	$1,427,124	$861,425	7,073,904,765	$ 0.20	$ 0.12
2050	30		$1,104,253	$466,961	$1,133,437	$408,632	$991,858	$3,229,548	$1,431,156	$875,593	7,256,200,000	$ 0.20	$ 0.12
							Total	$70,305,523	$45,865,626	$21,524,218	144,855,890,345	$ 0.32	$ 0.15

Alternative 4 - 30 Year Life Cycle Cost Analysis

Bond Rate	3.50%		Inflation	3.00%	O&M Cost % of Capital Cost (PS)	2.50%	Capital Cost PS	$ 13,297,500.00
Bond Term	30	Years	Discount Rate	2.75%	O&M Cost % of Capital Cost (PL)	1.00%	Capital Cost PL	$ 2,816,057.85

Year	Sequence Year	Capital Cost (PS+PL)	Debt Service	Power Costs Present Worth	Power Costs (Including Inflation)	O&M Costs Present Worth	O&M Costs (Including Inflation)	Total Annual Cost with Debt Service	Total Present Worth Annual Cost with Debt Service	Total Present Worth Annual Cost without Debt Service	Gallons/Year	Total Annual Cost With Debt Service (Unit Cost per 1,000 gal)	Total Annual Cost Without Debt Service (Unit Cost per 1,000 gal)
2020	0	$ 16,113,558	$876,116	$115,575	$115,575	$360,598	$360,598	$1,352,289	$1,352,289	$476,173	2,022,100,000	$ 0.67	$ 0.24
2021	1		$876,116	$126,118	$129,902	$360,598	$371,416	$1,377,434	$1,340,568	$486,716	2,204,600,000	$ 0.61	$ 0.22
2022	2		$876,116	$136,690	$145,014	$360,598	$382,559	$1,403,689	$1,329,557	$497,288	2,387,100,000	$ 0.56	$ 0.21
2023	3		$876,116	$147,503	$161,180	$360,598	$394,035	$1,431,332	$1,319,456	$508,101	2,573,250,000	$ 0.51	$ 0.20
2024	4		$876,116	$158,136	$177,983	$360,598	$405,856	$1,459,956	$1,309,822	$518,734	2,755,750,000	$ 0.48	$ 0.19
2025	5		$876,116	$168,802	$195,688	$360,598	$418,032	$1,489,836	$1,300,856	$529,400	2,938,250,000	$ 0.44	$ 0.18
2026	6		$876,116	$179,289	$214,081	$360,598	$430,573	$1,520,770	$1,292,327	$539,887	3,117,100,000	$ 0.41	$ 0.17
2027	7		$876,116	$189,382	$232,916	$360,598	$443,490	$1,552,522	$1,284,000	$549,980	3,288,650,000	$ 0.39	$ 0.17
2028	8		$876,116	$199,940	$253,278	$360,598	$456,795	$1,586,189	$1,276,734	$560,538	3,467,500,000	$ 0.37	$ 0.16
2029	9		$876,116	$210,321	$274,421	$360,598	$470,499	$1,621,036	$1,269,861	$570,919	3,642,700,000	$ 0.35	$ 0.16
2030	10		$876,116	$220,523	$296,365	$360,598	$484,614	$1,657,094	$1,263,365	$581,121	3,814,250,000	$ 0.33	$ 0.15
2031	11		$876,116	$230,983	$319,734	$360,598	$499,152	$1,695,002	$1,257,680	$591,581	3,989,450,000	$ 0.32	$ 0.15
2032	12		$876,116	$241,703	$344,611	$360,598	$514,127	$1,734,854	$1,252,798	$602,301	4,168,300,000	$ 0.30	$ 0.14
2033	13		$876,116	$252,029	$370,114	$360,598	$529,550	$1,775,780	$1,248,031	$612,627	4,339,850,000	$ 0.29	$ 0.14
2034	14		$876,116	$262,841	$397,570	$360,598	$545,437	$1,819,123	$1,244,275	$623,439	4,518,700,000	$ 0.28	$ 0.14
2035	15		$876,116	$273,701	$426,417	$360,598	$561,800	$1,864,334	$1,241,070	$634,299	4,697,550,000	$ 0.26	$ 0.14
2036	16		$876,116	$284,389	$456,360	$360,598	$578,654	$1,911,130	$1,238,172	$644,987	4,872,750,000	$ 0.25	$ 0.13
2037	17		$876,116	$295,350	$488,169	$360,598	$596,014	$1,960,299	$1,236,036	$655,948	5,051,600,000	$ 0.24	$ 0.13
2038	18		$876,116	$306,591	$521,951	$360,598	$613,894	$2,011,961	$1,234,658	$667,189	5,234,100,000	$ 0.24	$ 0.13
2039	19		$876,116	$317,436	$556,626	$360,598	$632,311	$2,065,053	$1,233,322	$678,034	5,409,300,000	$ 0.23	$ 0.13
2040	20		$876,116	$328,108	$592,600	$360,598	$651,280	$2,119,996	$1,232,249	$688,706	5,580,850,000	$ 0.22	$ 0.12
2041	21		$876,116	$336,156	$625,349	$360,598	$670,819	$2,172,284	$1,228,848	$696,754	5,709,648,645	$ 0.22	$ 0.12
2042	22		$876,116	$346,859	$664,618	$360,598	$690,943	$2,231,677	$1,228,658	$707,457	5,880,180,660	$ 0.21	$ 0.12
2043	23		$876,116	$357,617	$705,789	$360,598	$711,672	$2,293,577	$1,228,941	$718,216	6,050,712,675	$ 0.20	$ 0.12
2044	24		$876,116	$368,433	$748,948	$360,598	$733,022	$2,358,086	$1,229,690	$729,031	6,221,244,690	$ 0.20	$ 0.12
2045	25		$876,116	$379,306	$794,183	$360,598	$755,012	$2,425,311	$1,230,897	$739,904	6,391,776,705	$ 0.19	$ 0.12
2046	26		$876,116	$390,239	$841,587	$360,598	$777,663	$2,495,365	$1,232,556	$750,837	6,562,308,720	$ 0.19	$ 0.11
2047	27		$876,116	$401,233	$891,255	$360,598	$800,993	$2,568,363	$1,234,659	$761,831	6,732,840,735	$ 0.18	$ 0.11
2048	28		$876,116	$412,289	$943,288	$360,598	$825,022	$2,644,426	$1,237,201	$772,887	6,903,372,750	$ 0.18	$ 0.11
2049	29		$876,116	$423,409	$997,791	$360,598	$849,773	$2,723,680	$1,240,175	$784,007	7,073,904,765	$ 0.18	$ 0.11
2050	30		$876,116	$435,368	$1,056,751	$360,598	$875,266	$2,808,134	$1,244,408	$795,966	7,256,200,000	$ 0.17	$ 0.11
							Total	$60,130,581	$39,093,159	$19,674,861	144,855,890,345	$ 0.27	$ 0.14

Alternative 5 - 30 Year Life Cycle Cost Analysis

Bond Rate	3.50%		Inflation	3.00%	O&M Cost % of Capital Cost (PS)	2.50%	Capital Cost PS	$ 13,297,500.00
Bond Term	30	Years	Discount Rate	2.75%	O&M Cost % of Capital Cost (PL)	1.00%	Capital Cost PL	$ 2,888,127.27

Year	Sequence Year	Capital Cost (PS+PL)	Debt Service	Power Costs Present Worth	Power Costs (Including Inflation)	O&M Costs Present Worth	O&M Costs (Including Inflation)	Total Annual Cost with Debt Service	Total Present Worth Annual Cost with Debt Service	Total Present Worth Annual Cost without Debt Service	Gallons/Year	Total Annual Cost With Debt Service (Unit Cost per 1,000 gal)	Total Annual Cost Without Debt Service (Unit Cost per 1,000 gal)
2020	0	$ 16,185,627	$880,034	$115,558	$115,558	$361,319	$361,319	$1,356,911	$1,356,911	$476,877	2,022,100,000	$ 0.67	$ 0.24
2021	1		$880,034	$126,097	$129,880	$361,319	$372,158	$1,382,072	$1,345,082	$487,416	2,204,600,000	$ 0.61	$ 0.22
2022	2		$880,034	$136,663	$144,986	$361,319	$383,323	$1,408,343	$1,333,966	$497,982	2,387,100,000	$ 0.56	$ 0.21
2023	3		$880,034	$147,470	$161,144	$361,319	$394,823	$1,436,001	$1,323,760	$508,788	2,573,250,000	$ 0.51	$ 0.20
2024	4		$880,034	$158,095	$177,938	$361,319	$406,667	$1,464,639	$1,314,024	$519,414	2,755,750,000	$ 0.48	$ 0.19
2025	5		$880,034	$168,754	$195,632	$361,319	$418,867	$1,494,533	$1,304,958	$530,072	2,938,250,000	$ 0.44	$ 0.18
2026	6		$880,034	$179,232	$214,012	$361,319	$431,434	$1,525,480	$1,296,330	$540,551	3,117,100,000	$ 0.42	$ 0.17
2027	7		$880,034	$189,315	$232,834	$361,319	$444,377	$1,557,244	$1,287,905	$550,634	3,288,650,000	$ 0.39	$ 0.17
2028	8		$880,034	$199,863	$253,180	$361,319	$457,708	$1,590,922	$1,280,543	$561,181	3,467,500,000	$ 0.37	$ 0.16
2029	9		$880,034	$210,232	$274,305	$361,319	$471,439	$1,625,778	$1,273,575	$571,550	3,642,700,000	$ 0.35	$ 0.16
2030	10		$880,034	$220,421	$296,228	$361,319	$485,582	$1,661,844	$1,266,986	$581,740	3,814,250,000	$ 0.33	$ 0.15
2031	11		$880,034	$230,867	$319,574	$361,319	$500,150	$1,699,757	$1,261,208	$592,186	3,989,450,000	$ 0.32	$ 0.15
2032	12		$880,034	$241,572	$344,424	$361,319	$515,154	$1,739,612	$1,256,234	$602,891	4,168,300,000	$ 0.30	$ 0.14
2033	13		$880,034	$251,882	$369,897	$361,319	$530,609	$1,780,540	$1,251,376	$613,201	4,339,850,000	$ 0.29	$ 0.14
2034	14		$880,034	$262,676	$397,321	$361,319	$546,527	$1,823,882	$1,247,530	$623,995	4,518,700,000	$ 0.28	$ 0.14
2035	15		$880,034	$273,517	$426,130	$361,319	$562,923	$1,869,087	$1,244,234	$634,836	4,697,550,000	$ 0.26	$ 0.14
2036	16		$880,034	$284,184	$456,032	$361,319	$579,811	$1,915,876	$1,241,247	$645,503	4,872,750,000	$ 0.25	$ 0.13
2037	17		$880,034	$295,124	$487,794	$361,319	$597,205	$1,965,033	$1,239,021	$656,442	5,051,600,000	$ 0.25	$ 0.13
2038	18		$880,034	$306,340	$521,524	$361,319	$615,121	$2,016,679	$1,237,553	$667,659	5,234,100,000	$ 0.24	$ 0.13
2039	19		$880,034	$317,161	$556,143	$361,319	$633,575	$2,069,752	$1,236,128	$678,479	5,409,300,000	$ 0.23	$ 0.13
2040	20		$880,034	$327,807	$592,056	$361,319	$652,582	$2,124,672	$1,234,967	$689,126	5,580,850,000	$ 0.22	$ 0.12
2041	21		$880,034	$335,835	$624,751	$361,319	$672,159	$2,176,944	$1,231,484	$697,153	5,709,648,645	$ 0.22	$ 0.12
2042	22		$880,034	$346,509	$663,948	$361,319	$692,324	$2,236,306	$1,231,207	$707,828	5,880,180,660	$ 0.21	$ 0.12
2043	23		$880,034	$357,238	$705,040	$361,319	$713,094	$2,298,168	$1,231,402	$718,557	6,050,712,675	$ 0.20	$ 0.12
2044	24		$880,034	$368,022	$748,113	$361,319	$734,487	$2,362,634	$1,232,062	$729,341	6,221,244,690	$ 0.20	$ 0.12
2045	25		$880,034	$378,863	$793,254	$361,319	$756,521	$2,429,809	$1,233,180	$740,181	6,391,776,705	$ 0.19	$ 0.12
2046	26		$880,034	$389,761	$840,555	$361,319	$779,217	$2,499,806	$1,234,749	$751,080	6,562,308,720	$ 0.19	$ 0.11
2047	27		$880,034	$400,719	$890,112	$361,319	$802,593	$2,572,739	$1,236,763	$762,037	6,732,840,735	$ 0.18	$ 0.11
2048	28		$880,034	$411,737	$942,024	$361,319	$826,671	$2,648,729	$1,239,214	$773,056	6,903,372,750	$ 0.18	$ 0.11
2049	29		$880,034	$422,817	$996,395	$361,319	$851,471	$2,727,901	$1,242,097	$784,136	7,073,904,765	$ 0.18	$ 0.11
2050	30		$880,034	$434,731	$1,055,206	$361,319	$877,015	$2,812,255	$1,246,235	$796,050	7,256,200,000	$ 0.17	$ 0.11
							Total	$60,273,949	$39,191,931	$19,689,941	144,855,890,345	$ 0.27	$ 0.14