Project 8: Upgrade San Antonio de los Buenos Wastewater Treatment Plant to Reduce Untreated Wastewater to Coast

Addendum to the Feasibility Analysis

USMCA Mitigation of Contaminated Transboundary Flows Project

Prepared for:

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1. INTRODUCTION

Under the modified EPA Contract No. 68HERH19D0033, Task Order No. 53, PG Environmental has prepared this addendum to the feasibility analysis for Project 8 to provide additional analysis on constructing a new 5 MGD San Antonio de los Buenos Wastewater Treatment Plant (SABTP), constructing a new 10 MGD SABTP, and replacing one of the parallel conveyance pipelines. PG evaluated a conventional activated sludge process for this analysis, which is expected to meet secondary treatment standards in the U.S., as defined by EPA. PG also reviewed a cost estimate for Border Water Infrastructure Program funding, developed by the Comisión Estatal de Servicios Públicos de Tijuana (CESPT), to replace one of the parallel conveyance pipelines

This feasibility analysis addendum addresses the following projects:

- A new, 5 MGD wastewater treatment plant constructed at the SABTP site
- A new, 10 MGD wastewater treatment plant constructed at the SABTP site
- Replacing one of the two parallel conveyance pipelines

Either proposed SABTP size would provide secondary treatment using a conventional activated sludge process. Each plant would be designed to produce a final effluent with BOD_5 (the amount of oxygen consumed by microorganisms in five days) and TSS (total suspended solids) less than 30 mg/L on a monthly average. Effluent disinfection and sludge treatment processes would be part of both proposed treatment processes. The goal is to provide a wastewater treatment plant on the site of the current SABTP that will provide excellent benefit to the environment and optimize costs.

Replacing one of the parallel conveyance pipelines would be required if wastewater flows in Tijuana continue to be pumped to SABTP. Such a replacement would include installing a gravity conveyance line in the section that is currently an open trench. This would reduce stormwater inflow that might otherwise necessitate additional treatment capacity at SABTP.

2. DESIGN INFORMATION

Sections 2.1 and 2.2 provide overviews of the design features and engineering issues associated with a 5 MGD or 10 MGD conventional activated sludge process and replacing one of the parallel conveyance pipelines. Figure 2-1, on the next page, shows the location and known elevations of the current SABTP, as well as the area proposed for the new treatment facility.

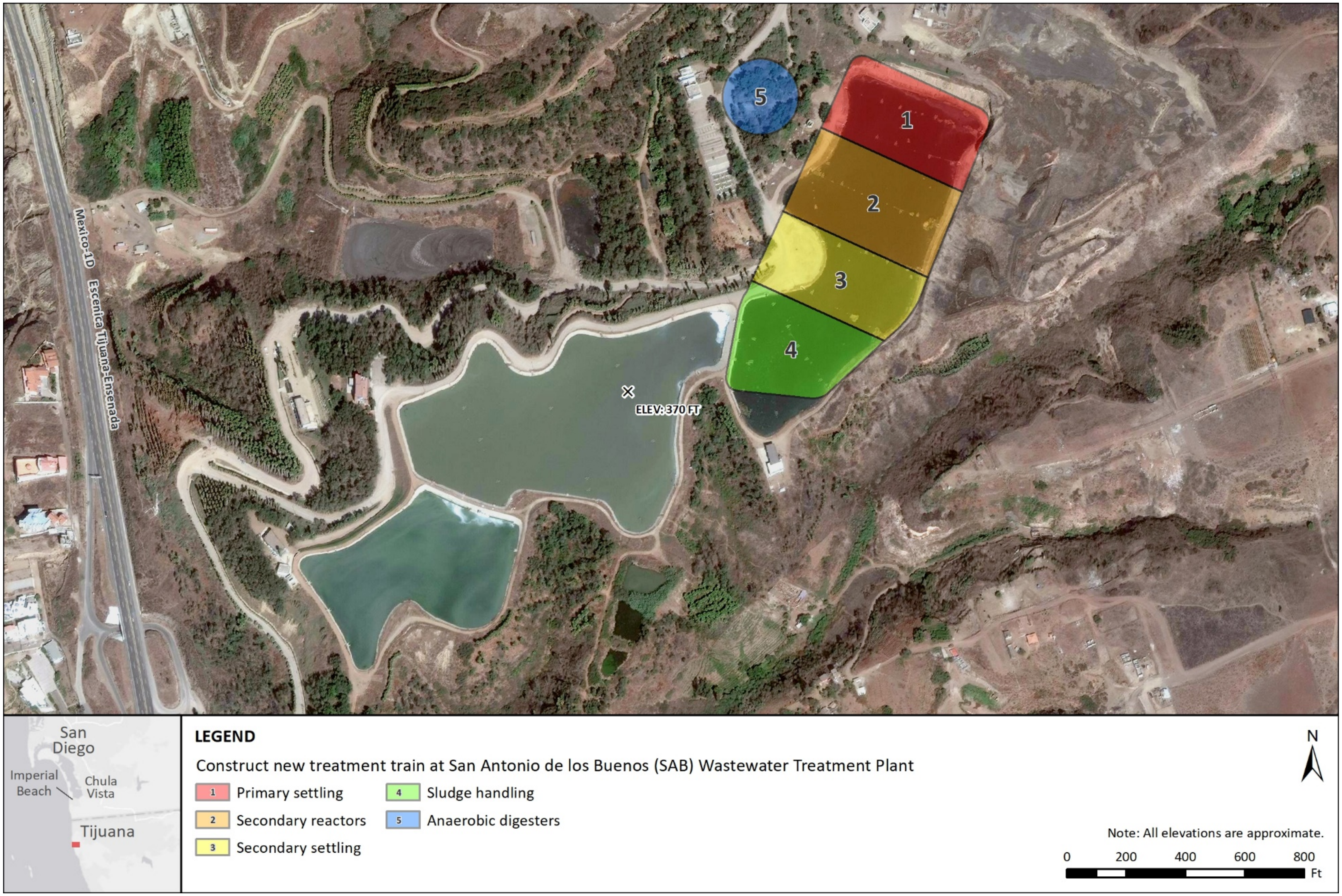

Figure 2-1. Proposed Layout of the Step-Feed Activation Sludge Facility Within the SABTP Footprint

2.1 Design Features

2.1.1 New SABTP

PG proposes using a step-feed activated sludge treatment process for the new SABTP at both the 5 MGD size and the 10 MGD size. Such a process will provide very good effluent quality (95% removal of TSS and 95% removal of BOD) and flexibility of operation. The proposed process will be constructed in one stage, giving it full design capability upon startup. The step-feed activated sludge process is the most flexible type of conventional activated sludge process, because it can be operated in three modes in response to different influent conditions:

- **Plug flow activated sludge.** If all influent is directed to the front of the aeration tanks, the process will operate in plug-flow activated sludge mode. Operating the reactor in plug flow activated sludge mode would provide the greatest BOD_5 removal efficiency if influent loadings are relatively consistent.
- **Step-feed activated sludge.** If influent is distributed along the length of the reactor, it will operate in the step-feed mode. The main advantage of this mode is that it tends to even out the oxygen demand along the length of the reactor.
- **Contact stabilization activated sludge.** If high flows occur, all influent flows can be directed to the last of four quadrants in the reactor. This mode, known as contact stabilization activated sludge, will prevent biomass washout when influent flow rates are high.

2.1.1.1 New 5 MGD SABTP

The 5 MGD plant design proposed in this report has the following components:

- Preliminary treatment will consist of mechanically cleaned coarse bar screens and vortex grit removal. Two mechanically cleaned bar screens and two manually cleaned screens (as backup) will be provided. Two vortex grit removal tanks will be used to remove sand, pieces of glass, and other grit particles from the wastewater.
- Primary treatment will consist of two rectangular primary settling tanks designed to remove about 50% of the influent BOD_5 loading and 30% of the influent TSS loading. Each primary tank will be 20 feet wide, 120 feet long, and 15 feet deep.
- The activated sludge process will have two aeration tanks (reactors) with baffles that divide each tank into four equal-volume compartments. Twenty-five percent of primary effluent will be directed to the front end of each quadrant to approximately even out the organic loading along the reactor. At design conditions (average daily), hydraulic detention time in each aeration tank will be 9.6 hours, and the volumetric organic loading rate will be 43.7 pounds BOD_5/day/1,000 cubic feet of aeration volume. Each reactor will be 30 feet wide, 300 feet long, and 15 feet deep; each will have a total volume of 1.0 million gallons.
- Three rectangular secondary clarifiers will be used in the activated sludge process. Each clarifier will be 20 feet wide, 160 feet long, and 15 feet deep.
- Two aerobic digesters will be used to stabilize the waste primary and secondary sludges. Each digester will be 70 feet in diameter and 15 feet deep; each will have a total volume of 0.43 million gallons. Waste activated sludge (WAS) will be thickened with two gravity belt thickeners, then combined with raw primary sludge in two sludge holding/blending tanks

before entering the aerobic digestion process. After aerobic digestion, the sludge will be chemically conditioned and dewatered with one 2-meter belt filter press.

Table 2-1 lists the design capacities of this treatment plant's major components.

Table 2-1. Design Capacities for Each Stage of the Proposed 5 MGD Design

Type of Treatment	Average Daily Flow Rate (MGD)	Peak Daily Flow Rate (MGD)
Preliminary	5	12.5
Primary	5	12.5
Secondary	5	12.5

The secondary treatment process will be a conventional activated sludge process designed for flexibility. The aeration tanks will have fine-bubble diffusers (flexible membranes) that receive air from four 150-HP high-performance blowers. At design loadings, three blowers would be in operation to meet design oxygen requirements and one blower would be on standby. Table 2-2 and Table 2-3 summarize the design parameters for the 5 MGD secondary treatment process.

Table 2-2. Description of Each of the Two Secondary Reactors

Type of Zone	Number of Zones	Volume of Each Zone (Million Gallons)	Detention Time (Hours) in Each Zone at Average Daily Design Flow Rate of 2.5 MGD to Each Reactor
First quadrant	1	0.25	2.4
Second quadrant	1	0.25	2.4
Third quadrant	1	0.25	2.4
Fourth quadrant	1	0.25	2.4
Total for one reactor	**4**	**1.00**	**9.6**

Table 2-3. Description of Each of the Three Secondary Clarifiers at Design Loadings

Type of Zone	Design Surface Overflow Rate (gpd/ft^2)	Design Solids Loading Rate (lb TSS/Day/ft^2)	Detention Time in Each Clarifier (Hours)
Average daily flow rate	522	20	5.2
Peak daily flow rate	1,300	47	2.08

2.1.1.2 New 10 MGD SABTP

The 10 MGD plant design proposed in this report has the following components:

- Preliminary treatment will consist of mechanically cleaned coarse bar screens and vortex grit removal. Two mechanically cleaned bar screens and two manually cleaned screens (backup) will be provided. Two vortex grit removal tanks will remove sand, pieces of glass, and other grit particles from the wastewater.
- Primary treatment will consist of three rectangular primary settling tanks designed to remove about 50% of the influent BOD_5 loading and 30% of the influent TSS loading. Each primary tank will be 20 feet wide, 160 feet long, and 15 feet deep.
- The activated sludge process will have four aeration tanks (reactors) with baffles that divide each tank into four equal-volume compartments. Twenty-five percent of primary effluent will be directed to the front end of each quadrant to approximately even out the organic loading along the reactor. At design conditions (average daily), hydraulic detention time in each aeration tank will be 9.6 hours, and the volumetric organic loading rate will be

43.7 pounds BOD_5/day/1,000 cubic feet of aeration volume. Each reactor will be 30 feet wide, 300 feet long, and 15 feet deep; each will have a total volume of 1.0 million gallons.

- Six rectangular secondary clarifiers will be used in the activated sludge process. Each clarifier will be 20 feet wide, 160 feet long, and 15 feet deep.
- Two aerobic digesters will be used to stabilize the waste primary and secondary sludges. Each digester will be 100 feet in diameter and 15 feet deep; each will have total volume of 0.88 million gallons. WAS will be thickened with two gravity belt thickeners, then combined with raw primary sludge in two sludge holding/blending tanks before entering the aerobic digestion process. After aerobic digestion, the sludge will be chemically conditioned and dewatered with two 2-meter belt filter presses.

Table 2-4 lists the design capacities of this treatment plant's major components.

Table 2-4. Design Capacities for Each Stage of the Proposed 10 MGD Design

Type of Treatment	Average Daily Flow Rate (MGD)	Peak Daily Flow Rate (MGD)
Preliminary	10	25
Primary	10	25
Secondary	10	25

The secondary treatment process will be a conventional activated sludge process designed for flexibility. The aeration tanks will have fine-bubble diffusers (flexible membranes) that receive air from four 300-HP high-performance blowers. At design loadings, three blowers would be in operation to meet design oxygen requirements and one blower would be on standby. Table 2-5 and Table 2-6 summarize the design parameters for the 10 MGD secondary treatment process.

Table 2-5. Description of Each of the Four Secondary Reactors

Type of Zone	Number of Zones	Volume of Each Zone (Million Gallons)	Detention Time (Hours) in Each Zone at Average Daily Design Flow Rate of 2.5 MGD to Each Reactor
First quadrant	1	0.25	2.4
Second quadrant	1	0.25	2.4
Third quadrant	1	0.25	2.4
Fourth quadrant	1	0.25	2.4
Total for one reactor	**4**	**1.00**	**9.6**

Table 2-6. Description of Each of the Six Secondary Clarifiers at Design Loadings

Type of Zone	Design Surface Overflow Rate (gpd/ft^2)	Design Solids Loading Rate (lb TSS/Day/ft^2)	Detention Time in Each Clarifier (Hours)
Average daily flow rate	522	20	5.2
Peak daily flow rate	1,300	47	2.08

2.1.1.3 Bio-Tiger Model Results for the Proposed SABTP Designs and Anaerobic Digestion Process

Table 2-7. Bio-Tiger Model Results for Secondary Treatment Process Performance

Category	Item	Operating Data	
		5 MGD Plant	10 MGD Plant
Secondary influent loadings	Average flow rate (MGD)	5	10
	BOD_5 loading (lb/day)	11,700	23,400
	TSS loading (lb/day)	8,350	16,700
	Total Kjeldahl nitrogen loading (lb/day)	2,500	5,000
Operating performance parameters	Solids retention time (days) (including reactor/clarifier solids)	6.1	6.7
	Mixed liquor suspended solids concentration (mg/L)	3,000	3,200
	Total sludge production (lb/day)	9,800	20,000
	Total oxygen requirements (lb/day)	15,400	32,200
	Total oxygen supplied (lb/day)	15,600	32,600
	Return activated sludge flow rate (MGD)	2.1	4.7
	WAS flow rate (MGD)	0.11	0.24
	Volumetric organic loading rate (lb BOD/day/1,000 ft^3)	43.7	43.7
	Blower horsepower in use	450 (100% output)	900 (100% output)
Secondary effluent quality	Carbonaceous BOD_5 (mg/L)	11	11
	TSS (mg/L)	15	15
	Ammonia-N (mg/L)	11	11

Table 2-8. Description of Aerobic Digestion Process

Design Parameter	5 MGD Plant	10 MGD Plant
Primary sludge flow	130 m^3/day (0.034 MGD)	260 m^3/day (0.068 MGD)
Primary sludge solids	3%	3%
WAS flow	150 m^3/day (0.04 MGD after thickening)	300 m^3/day (0.08 MGD after thickening)
WAS solids	3% (after thickening)	3% (after thickening)
TSS of combined sludge	30,000 mg/L	30,000 mg/L
Volatile suspended solids (VSS) of combined sludge	24,000 mg/L	24,000 mg/L
Mass loading of TSS	8,400 kg/day (18,500 lb/day)	16,800 kg/day (18,500 lb/day)
Mass loading of VSS	6,700 kg/day (14,800 lb/day)	13,400 kg/day (14,800 lb/day)
Total volume of digesters	3,260 m^3 (0.86 million gallons)	6,660 m^3 (1.76 million gallons)
Number of digesters	2	2
Volume of each digester	1,630 m^3 (0.43 million gallons)	3,330 m^3 (0.88 million gallons)
Diameter of each digester	21.3 meters (70 feet)	30.5 meters (100 feet)
Liquid depth of each digester	4.6 meters (15 feet)	4.6 meters (15 feet)
Hydraulic detention time	12 days	12 days
Solids retention time	40 days	40 days
VSS loading rate	2.08 kg/m^3/day (0.13 lb/ft^3/day)	2.08 kg/m^3/day (0.13 lb/ft^3/day)
Blower capacity	Three 75-HP blowers (one is standby)	Three 150-HP blowers (one is standby)
Estimated VSS destruction	43%	43%

2.1.2 Replacing One of the Parallel Conveyance Pipeline

The parallel conveyance pipelines consist of two pipelines that convey flows from Pump Stations 1-A and 1-B (PB1-A and PB1-B) to SAB Creek and SABTP, respectively. Each of the two pipelines consists of a force main section, a gravity section, and an open channel section. In 2020, CESPT applied for Border Water Infrastructure Program funding to replace both the force main section and the gravity main section of the newer of the two pipelines, which runs from PB1-B to SABTP. This project includes replacing about 4,400 meters of 42-inch reinforced concrete pipeline from PB1-B to the transition box between the gravity line and the force main, and about 4,300 meters of concrete pipeline from the transition box to the start of the open channel. CESPT also evaluated the costs of replacing the open channel section of one of the parallel conveyance pipelines with a 60-inch concrete gravity line; however, CESPT has not yet applied for Border Water Infrastructure Program funding for replacing this section. The new gravity line would run from the end of the existing gravity line to SABTP and would be about 7,400 meters long.

2.2 Engineering Issues

This conventional activated sludge process is constructible within the footprint of the existing SABTP lagoon system. The proposed design should use the footprint of only one of the current lagoons, leaving the lower two lagoons as an area for future expansion or additional facilities. It is not clear, however, whether the soils at the SABTP—particularly those within the footprint of the existing lagoons—have been adequately studied to establish that they would be able to support the construction proposed.

PG reviewed the cost estimate in the application to replace the pressurized and gravity sections of the one of the parallel conveyance pipelines and determined that both sections were sized properly to convey flows up to the capacity of PB1-B to SABTP or SAB Creek (PB1-B has a firm capacity of 1000 L/s, or about 23 MGD). The proposed 42-inch replacement line for the pressurized section would convey 23 MGD of flows at an average linear velocity of 3.6 ft/s, which is within the 2–8 ft/s range that is standard for force mains. PG notes that a reinforced concrete pipe would need proper maintenance to ensure that the interior of the pipe does not roughen over time. A sufficiently rough pipe may increase the frictional losses such that PB1-B may not provide enough hydraulic energy to overcome them. PG estimates that a 60-inch concrete pipe would convey 1,000 L/s of flow at 5.78 ft/s, with pipe flowing at 32% full.

3. WATER QUALITY IMPACTS

The 5 MGD and 10 MGD plants would both provide secondary treatment to wastewater before discharge into the Pacific Ocean via SAB Creek. As the Scripps report (Feddersen et al. 2020) demonstrates, this would have a positive impact on water quality along the coast as far north as Point Loma, especially during periods of northward ocean currents. This would likely improve the beach conditions on both sides of the international border and reduce the number of days with impacts predicted to result in beach closures.

PG estimated the total BOD_5 and sediment loads that are conveyed to SAB Creek under current conditions, with the 5 MGD SABTP, and with the 10 MGD SABTP. PG estimated the discharges from SAB Creek using flow data from the major pump stations from January 1, 2016, through December 31, 2019, and flow balances. More details on this methodology, including assumptions about BOD_5 and sediment levels, can be found in PG's *Baseline Conditions Summary: Technical Document.* Table 3-1 presents the reduction in BOD_5 and sediment loads to SAB Creek for the new 5 MGD and 10 MGD SABTP, compared to current conditions.

Table 3-1. Impact of Both Proposed SABTP Sizes on Discharges to the Pacific Ocean via SAB Creek

Parameter	Current Conditions	5 MGD Plant	10 MGD Plant
BOD_5 load (tons/year)	17,200	14,300	11,400
Percent reduction	*N/A*	*17%*	*34%*
TSS (sediment) load (tons/year)	17,900	15,000	12,100
Percent reduction	*N/A*	*16%*	*32%*

PG used the estimated BOD_5 load reductions in Table 3-1 to estimate that a new SABTP would reduce the untreated wastewater discharges to SAB Creek from an average flow rate of 28 MGD to an average flow rate of 23 MGD for the 5 MGD plant, and 18 MGD for the 10 MGD plant. Scripps Institution of Oceanography estimated that reducing untreated wastewater discharges from SAB Creek to an average of 10 MGD and eliminating transboundary flows below 35 MGD would reduce the frequency of beach impacts predicted to result in beach closures at Imperial Beach from an average of 14% of the time to 7%. The Scripps report also estimated that reducing the untreated wastewater discharges from SAB Creek to an average of 10 MGD would reduce regional impacts predicted to result in beach closures during the dry tourist season (May 22 through September 8) from an average of 24% of the time to an average of 9% (Feddersen et al. 2020). Although neither the 5 MGD plant nor the 10 MGD plant alone would reduce untreated wastewater discharges to SAB Creek to less than 10 MGD, the results from the Scripps report indicate that the reduction in untreated wastewater discharges to SAB Creek caused by the implementing a new SABTP is likely to improve water quality at the beaches and Naval facilities in San Diego County, including the Navy SEALs training facility in Coronado, California. Additionally, a new SABTP combined with other improvements could bring the average untreated wastewater discharges below 10 MGD.

PG expects that replacing one of the parallel conveyance pipelines would improve water quality in the Tijuana River by preventing untreated wastewater from leaking from the pipeline and flowing through the canyons and into the Tijuana River during wet weather. PG does not expect that replacing one of the parallel conveyance pipelines will affect dry weather flows in the Tijuana River, because wastewater from the canyons is diverted to the ITP.

4. COST IMPACT ANALYSIS

PG's cost estimates in all feasibility analyses were developed to a Class V level of accuracy in accordance with AACE International Recommended Practice No. 17R-97 (AACE International 2020). Class V estimate accuracy can range from +40%/-20% to +200%/-100%. Based on the information that PG has reviewed thus far, PG's estimate accuracy goal for construction in the U.S. is +50%/-25%, meaning actual construction costs may range from 50% higher than PG estimates to 25% lower. Because there are fewer sources of cost data for construction in Mexico, PG's estimate accuracy goal for construction in Mexico is +100%/-50%, meaning actual construction costs may range from 100% higher than PG estimates to 50% lower.

For project construction cost data, PG used manufacturers' cost information, bid tabulations from similar projects in the U.S. and Mexico in recent years, R.S. Means Heavy Construction Cost Data 2020, EPA cost databases (cost curves for various treatment technologies), Hydromantis CapdetWorks™ cost data, and adjustments for a 2020 *Engineering News-Record* (ENR) value of 11455. The sum of project construction cost plus equipment/material cost was multiplied by 1.4 to account for project engineering and owner administration costs. That total was multiplied by a general contingency factor of 1.5 to account for unanticipated construction, unknown subsoils, and other factors. Therefore, project capital cost equals project construction cost × 1.4 × 1.5, which is equivalent to project construction cost × 2.1.

PG's operation and maintenance (O&M) estimates include personnel, energy, materials, monitoring, maintenance, and sludge/grit disposal costs associated with operating the proposed treatment plants. An interest rate of 3% and an inflation factor of 2% annually was applied to calculate the life cycle cost over a 40-year lifespan. Service life of all equipment is estimated to be 20 years.

Table 4-1 summarizes the estimated capital and life cycle costs for the 5 MGD and 10 MGD treatment plants. The sources for these cost estimates are EPA cost curves (adjusted for ENR values) and the CESPT report.

4.1 Opinion of Probable Costs—New SABTP

Table 4-1. Cost Estimates for the Proposed SABTP Designs

Category	Item	Estimated Cost (USD)	
		5 MGD Plant	10 MGD Plant
Capital costs	Preliminary treatment	$730,000	$1,100,000
	Extension and rehabilitation of the ditch	$330,000	$440,000
	Preliminary	$9,000	$13,000
	Distribution box	$25,000	$38,000
	Primary settling	$450,000	$640,000
	Primary settling equipment	$610,000	$870,000
	Bioreactors	$2,900,000	$4,800,000
	Secondary settling	$1,020,000	$1,540,000
	Secondary settling equipment	$1,720,000	$2,600,000
	Sludge thickener	$300,000	$430,000
	Sludge recirculation	$41,000	$59,000
	Sludge pumping	$1,500,000	$2,300,000
	Sludge storage/blending	480,000	640,000
	Aerobic digester	$1,650,000	$2,500,000
	Chemical treatment of sludge	$170,000	$250,000
	Sludge dewatering	$510,000	$750,000
	Chlorination relocation	$695,000	$1,000,000
	Plumbing and equipment	$540,000	$810,000
	Total project cost (plus 16% tax)	$15,869,000	$24,105,000
	General contractor: mobilization/demobilization, insurance, bonds, general administration, profit (30%)	$4,761,000	$7,232,000
	Total construction cost	$20,630,000	$31,337,000
	Engineer and administrative contingency (40%)	$8,252,000	$12,535,000
	Total construction cost (with engineering)	$28,882,000	$43,872,000
	Contingency (50%)	$14,441,000	$21,936,000
	Total capital costs	**$43,323,000**	**$65,808,000**
O&M	**Annual O&M costs**	**$2,200,000**	**$3,700,000**
Life cycle factors	Mid-cycle replacement/major repair cost (at 20 years)	$7,000,000	$10,000,000
	Interest rate	3%	3%
	Inflation rate	2%	2%
	Total life cycle used	40 years	40 years
Total life cycle cost		**$121,000,000**	**$195,000,000**

Sources: MAV and CEISA 2020 and EPA cost curves.

4.2 Opinion of Probable Costs—Replacing One of the Parallel Conveyance Pipelines

PG reviewed CESPT's cost estimates for replacing the force main and gravity main sections of one of the parallel conveyance pipelines, and for converting the open channel section to a gravity conveyance line. The capital cost estimates from CESPT are presented in Table 4-2. CESPT did not evaluate the O&M costs of the replaced pipeline; however, the O&M requirements are expected to be similar to the current requirements. Overall, CESPT estimated that replacing the force main section of one of the parallel conveyance pipelines would cost about $660 per foot and replacing the gravity section would cost about $735 per foot. PG compared these costs to previous bid tabulations and RSMeans heavy construction costs and found that CESPT's cost estimates are consistent with cost estimates from these sources.

CESPT estimated that replacing the open channel section with a 60-inch gravity pipeline would cost about $535 per foot, which is significantly cheaper than replacing the 60-inch gravity main section. This cost reduction is primarily attributed to a lower cost per foot for earthwork. PG found this estimate to be reasonable if the pipe is expected to be constructed in the current channel and not buried underground.

Table 4-2. Cost Estimate for Replacing One of the Parallel Conveyance Pipelines

Category	Item	Estimated Cost (USD)*
Force main section	Earthwork (excavation, filling, demolishing, and replacing concrete)	$2,000,000
	42-inch reinforced concrete pipe (including installation costs)	$6,650,000
	Civil costs (construction of boxes, wells, etc.)	$800,000
	Signage	$50,000
	Estimated force main replacement costs	**$9,500,000**
Gravity main section	Earthwork (excavation, filling, demolishing and replacing concrete)	$3,050,000
	60-inch concrete pipe (including installation costs)	$6,150,000
	Civil costs (construction of boxes, wells, etc.)	$1,000,000
	Signage	$50,000
	Estimated gravity main replacement costs	**$10,250,000**
Open trench section	Earthwork (excavation, filling, demolishing and replacing concrete)	$2,050,000
	60-inch concrete pipe (including installation costs)	$7,650,000
	Civil costs (construction of boxes, wells, etc.)	$3,000,000
	Signage	$50,000
	Estimated open trench replacement costs	**$12,750,000**
Total capital costs		**$32,500,000**

Source: CESPT applications for funding, reviewed by PG.

* Original cost estimates were presented in pesos. PG used a factor of 20 pesos/USD to convert all costs into U.S. dollars.

5. DISCUSSION

Constructing either a 5 MGD or a 10 MGD wastewater treatment plant within the footprint of the current SABTP is technically feasible and would provide secondary treatment to some of the untreated wastewater that is currently discharged to the Pacific Ocean via SAB Creek. However, neither plant has the capacity to treat all of the wastewater currently discharged to SAB Creek, which PG estimates is an average of 28.2 MGD. Therefore, either plant would need to be constructed in conjunction with other treatment plant projects to eliminate untreated wastewater discharges to the Pacific Ocean via SAB Creek.

CESPT identified replacing the force main and gravity main sections of one of the parallel conveyance pipelines as a higher priority than replacing the open channel section with a gravity line. The replacement projects assume that the average flow rate at PB1-B remains unchanged. If flows in the parallel conveyance pipelines are reduced, the pipe sizes may be reduced to ensure that the linear flow velocity remains between 2 and 8 ft/s in the force main section and 2 and 10 ft/s in the gravity section. PG reviewed the cost estimates from CESPT and found that they were reasonable costs to replace each section of pipe. However, the price to replace the open channel section of the line may increase if the pipe cannot be constructed in the existing channel without being buried.

6. REFERENCES

AACE International. (2020). *Cost Estimate Classification System.* Recommended Practice 17R-97.

Feddersen, F., Wu, X., Giddings, S. (2020). *Modeling Impacts of Various Wastewater and Stormwater Flow Scenarios on San Diego South Bay and Tijuana Beaches.* Scripps Institution of Oceanography, University of California San Diego.

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