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TIJUANA RIVER DIVERSION STUDY:

Flow Analysis, Infrastructure Diagnostic and Alternatives Development

FINAL REPORT

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ACRONYMS AND ABBREVIATIONS

%	Percent
ANOVA	Analysis of variance
BMPs	Best Management Practices
CEPT	Chemically enhanced primary treatment
CESPT	Comisión Estatal de Servicios Públicos de Tijuana, (State Commission of Public Services of Tijuana)
CILA	Comisión Internacional de Límites y Aguas, Sección Mexicana, (Mexican Section of the International Boundary and Water Commission)
CoF	Consequence of Failure
CONAGUA	Comisión Nacional del Agua (Mexican National Water Commission)
CR	Condition ratings
CY	Cubic yard
CRWQCB	California Regional Water Quality Control Board
gpm	Gallons per minute
HEC	Hydrologic Engineering Center
I&C	Instrumentation and Controls
JB#1	Joint box #1
kVA	kilo-volt-ampere
LF	Linear feet
LoF	Level of Failure
lps	Liters per second
LS	Lump sum
m^3	cubic meters
m^3/s	cubic meters per second
MCC	Motor Control Center
mgd	Million gallons per day
NADB	North American Development Bank
NPDES	National Pollutant Discharge Elimination System
NPV	Net present value
O&M	Operations & Maintenance

PBCILA	CILA Pump Station
PERC	Primary Effluent Return Connection
PLC	Programmable Logic Controller
R&R	Rehabilitation and Replacement
RUL	Remaining Useful Life
SAB	San Antonio de los Buenos
SBIWTP	South Bay International Wastewater Treatment Plant
SBWRP	South Bay Water Reclamation Plant
SBOO	South Bay Ocean Outfall
SCADA	Supervisory Control and Data Acquisition
SEMARNAT	Secretaría del Medio Ambiente y Recursos Naturales (Secretariat of Environment and Natural Resources)
SSO	Sanitary Sewer Overflows
SSP	Statistical Software Package
TRNERR	Tijuana River National Estuarine Research Reserve
U.S.	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USIBWC	United States Section of the International Boundary and Water Commission
WWTP	Wastewater treatment plant

EXECUTIVE SUMMARY

Introduction

The Tijuana River Diversion Study (the "Study") provides an analysis of diversion management capabilities for northbound flows in the Tijuana River Watershed shared by Tijuana, Baja California in Mexico, and San Diego County, California. While seventy percent (70 %) of this watershed lies in Mexico, the mouth of the river is located in the United States (U.S.). During dry-weather, flows in the Tijuana River reach volumes nearing 1,000 liters per second (lps) or 23 million gallons per day (mgd) and consist mainly of treated wastewater effluent along with unmanaged quantities of untreated sewage discharges, percolating groundwater, or other unidentified point or non-point sources from the urban areas of Tijuana. These flows are normally diverted before they cross into the U.S., and pumped to the coast, approximately 6 miles south of the border. During storm events, however, flows in the river exceed the operational capacity of the diversion system (1,000 lps), and the stormwater flows – laden with sewage, sediment and trash – flow into the United States and empty into the Tijuana River Estuary and, depending on volume of flows and other factors, may reach the Pacific Ocean. Smaller volumes, due to occasional diversion system failures during dry-weather conditions, may also reach the U.S.

Untreated transboundary flows may result in closure of San Diego County beaches due to potential bacteriological impacts. While it is not practical to prevent 100% of the transboundary flows, especially those flows due to significant storm events, the purpose of this study is to evaluate alternatives to enhance the river diversion infrastructure in order to reduce the number of days of transboundary flows during both dry-weather and post-wet-weather[1]. These alternatives include both improvements to the existing diversion system infrastructure in Mexico as well as new infrastructure in Mexico and in the U.S. to prevent flows from reaching the Tijuana River Estuary. Alternatives evaluated in the study include operational improvements to increase the reliability of existing infrastructure, facility improvements, and capacity expansion to enable operation during some small wet-weather conditions and mitigation of post-storm event transboundary flows. The study does not result in a recommendation for a single solution.

This study consists of (1) a **transboundary flow analysis**, (2) a **diversion infrastructure and operations diagnostic**, and (3) an **evaluation of technical alternatives** identified for potential infrastructure investments in Mexico, in the U.S., or in both countries for mitigation of transboundary flows. The study was directed by the North American Development Bank (NADB), in coordination with the U.S. Environmental Protection Agency (EPA), the U.S. Section of the International Boundary and Water Commission (IBWC), the Mexican Section of the International Boundary and Water Commission (CILA), the Mexican National Water Commission (CONAGUA), and the Tijuana water utility, Comisión Estatal de Servicios Públicos (CESPT). This group of agencies form the Study's Core Group for review of all study deliverables and participation in periodic meetings held in Tijuana and San Diego to present study progress and receive agency comments and input.

[1] Dry-weather flows are flows not caused by rainfall. Dry-weather flows include treated effluent from wastewater treatment plants located in Mexico and "fugitive" untreated domestic and industrial wastewater discharges. For purposes of this study, dry-weather flows are defined as flows less than 1,000 lps (23 mgd), while wet-weather flows exceed 23 mgd and are generally associated with rainfall.

In addition, the study involved stakeholder coordination efforts that included three meetings held in San Diego and Tijuana:

- May 2018: Study kick-off Meeting
- August 2018: 30% progress meeting
- December 2018: 60% progress meeting
- June 2019: final meeting

Representatives of fifteen external stakeholder entities attended the kick-off meeting for the study. During and after the meeting, interviews were held with interested stakeholders to gather information on existing data and efforts relevant to the project, and to solicit stakeholder ideas for resolution of present transboundary flow issues. Stakeholder input was valuable in defining existing problems, identifying potential solutions, and emphasizing the need to secure and leverage financial resources from all funding partners.

Background

CESPT is responsible for the operation and maintenance (O&M) of the drinking water distribution system, as well as wastewater collection and treatment infrastructure serving the residents of Tijuana and Playas de Rosarito, Baja California. This region, one of the largest urban areas in Mexico, has an estimated population of 1.64 million people. The rapid growth of the region has placed a significant burden on public water and wastewater infrastructure and services. Over the past 20 years, CESPT has focused much of its investment efforts on expanding wastewater collection infrastructure to eliminate unsanitary conditions related to direct discharges or inadequate on-site disposal practices. This effort has increased the number of wastewater connections from 170,916 in 1997 to 569,211 in 2017 and improved service coverage from 61.8% to 89.6%. However, the poor condition of critical wastewater collection lines, pumps, and the San Antonio de Los Buenos wastewater treatment plant, which have not been modernized or received sufficient maintenance, result in approximately 30% of Tijuana's wastewater entering the river and/or ocean without treatment.

In 1990, IBWC/CILA Minute 283 was signed to provide proper collection, treatment and final disposal of sewage flows in the Tijuana River prior to crossing into the United States. As part of Minute 283, diversion and treatment systems were implemented in both Tijuana and San Diego County as a binational solution to capture wastewater flows and to provide treatment and final disposal of northbound flows. The existing diversion system, schematically diagrammed in Figure ES-1, pumps dry-weather river flows via the CILA Pump Station (PBCILA), located just upstream of the border, to the International Collector (gravity line). From there, flows are conveyed to either the South Bay International Wastewater Treatment Plant (SBIWTP), located in the U.S., or sent to a second dual-pump station ("PB1A" and "PB1B") and then toward the San Antonio de Los Buenos Wastewater Treatment Plant (SAB WWTP),[2] both located in Mexico. Flows from PB1B sent to SAB WWTP are conveyed via one of two 10-mile pipelines ("parallel conveyance pipeline system") over a 100-meter grade. River flows reaching the SAB WWTP site bypass the treatment plant and discharge directly to the ocean.

[2] Although the capacity of the SAB WWTP is 1,100 lps, it is currently operating at approximately 450 lps due to deteriorated aeration system and limited treatment capacity in the lagoons due to sludge build-up, which has not been maintained adequately for more than 10 years.

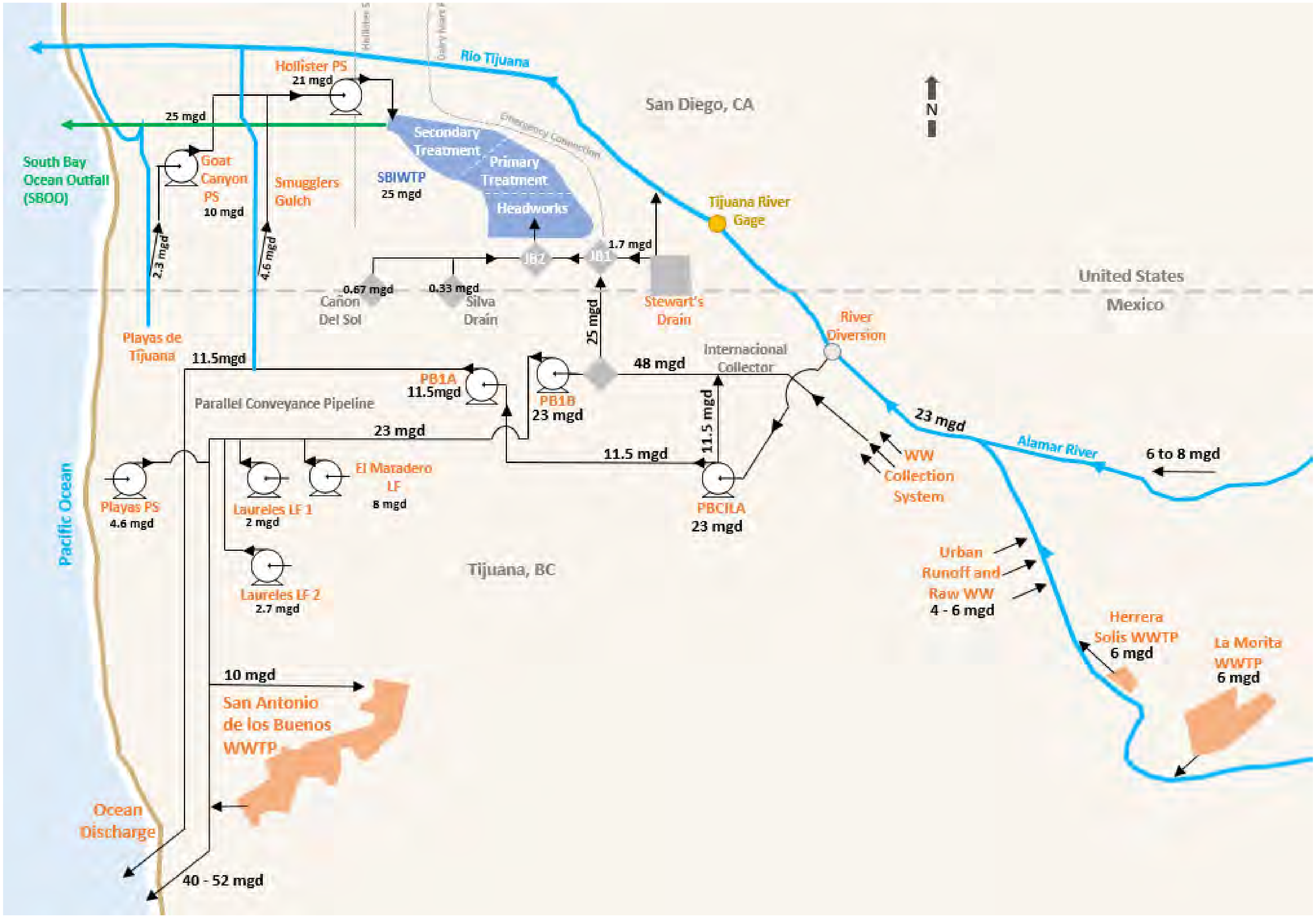


Figure ES- 1. Existing diversion system schematic

The Tijuana River diversion system has been in operation on the Tijuana River (approximately 1,000 feet south of the U.S.-Mexico border) since 1991. CESPT operates the diversion infrastructure through an operations and communication protocol established in coordination with IBWC/CILA. The four-phase protocol defines manual cleanup and monitoring procedures, a required data log for flow volume and pump operations, and communication procedures for service interruption and re-initiation of operations. Although the design capacity of the diversion system is 29 mgd or 1,300 lps, the protocol recommends that pumps be shut down when the river, due to rain, exceeds 23 mgd, 1000 lps.[3] The purpose of the shut-down is to prevent damage to the pumps from grit and sand carried by stormwater. Once post-wet-weather flows fall back below 23 mgd, CESPT is directed to begin cleaning trash and sediment from the system in order to re-start the pumps. Unfortunately, transboundary flows also occur during dry-weather, due to blockages in the river channel caused by trash and sediment, lift station power outages and/or mechanical failures, and limited O&M practices. Identifying ways to reduce the length of time it takes to get the river diversion system back on-line following a storm event as well as to reduce the transboundary flows associated with these system failures are both goals of this study. However, because the river diversion system cannot be expected to manage all stormwater flows, untreated sewage will continue to reach the U.S. during storm events unless critical improvements are made to Tijuana's wastewater collection and treatment systems.

Transboundary Flow Analysis

The purpose of the **Transboundary Flow Analysis** was to estimate the benefits associated with each alternative by estimating an anticipated reduction in the days of transboundary flows experienced on an annual basis. For the purposes of this study, the number of days of transboundary flows associated with the existing or proposed capacity at the diversion infrastructure was established through a statistical analysis of transboundary flows reported at the IBWC flow gage. It is important to note that the volume of transboundary flows from the Tijuana River can reach levels of up to 9 billion gallons per day due to storm events, making it unrealistic to capture and eliminate all transboundary flows. Additionally, because beach closures/advisories are influenced by a myriad of factors, including flow volume, flow duration, level of river contamination, and direction and strength of currents; it was not possible, during this study, to determine the impacts of each alternative on reducing beach closures.[4] Therefore, findings related to a reduction in days of transboundary flows do not translate to an equal reduction in days of beach closures.

An important finding of the analysis is that improving the operational reliability of the existing diversion system infrastructure can significantly reduce the frequency of transboundary flows (measured by average number of transboundary flow days per year) in comparison to past operations. Coupled with reliability improvements, system capacity expansion could virtually eliminate dry-weather transboundary flows while reducing small wet-weather flows as well, when compared with historical patterns. From November 2009 to March 2016, for example, transboundary flows occurred on average 138 days per year. These flows are mostly associated with wet weather. Improvements in reliability to enable full compliance with the existing operating protocol would reduce this number to about 90 days per year – a 35% reduction. As subsequently described in this report and summarized in Table ES-1, storage, treatment, and conveyance system

[3] The analysis of diversion infrastructure technical alternatives presented in this report assumes adjustments to the operational protocol commensurate with the proposed improvements.

[4] Scripps Institution of Oceanography has developed a coastal plume tracking model for the estuary that could be used for such purposes. However, it was not available in time for this study.

infrastructure investments to increase diversion system capacity provide potential opportunities for further reduction in frequency of transboundary flows from historical conditions.

Table ES - 1. Transboundary flow days vs. diversion capacity, November 1, 2009 – March 9, 2016

PBCILA diversion capacity*	Average number of transboundary flow days/year
≤ 1,000 lps, no action (historical baseline)	**138**
≤ 1,000 lps	**90**
≤ 1,300 lps	**69**
≤ 1,500 lps	**58**
≤ 2,600 lps	**30**

*Other than the historical baseline, diversion capacities reflect a protocol-compliant operation, which, when analyzed using existing data (November 1, 2009 – March 9, 2016), result in the average number of transboundary flow days per year shown.

Diversion System Infrastructure and Operations Diagnostic

The **diversion system infrastructure and operations diagnostic**, described in Section 2.2 of this report, presents findings of Arcadis' site visits, interviews, and condition assessment of 170 components of the diversion system. In general, the following contributory factors to transboundary flows were diagnosed:

- **Limited personnel:** For operation and maintenance, CESPT has a total of 12 mechanics and two electricians for 148 sites (20 treatment plants, 80 drinking water facilities and 48 lift stations). It is important to note that, while available resources are stretched to operate the system, the existing personnel are very knowledgeable, dedicated and creative in their efforts to maintain the best operating results possible.
- **Limited O&M budget:** It appears that the annual O&M budget is approximately one-third of the amount requested annually.
- **Limited preventive maintenance practices:** Based on site observations and the limited personnel and budget allocated to the system, preventive maintenance of the system appears to be minimal.
- **High-risk physical and performance conditions:** Site visit observations noted deteriorated construction material, evidence of unaddressed mechanical failures, a lack of general site maintenance, as well as the absence of a back-up system in the event of power outages.

Even without an increase in infrastructure capacity, developing and implementing best management practices, hiring sufficient personnel and allocating an adequate budget would improve the reliability of operations and, based on historical data, would **decrease transboundary flow days to less than 95 days/year on average.** The resulting flows would be, by definition, wet-weather flows.

Twenty of the vertical assets evaluated and specific to the diversion system displayed conditions compatible with placement into the two highest risk groups for failure considered in the methodology.[5] Many of the facilities appeared to be in poor states of repair and in need of replacement, including piping, gate, check, plug, and air release valves, pumping, electrical equipment, and motor control centers (MCC) at PBCILA, PB1A and PB1B lift stations. Some of the observed defects at the lift stations include:

- Deteriorated construction materials
- Inefficient intake location and configuration
- Insufficient sediment trapping upstream of the intake
- Inadequate intake screen design for debris
- Lack of mechanical intake debris and sediment removal systems
- Lack of backup power supply
- Lack of stored supplies or equipment and personnel shortages to address mechanical failures in a timely manner
- Inadequate power supply at all lift stations

While some assets may benefit from repairs, this effort would only achieve a short-term solution, with the assets most likely needing to be replaced in the near future. The investment cost to replace those priority assets only on key diversion system facilities is estimated at just over US$8 million as shown in Table ES-2. CESPT has already implemented some of the identified investments, including the purchase of a back-up power supply for PBCILA and two new pumps for PB1A.

Table ES - 2. Estimated Replacement Cost of Vertical Assets

Facility	Asset type	Replacement cost (USD)
PBCILA	Electrical	$ 450,000
	Mechanical	$ 2,830,000
	Structural	$ 520,000
PB1A	Structural	$ 400,000
	Mechanical	$ 1,750,000
PB1B	Structural	$ 460,000
	Mechanical	$ 1,750,000
		$ 8,160,000

[5] Vertical assets consist of the electrical, mechanical and structural components of facilities typically constructed above ground or accessible from above ground.

In addition, more than US$17 million is required to replace linear assets in the diversion system where the remaining useful life is estimated to be less than three years.[6]

Table ES - 3. Estimated Replacement Cost of Linear Assets

Location	Remaining useful life	Replacement cost (USD)
PBCILA intake	3	$ 55,000
Gravity main from PBCILA intake	3	$ 2,000,000
International Collector	2.85	$ 15,000,000
		$ 17,055,000

With the exception of the International Collector, the above investment needs are included in the costs of implementing the technical alternatives proposed to address transboundary flows. The International Collector, while not a specific component of the diversion infrastructure, is critical to the overall function of the utility's collection and conveyance system and is located adjacent to the border. The Study also estimates a repair cost for this asset of US$9 million, which would include a "cure-in-place" construction method. Further analysis is required to determine whether this option would be a viable solution for preventing failure of the asset, which could cause a significant spill of raw wastewater into the U.S.[7]

Completing both the Transboundary Flow Analysis and Infrastructure and Operation Assessment was an essential step for defining the baseline information needed to determine potential infrastructure investments that could improve management of the diversion systems for northbound flows in the Tijuana River.

Evaluation of Technical Alternatives

The **evaluation of technical alternatives,** described in Section 3 of this report, documents the performance of fourteen alternatives designed to reduce transboundary flows from the existing (no-action) alternative. Alternatives are categorized as follows:

- **Category 1 – No Action**
  - 1a. No Action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016 up to 1,000 lps (23 mgd)
- **Category 2 – Optimize existing diversion facilities in Mexico**
  - 2a. Diversion of all Tijuana River flows up to 1,000 lps
  - 2b. Allow diversions up to 1,300 lps (29 mgd) and improve reliability

[6] Linear assets are those infrastructure components typically constructed at or below ground level in a linear direction and are often not accessible without unearthing materials or using video equipment to assess internal infrastructure conditions.

[7] The International Collector has been selected for funding from EPA's Border Water Infrastructure Program. Project development activities including an alternative analysis to determine the best option to improve this critical wastewater conveyance infrastructure.

2c. Added detention storage upstream of PBCILA in combination with 2b improvements up to 1,300 lps (29 mgd)

- **Category 3 – Expansion of existing diversion facilities in Mexico**
  3a. Diversion system expansion in Mexico up to 2,600 lps (60 mgd)

- **Category 4 – New diversion facilities in the U.S. up to 1,500 lps (35 mgd)**
  4a. New lift station to discharge directly to the South Bay Ocean Outfall (SBOO) without treatment
  4b. New lift station to discharge at SBIWTP for primary treatment only
  4c. New lift station to discharge at SBIWTP for full treatment
  4d. New lift station to discharge at Point Loma WWTP
  4e. Gravity flow to the SBOO

- **Category 5 – Combination of diversion facilities in the U.S. and Mexico up to 1,500 lps (35 mgd)**
  5a. Gravity reclaimed water pipeline from Tijuana's WWTP to SBOO
  5b. Gravity reclaimed water pipeline system from Tijuana's WWTPs to Point Loma WWTP
  5c. Gravity reclaimed water pipeline system from Tijuana's WWTPs to Punta Bandera

  5d. New lift station to divert flows in the U.S. to the Primary Effluent Return Connection (PERC) and treatment at SAB WWTP up to 1,500 lps (35 mgd)

For each alternative, required improvements and equipment or system component replacements were defined, capital[8] and operations and maintenance (O&M)[9] costs estimated, and reduction of transboundary flow days calculated and compared with historical operational data from November 2009-March 2016. To invite input from interested parties, the technical alternatives were presented to the public stakeholders and Core Group on August 28, 2018. Proposed performance measures for evaluation of technical alternatives were also presented and explained, including cost, number of transboundary flow-day reductions, and feasibility of implementation.

Considering stakeholder input and after further analysis of the alternatives, in December 2018, updated information related to the investment options was presented to the Core Group. In addition to refining cost and technical definitions, the following changes were made to the list of alternatives:

- Alternative 4e, using a gravity line in the U.S. to convey flows from Mexico to the South Bay Ocean Outfall (SBOO), was eliminated because it would not be technically feasible to meet the required grade for gravity conveyance given the topography for the infrastructure alignment.
- Alternative 2c, using inflatable dams in the Tijuana River Channel in Mexico to manage the volume and release rate of flow past the PBCILA intake, was eliminated because the Core Group

[8] Capital costs are planning-level estimates, include 30% contingency and reflect U.S.-side labor and material costs. Capital costs for infrastructure in Mexico will be updated in consideration of local implementation costs for the final report.
[9]US-side options are anticipated to operate only during failures of the diversion system in Mexico or when wet-weather flows are less than 1,500 lps (35 mgd). O&M costs assume the diversion infrastructure in Mexico will continue to divert dry-weather flows, as currently operated; therefore, O&M costs for the technical alternatives located in the U.S. include the existing O&M costs for the No Action alternative plus the O&M costs for the new U.S.-side infrastructure, which is estimated to be in operation for less than 100 days per year.

determined that this alternative would most likely face insurmountable obstacles for implementation, including safety concerns.

- An additional technical alternative was identified and added to the list. This option (4f) would use a single inflatable dam on the U.S. side of the Tijuana river, which would formalize an existing practice of using sandbags/soil for the same purpose; a practice that has been found to be effective in controlling relatively low excess dry-weather flows not captured by the existing diversion infrastructure in Mexico.
- An additional option to Alternative 4b was identified and included in the final evaluation. This component involves treatment of wastewater flows at the South Bay Water Reclamation Plant (SBWRP), with a limited available capacity of 2.5 mgd. Flows up to 2.5 mgd from a new U.S.-based lift station could be conveyed to SBWRP.

Further screening of the fourteen alternatives reduced the list shown in Table ES-4 to the six highest ranking investment options in Mexico and the U.S. for flow diversion. These alternatives can significantly reduce the number of transboundary flow days experienced annually, from 138 days per year on average (38 % of the time) currently, to between 30 and 90 days per year (8 and 25% of the time, respectively) depending on the alternative implemented.

The purpose of this study is to provide decision-makers on both sides of the border with technically feasible alternatives that have the potential to reliably address the dry-weather flows in the Tijuana River, in accordance with the binational agreement established by Minute 283. It is important to note that the study does not offer a single recommendation and that the implementation of any of these alternatives must be followed with a detailed feasibility study, preliminary engineering, environmental assessment, final design, specifications and opinion of probable construction cost.

Table ES - 4. Top Investment Options.

Category		Alternative	Description	Targeted diversion flow capacity[1]	Capital cost[2]	O&M cost	Average trans-boundary flow days/yr	Comments
No Action	1a	No Action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016	Existing facilities and historical diversions	23 mgd 1,000 lps	$0	$2.7 M/yr	138	
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	2a	Optimize Existing Facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps	River intake and lift station systems improvements (PBCILA, PB1A&1B) for reliable diversion of Tijuana River flows in accordance with existing operational protocol	23 mgd 1,000 lps	$16 M	$4.35 M/yr	90	- Improves capacity for full system operations - Built-up sludge and sediment will be removed from wet wells and influent channels, restoring needed capacity. - Improves operational flexibility. - Increases reliable operations for diversion of all dry-weather transboundary wastewater flows.
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	2b	Optimize Existing Facilities with Improvements: Allow diversions up to 1,300 lps and improve reliability	River intake and lift stations (PBCILA, PB1A&1B) additional equipment, backup power supply, removal of silt and trash, and operational protocol modified to allow diversion of Tijuana River flows up to 1,300 lps	29 mgd 1,300 lps	$24.5 M	$4.95 M/yr	69	- Increase the reliability of the diversion system. - Adds new capability to continue operations during small storm events and quick start-up of equipment post-storm - In-take improvements for sediment and debris removal protect upstream equipment and reduce manual labor . - New generators mitigate interruptions in electricity service
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	3a	Diversion Capacity Expansion: Diversion system expansion in Mexico	Double the nominal capacity of diversion intake, PBCILA, and PB1A&1B lift stations, and modify operational protocol to allow diversion of Tijuana River flows up to 2,600 lps	60 mgd 2,600 lps	$110 M	$6.59 M/yr	30	- In-take improvements for sediment and debris removal protect upstream equipment and reduce manual labor. - New generators mitigate interruptions in electricity service. - Provides additional flexibility in operation. - Additional capacity is only required during storm events (approximately 50 days average per year), resulting in O&M challenges.
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4a	New U.S. Diversion Infraestructure: New lift station to discharge directly to SBOO without treatment	New concrete diversion structure, a 35-MGD lift station to tie into SBOO without additional treatment.	35 mgd 1,500 lps	$27.5 M	$5.5 M/yr[3]	58	- Establishes a redundant diversion capacity. - To be used if operations fail in Mexico and/or for small storm events, upto 1,500 lps. - Typical lift station design with familiar operation requirements. Designed for improved water quality. - Includes physical and chemical removal of some sediment. - Undefined terms: Owner/operator? Income source to support operations? Regulatory compliance (CWA) / exception for water quality exceedances?
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4b	New U.S. Diversion Infrastructure: New lift station to discharge at SBIWTP for primary treatment only *OPTION: Discharge at South Bay Reclamation Plant*	New concrete diversion structure, a 35-MGD lift station with primary treatment at SBIWTP, blending with full treatment discharges.	35 mgd 1,500 lps	$48 M	$8.9 M/yr[3]	58	- Same benefits and concerns as 4a. - Flows receive chemically enhanced primary treatment at SBIWTP, most likely avoiding water quality concerns for discharge; requires upgrades at SBIWTP. - Technical Feasibility: Will mix of water low in food sources affect the biological process? - Regulatory approval may be more favorable due to primary treatment.
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4f	New U.S. Diversion Infrastructure: Single inflatable dam or permanent weir on US-side of Tijuana River *OPTION: To be located in Mexico*	**Detention of small transboundary flows up to 100 lps (2.3 mgd). Flows will be pumped back to PBCILA once the diversion system goes back on-line.**	< 2.3 mgd < 100 lps	$8.6 M	$4 M/yr[3]	122	- To control dry-weather transboundary flows due to failure at diversion infrastructure - Formalizes a similar practice implemented by IBWC with effective results (temporary soil berm). - Detention of dry-weather flows to prevent small transboundary discharges due to breakdowns of system in Mexico. - Storage capacity of up to 16 MG or 60,000 m3. - Yearly maintenance required, includes sediment removal - Undefined terms: Owner/operator?

[1]Data available from November 2009 - March 2016. [2]Capital costs are estimated to reflect regional labor, materials are U.S. Based, and all include a 30% contingency. [3]U.S. Side options are anticipated to operate only during failures of the diversion system in Mexico or when wet-weather flows are less than 1,500 lps (35 mgd). O&M Cost assume that the diversion system in Tijuana, B.C., Mexico will continue to divert dry-weather flows, as currently operated; therefore, O&M costs for the technical alternatives located in the U.S. include the existing O&M costs for the No Action alternative plus the cost for the new U.S. side alternative.

Conclusions

This study highlights the following facts about the existing conditions of wastewater infrastructure in Tijuana and the River Diversion System:

- The condition of critical wastewater collection and conveyance infrastructure in Tijuana is poor. This has resulted in frequent pump failures and line breaks causing raw sewage to flow into the Tijuana River and adjacent canyons.
- Continued investment in Tijuana's wastewater infrastructure and O&M is critical to address the aged and deteriorated infrastructure vulnerable to pipe and pump failures, and inadequate wastewater treatment.
- Operation of the diversion infrastructure in Mexico has been unreliable, with frequent service interruptions due to blockages in the intake structure, lift station power outages, mechanical failures, limited operation and maintenance practices, and an inability to accommodate high trash- and sediment-laden flows associated with rain events.
- Dry-weather flows in the river are approaching the capacity of the diversion system. The raw sewage from infrastructure failures mixes in the river with natural flow from groundwater and treated effluent from upstream wastewater treatment plants. The system that diverts the combined flows into Tijuana's wastewater collection and treatment system is approaching its capacity. Without reuse of Tijuana's treated effluent, continued growth of wastewater generation will continue to exacerbate the problem.
- Temporary soil berms built by IBWC to contain flows in Mexico have been effective in reducing dry-weather transboundary flows caused by mechanical breakdowns, power outages, trash blockages at the diversion system. Similarly, permanent debris traps built by CESPT to contain trash and large items along the river prior to the diversion system have helped to avoid blockages at the in-take infrastructure.
- Beach closures are more related to number of days of precipitation and transboundary flows than precipitation amount or transboundary flow magnitude. The analysis indicates that, on average, there is a roughly one-to-one correspondence of beach closure days to transboundary flow days. This study identifies options to reduce the number of days of transboundary flows as well as to address the smaller flows in the river occurring after storms have receded, or when there is a breakdown in equipment. The study did not identify any feasible options to prevent transboundary flows greater than 60 mgd (2,600 lps).

The following conclusions may be drawn from the study regarding opportunities for reduction of transboundary flows:

- For a variety of reasons, Mexican-side alternatives for diversion and treatment of river flows are typically more cost-effective than U.S.-based alternatives. In addition, obstacles to permitting and O&M costs are less in Mexico, making Mexican-side alternatives easier to implement as well.
- Reliable operation of the existing diversion infrastructure in compliance with the existing operational protocol using 23 mgd (1,000 lps) diversion capacity in Mexico provides the lowest-cost approach and reduces annual transboundary flow – by 48 days per year on average (Alternative 2a).

- Reliable operation of diversion infrastructure and operational protocol with a capacity targeted at 29 mgd (1,300 lps) in Mexico provides the most cost-effective reduction in transboundary flow days – by half, or 69 days per year on average. (Alternative 2b).
- Projected O&M budgets for U.S.-side alternatives assume that Mexico will still be operating their system at full installed capacity and in compliance with applicable operational protocols, and that the U.S.-side alternatives would only be operated on an as-needed emergency basis.
- Upstream wastewater recycling would reduce the need to increase capacity of the diversion system. Diverting treated effluent, from both La Morita and Herrera-Solis WWTPs for reuse would reduce dry-weather flows in the Tijuana River.
- Diverted river flows and outflows at all lift stations should be metered continuously with a new Supervisory Control and Data Acquisition system and new central control room, with a commitment to share these data with the Core Group entities.
- Backup power supply is needed for reliable operation of the PBCILA, PB1A and PB1B lift stations.

In conjunction with diversion system improvements, it is also crucial that the following investments be made in Tijuana's wastewater system:

- Repairs to prevent pipeline failures, uncontrolled discharges, and inadequate treatment within the collection, conveyance and treatment infrastructure
- Investigations to identify causes and measures to mitigate uncontrolled discharges (fugitive flows) to the river or other low-lying areas
- Adequate and sustained funding of O&M budgets and programs

Finally, a comprehensive solution to reducing transboundary flows must include actions related to stormwater and solid waste management; however, neither is the responsibility of CESPT, nor will they be improved by the infrastructure investment options identified in this study.

Overall, the study presents the top six investment options to improve the effectiveness of the diversion system at the U.S.-Mexico border for management of dry-weather flows in the Tijuana River. Some of these options also offer the potential for diversion and treatment of small wet-weather flows resulting from storm events, as well as a more rapid response to post-storm event conditions. Implementation of diversion system operational and/or capacity improvements in conjunction with other collection, conveyance and treatment system improvements are needed to maximize the effectiveness of the diversion system.

1 INTRODUCTION AND STUDY OBJECTIVES

The Baja California region of Mexico includes the City of Tijuana, Playas de Tijuana and Playas de Rosarito, with an estimated population of 1.64 million[10]; it continues to be one of the largest urban areas in Mexico. The region's rapid growth has continued to put a burden on the operation, maintenance, and condition of public water/wastewater services and infrastructure. The State Commission of Public Services of Tijuana (Comisión Estatal de Servicios Públicos de Tijuana, CESPT) has conducted improvements to potable water distribution, wastewater collection, and treatment in recognition of the increased demand for public water and wastewater services.

These efforts have increased the number of wastewater connections from 170,916 in 1997 to 569,211 in 2017, and improved service coverage from 61.8% to 89.6%. However, the increase in wastewater collection corresponding to the expanded service area has led to overloading of the existing primary conveyance infrastructure, which has not been modernized or adequately maintained. The poor condition of critical infrastructure has resulted in frequent pump failures, line breaks, and untreated sewage that ultimately reaches the Tijuana River via tributary streams or overland flow. In addition, the topography of the Tijuana River watershed makes control and prevention of unsanitary flows from reaching the Tijuana River and other natural drainage systems difficult. As a result, untreated wastewater at times flows into the United States. Untreated transboundary flows also result in closure of San Diego beaches due to potential bacteriological impacts. Similar to the municipalities and government agencies across the U.S., the efforts from CESPT alone are not sufficient to address all of the wastewater and stormwater needs due to the many complexities within the region including topography, weather, aged infrastructure, operation and maintenance (O&M) resources, and population growth. The poor condition of critical wastewater collection lines, pumps, and the San Antonio de Los Buenos wastewater treatment plant, which have not been modernized or received sufficient maintenance, result in approximately 30% of Tijuana's wastewater entering the river and/or ocean without treatment.

The combination of operational shutdowns at the existing diversion system infrastructure and heavy rain events during the region's monsoon season (December through January of every year) is causing unwanted flows to cross into the U.S., which may result in beach closures. During rain events in 2017, 25 transboundary flow events were documented as spill reports by the U.S. Section of the International Boundary and Water Commission (USIBWC), with the largest event estimated at 143 million gallons from a major wastewater interceptor. Appendix A provides a summary of Tijuana River transboundary flow reports.

The Tijuana River watershed, shown in Figure 1-1, has a drainage area of 1,724 square miles, approximately two-thirds of which is in located in Mexico. The River flows through the City of Tijuana and the Tijuana River National Estuarine Research Reserve (TRNERR), discharging to the Pacific Ocean in San Diego County, California. High elevations within the Basin are shown in red in Figure 1-1, with the lower elevations graduating from yellow, green, and blue to purple at the River estuary. The River channel is concrete-lined from nine miles upstream of the U.S. – Mexico border to a point approximately one-quarter mile prior to and downstream of the border. Tributaries to the Tijuana River include the Alamar River, which drains the City of Tijuana, and Rio Tecate, which originates in Tecate Baja California, Mexico. The City of Tijuana is the largest dry-weather flow contributor to the Tijuana River due to wastewater treatment plant (WWTP) discharges and other uncontrolled sources, including water/wastewater pipeline breaks, construction dewatering, residential use, other un-accounted sources. Combined flows crossing the international border become transboundary flows upon entering into San Diego County. Bacteria, sediment and trash conveyed by transboundary flows have caused

[10] Source: Mexican National Institute of Statistics and Geography, 2015.

the TRNERR to be listed as an “impaired” water body under Section 303(d) of the Clean Water Act and result in beach closures along the U.S. coast due to impaired coastal water quality.

Proactively, the USIBWC and the Mexican Section of the International Boundary and Water Commission (Comisión International de Límites y Aguas, Sección Mexicana [CILA]) recently adopted a Treaty Minute to the 1944 Colorado River Water Treaty (Minute 320, signed in 2015) aiming specifically to reduce bacteria, sediment and trash in the Tijuana River Watershed through bilateral cooperation. A previous USIBWC/CILA Minute (Minute 283, signed in 1990) required that the Government of Mexico to assure that “…there are no discharges of treated or untreated domestic or industrial wastewaters into [the] Waters of the Tijuana River that cross the International Boundary.”

Led by the North American Development Bank (NADB) and the United States Environmental Protection Agency (USEPA), this study proactively aims to improve diversion of flows from the Tijuana River as stipulated in both USIBWC Minutes. It is a bilateral effort to analyze transboundary flows, document existing diversion system problems contributing to transboundary flows, and evaluate alternatives for reducing transboundary flows. The major goal of this study is to identify options to reduce or eliminate dry-weather flows (subsequently defined) from Mexico into the U.S., and, when possible, partially reduce wet-weather flows as well.

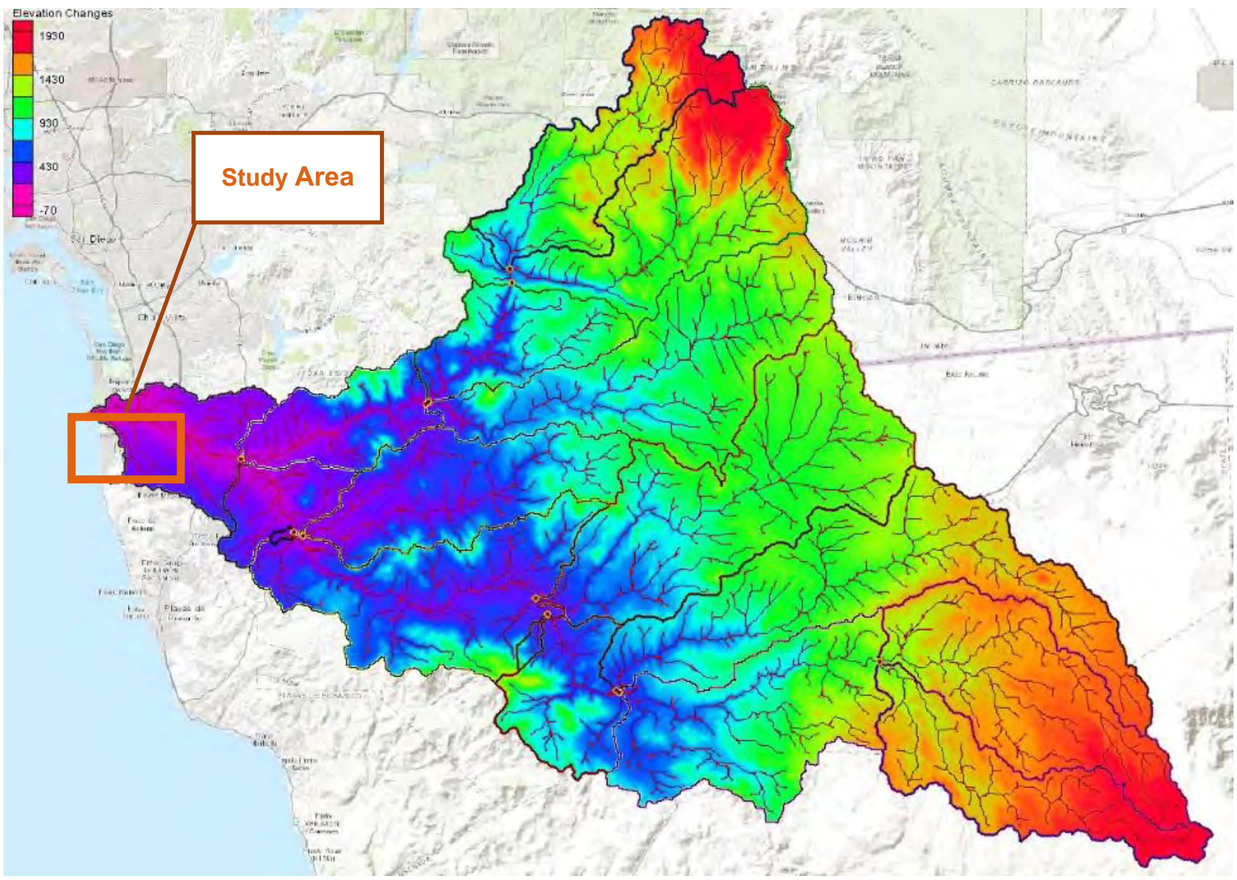


Figure 1-1. Tijuana River Basin

Arcadis U.S., Inc. (Arcadis) was retained by the NADB to complete the Tijuana River Diversion Study including (1) a **transboundary flow analysis**, (2) a **diversion system infrastructure and operations diagnostic**, and (3) an **evaluation of technical alternatives** identified for potential infrastructure investments in Mexico, in the U.S., or in both countries for mitigation of transboundary flows. The study was completed in coordination with the U.S. Section of the International Boundary and Water Commission (IBWC), the Mexican Section of the

International Boundary and Water Commission (CILA), the Mexican National Water Commission (CONAGUA), and the Tijuana water utility, Comisión Estatal de Servicios Públicos de Tijuana (CESPT). This group of agencies form the Study's Core Group for review of all study deliverables and participation in periodic meetings held in San Diego and Tijuana to present study progress and receive agency comments and input.

1.1 Diversion System Components

Based on Arcadis field assessments completed between June 18 - 22, 2018, we were able to observe the current operation of the diversion system and its components. The Tijuana River drains the Tecate and Alamar tributary basins, conveys treated wastewater (reclaimed water) from the La Morita and Herrera Solis WWTPs and urban runoff from the Tijuana River sub-basins. Tijuana River flows up to 23 million gallons per day (mgd) or 1,000 liters per second (lps) are categorized as dry-weather flows. Diversion and treatment of dry-weather flows and discharge to the Pacific Ocean are intended to be accomplished by the diversion system shown in Figure 1-2, which has been in operation since 1991. The system consists of lift stations, force mains, gravity mains, and treatment facilities, including the PBCILA lift Station (PBCILA) and intake, the PB1A and PB1B lift stations, Stewart's Drain, the South Bay International Wastewater Treatment Plant (SBIWTP), the San Antonio de Los Buenos ([SAB] WWTP), the International Interceptor, and the parallel conveyance pipeline system).

La Morita and Herrera Solis WWTPs shown in Figure 1-2 each discharge daily average flows of 6 mgd (250 lps) to the Tijuana River, which combine with urban runoff from the Alamar River averaging 6 to 8 mgd. Total Tijuana River flows at the PBCILA may reach up to 23 mgd (1,000 lps) during dry weather conditions. Under the current operational protocol, the system diverts up to 1,000 lps at the PBCILA intake, with gravity conveyance to the PBCILA lift station and pumping to the International Interceptor and SBIWTP for treatment, followed by ocean disposal through the South Bay Ocean Outfall (SBOO) or pumping to PB1A or PB1B for influent mixing and ocean discharge through the parallel conveyance pipeline system. The purpose of the operational protocol observance is to prevent damage to the pumps from grit and sand carried by stormwater. Once post-wet-weather flows fall back below 23 mgd, CESPT begins cleaning trash and sediment from the system in order to re-start the pumps.

As observed by the Arcadis team while performing the diversion system assessment visits, Figure 1-2 shows that dry-weather Tijuana River flows are diverted at the PBCILA intake and pumped by the PBCILA lift station to PB1A or to the International Interceptor. The Interceptor conveys 25 mgd (1,100 lps) on average to SBIWTP, with remaining flow from adjacent Tijuana service areas, averaging 23 mgd (1,000 lps), conveyed to PB1B. Flows from PB1B are pumped to the SAB WWTP, with limited capacity to partially treat approximately 10 mgd (450 lps). Excess flows are discharged as untreated wastewater to the Pacific Ocean via a conveyance canal that also carries discharges from PB1A. Combined untreated and partially treated discharges through the conveyance canal average 40 mgd (1,750 lps). The maintenance budget for SAB WWTP has been inadequate for the past 10 years, and the treatment capacity of the facility has been degraded by non-functioning aerators and sludge-filled lagoons. It appears that the intent of diversion system is to keep raw wastewater flows running to a treatment facility at all times, however during Arcadis site visits, this scenario was not observed.

As shown in Figure 1-2, the PBCILA, PB1A and PB1B lift stations are the primary facilities for diversion of Tijuana River flows, and their continuous operation is essential to prevent dry-weather transboundary flows. The current PBCILA operational protocol, however, prescribes shutdown of the diversion system when Tijuana River flow exceeds 1,000 lps to protect the pumps and equipment from damage due to trash, debris , and sediment. Arcadis' observations on conditions of these facilities are presented in Section 2.2

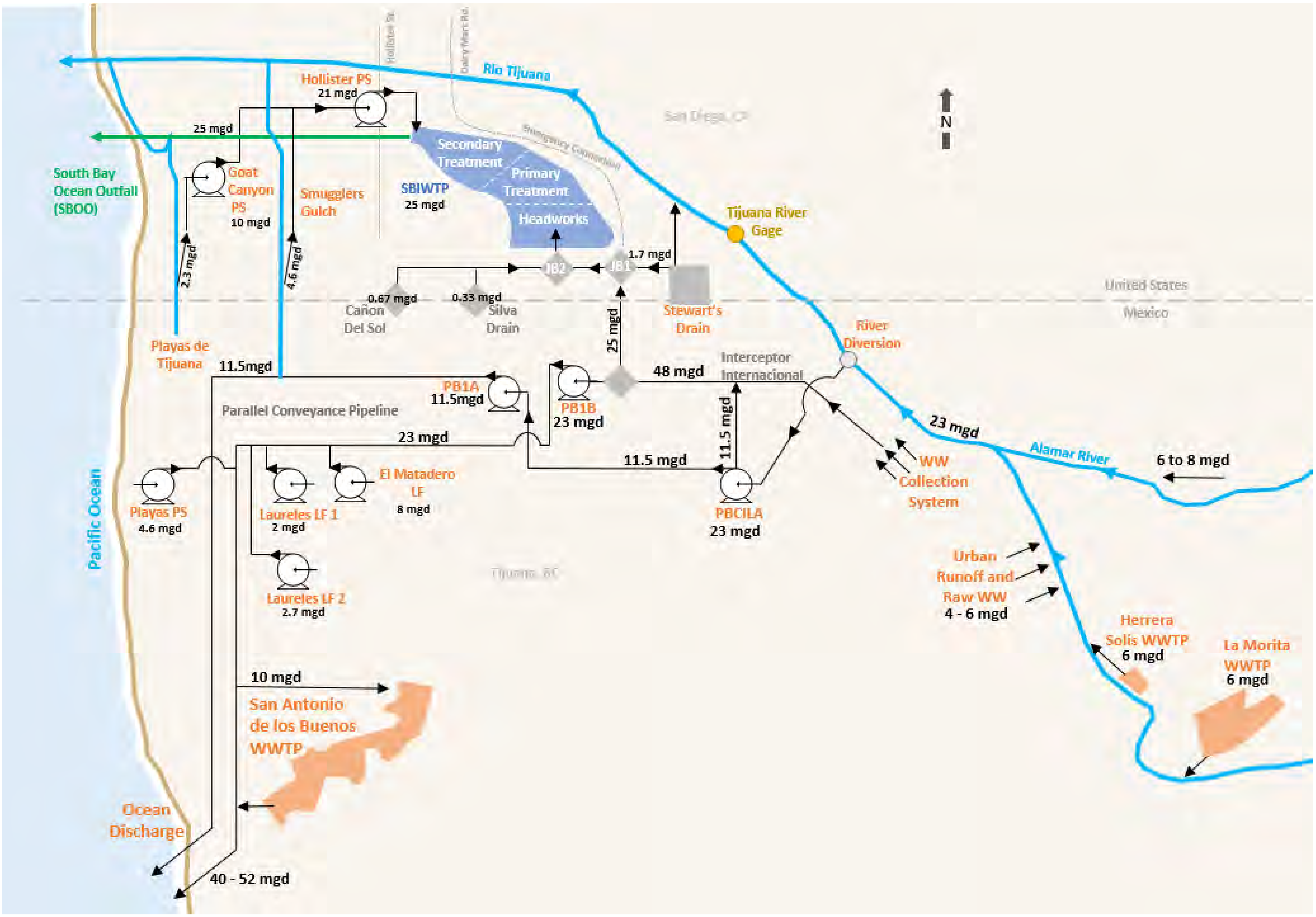


Figure 1-2. Tijuana River diversion system diagram (as observed by Arcadis team).

1.2 Flow Categories

For analysis of technical alternatives in this study, Tijuana River and Stewart's Drain flows were categorized as follows:

- **Dry-weather flows**[11] are daily flows occurring in the Tijuana River and include treated wastewater effluent from La Morita and Herrera Solis WWTPs, the Tecate WWTP (through the Alamar River), any uncontrolled spill occurrences from water or wastewater pipeline breaks, and urban runoff (discharges from residential, industrial, commercial, and other unaccounted-for sources) from the City of Tijuana. Currently, flows in the Tijuana River, during dry-weather, reach volumes nearing 1,000 liters per second (lps) or 23 million gallons per day (mgd) and less than 110 gallons per minute (gpm) (7 lps) in Stewart's Drain.
- **Wet-weather flows during storms** typically occur during the period of November through April and include the dry-weather base flows along with the additional influence of stormwater from regional rain events. During storm events, flows in the river usually exceed the operational capacity of the diversion system (1,000 lps), and the stormwater flows – laden with sewage, sediment and trash – flow into the United States and empty into the Tijuana River Estuary. These flows are not captured by the existing diversion system. For Stewart's Drain, wet-weather flows exceed 110 gpm (7 lps) into the Tijuana River. In general, precipitation events increase the volume of flows, often carry a higher sediment load and also create conditions for diluting the quality of the water, all of which must be considered when evaluating options for the diversion, treatment and/or disposal of transboundary flows that may be captured by infrastructure in the U.S.
- **Post-storm event flows** are flows that follow a storm event that typically exceed 1000 lps (23 mgd). These transboundary storm-water-influenced flows can continue for days and weeks following a storm event. Due to current operational limitations, operations of the diversion system in Mexico are slow to startup and, in practice, diversions are not re-initiated until Tijuana River flows recede below 1,000 lps.

Technically feasible alternatives will be evaluated to provide greater diversion capacity and operational reliability, thereby reducing the frequency of transboundary flows under dry-weather and post-storm event conditions. Some of the capacity expansion alternatives also enable diversion of minor wet-weather flows as well, with commensurate reduction of transboundary flows.

1.3 Treaty Obligations and Operational Protocol

1.3.1 Treaty Minutes

Minute 270 was signed in 1985 by USIBWC/CILA as the last paragraph of Article 3 of the United States-Mexico Water Treaty for Utilization of Waters of the Colorado and Tijuana Rivers, and of the Rio Grande. The USIBWC/CILA agreed that San Diego County in the U.S. and Tijuana, Baja California area in Mexico were to be given preferential attention in future planning and construction of infrastructure improvements to address transboundary flow and related water quality problems in the two countries. Minute 270 required Mexico to

[11] Dry-weather flows are flows not caused by rainfall and typically include treated effluent from wastewater treatment plants located in Mexico and "fugitive" untreated domestic and industrial wastewater discharges. For purposes of this study, dry-weather flows are defined as flows less than 1,000 lps (23 mgd), while wet-weather flows exceed 23 mgd and are generally associated with rainfall

improve potable water supply and distribution systems and expand sanitary wastewater collection capacity to meet year 2000 expected demand.

Minute 283, signed in 1990, provided a conceptual plan for an international solution that would provide proper collection, treatment, and final disposal of excess sewage coming into the U.S. from Mexico. Uncontrolled discharges from Mexico are normally intercepted by controls in the U.S. and returned to Mexico. However, due to outages at Pumping Plant No. 1 (now PB1A and PB1B), discharges are conveyed to the San Diego sewage collection and treatment system in conformance with stipulations in Commission Minute No. 222. The USIBWC and CILA Commissioners agreed that Mexico would share costs of construction, operations, and maintenance of an international wastewater facility Mexico to satisfy the requirements of Minute 270. The USIBWC Commissioner also noted that, even with a secondary treatment facility, a deep ocean discharge at a point to be selected upon completion of oceanographic studies for final disposal of effluent.

Seventeen recommendations were adopted and presented by USIBWC and CILA for the approval of the two governments. The first two require Mexico to fund construction, operation, and maintenance of the international treatment plant (SBIWTP) and the sewage collection system mandated by Minute 270. The 3rd, 5th, and 6th recommendations obligate the U.S. to construct a collection and pipeline system with a capacity to convey at least 25 mgd (1,100 lps) of sewage to SBIWTP, and construction, operation, and maintenance of a deep ocean outfall with the capacity to discharge treated sewage from SBIWTP. The 7th, 8th, and 11th recommendations require joint U.S.-Mexico funding of final design, construction, operation, and maintenance of the SBIWTP, and that both governments reserve the right to dispose of treated and untreated sewage within their own territories.

Minute 298, signed in 1997, focuses on four principal elements of proposed works certified by the Border Environment Cooperation Commission – the pumping plant, transboundary connection to the SBIWTP, the conveyance system, and rehabilitation of the SAB WWTP. The present costs of the parallel pumping and disposal system were estimated at $16 million; construction of the SAB WWTP was estimated at $2.2 million excluding design and value added tax.

Under Minute 298, the Government of Mexico and the state of Baja California are responsible for design and construction of all work done in Mexico. The U.S. is responsible for design and construct of the conveyance line in the U.S. from the international boundary to the SBIWTP under the general supervision of the USIBWC.

There are 11 recommendations purposed under Minute 298, two of which obligate the Government of Mexico. Recommendation 5 states that all the work done in Mexico will be the responsibility of Mexico and the state of Baja California. Recommendation 6 states that, once work is completed, CESPT will operate and maintain the pumping and conveyance system.

Minute 320, signed in 2005, refers to Articles 16, 3, and 24 paragraph (a) of the United States-Mexico Treaty for Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande. The Commissioners noted that stakeholders on both sides of the border were interested in a binational dialogue to identify joint cooperative opportunities on transboundary issues existing on the Tijuana River Basin. Based on this finding, the Commissioners created the Binational Core Group, consisting of representatives from the Commission, federal, state, and local governments, and non-governmental organizations from both countries. Issues raised included flood control, water quality, control of wastewater discharges, climate change, environmental protections, civic participation, sediment and solid waste deposition in the transboundary channels, and other related issues. A major issue of concern for both USIBWC and CILA was the transport of sediment, trash, and other pollutants across the border by stormwater flow, and the degradation of Tijuana River water quality as a result.

1.3.2 PBCILA Operational Protocol

The operational protocol for the PBCILA intake and lift station is presented in Appendix B and summarized as follows:

- **Phase 1 – dry-weather flow, normal operation:** This protocol is followed when flows are within the Tijuana Riverbanks and below the PBCILA intake capacity of 23 mgd or 1,000 lps. During the dry season, i.e. between May and October, normal operating procedures include stationing a two-person crew at the PBCILA intake and lift station for monitoring at 2 to 3 hours intervals and manual intake clearing as needed. A log of hourly pumping is maintained for determination of total daily station influent.
- **Phase 2 – dry-weather flow, atypical operation:** This protocol is followed when Tijuana River flows are within banks but exceed intake capacity. The PBCILA lift station remains in operation during high river flows surpassing the PBCILA intake diversion capacity of 29 mgd or 1,300 lps, which may occur from pipeline breaks within the city of Tijuana. CILA-MEX is to report higher flow levels to USIBWC when they surpass the intake capacity.
  - Manual intake cleanup and monitoring at 2-hour intervals
  - Depth measurements at the Tijuana River Channel upstream of the PBCILA intake
  - Manual activation of up to three pumps; pumping data are used to record daily inflows; pump run times and daily inflows are transmitted to CESPT for diagnosis and resolution of lift station problems.
- **Phase 3 – wet-weather flow operational protocol 1:** This protocol applies to small and intermittent rain events. The pumping rate is increased while sediment deposition levels are monitored at the wet well, with manual intake monitoring and cleaning as necessary every 1 to 2 hours. There is a possibility for transboundary flows to occur while operating under this protocol.
- **Phase 4. Wet-Weather Flow Operations Protocol 2:** This protocol is followed during higher-intensity rain events, typically when flows in the Tijuana River at the intake exceed 1,000 lps, accompanied by buildup of trash and sediment. When this occurs, CESPT closes the PBCILA intake and shuts down the lift station and informs CILA-MEX accordingly, which then informs USIBWC. The lift station is brought back into operation once Tijuana River flows fall below 1,300 (29 mgd) when no rain is forecast during the next 3 days. CESPT informs CILA-MEX of resumption of operation at PBCILA and basis of decision, which subsequently informs USIBWC of the resumption in operation.

The PBCILA Operational Protocol limits the Diversion System operations to flows under 23 mgd (1,000 lps), it will be important for USIBWC, CILA and the rest of the Core Group to review the protocol to permit flows at the flow volumes presented within the alternatives presented in this study.

Figure 1-3 displays PBCILA current operations as they attempt to follow these protocols from November 2009 to March 2016. The cyan-shaded areas in the top graph represent PBCILA daily diversions (pumping), and the gray cross-hatched areas indicate times when pumping is less than Tijuana River flow at the intake. The lower graph shows remaining (transboundary) flow after diversions. The figure shows PBCILA diversions ranging between 500 and 1,200 lps (averaging 636 lps) when the system is operating. Diversions overall (including non-operational periods) average 481 lps. It may be observed in Figure 1-3 that dry-weather flow, atypical operation (Phase 2 protocol) has not occurred since 2011.

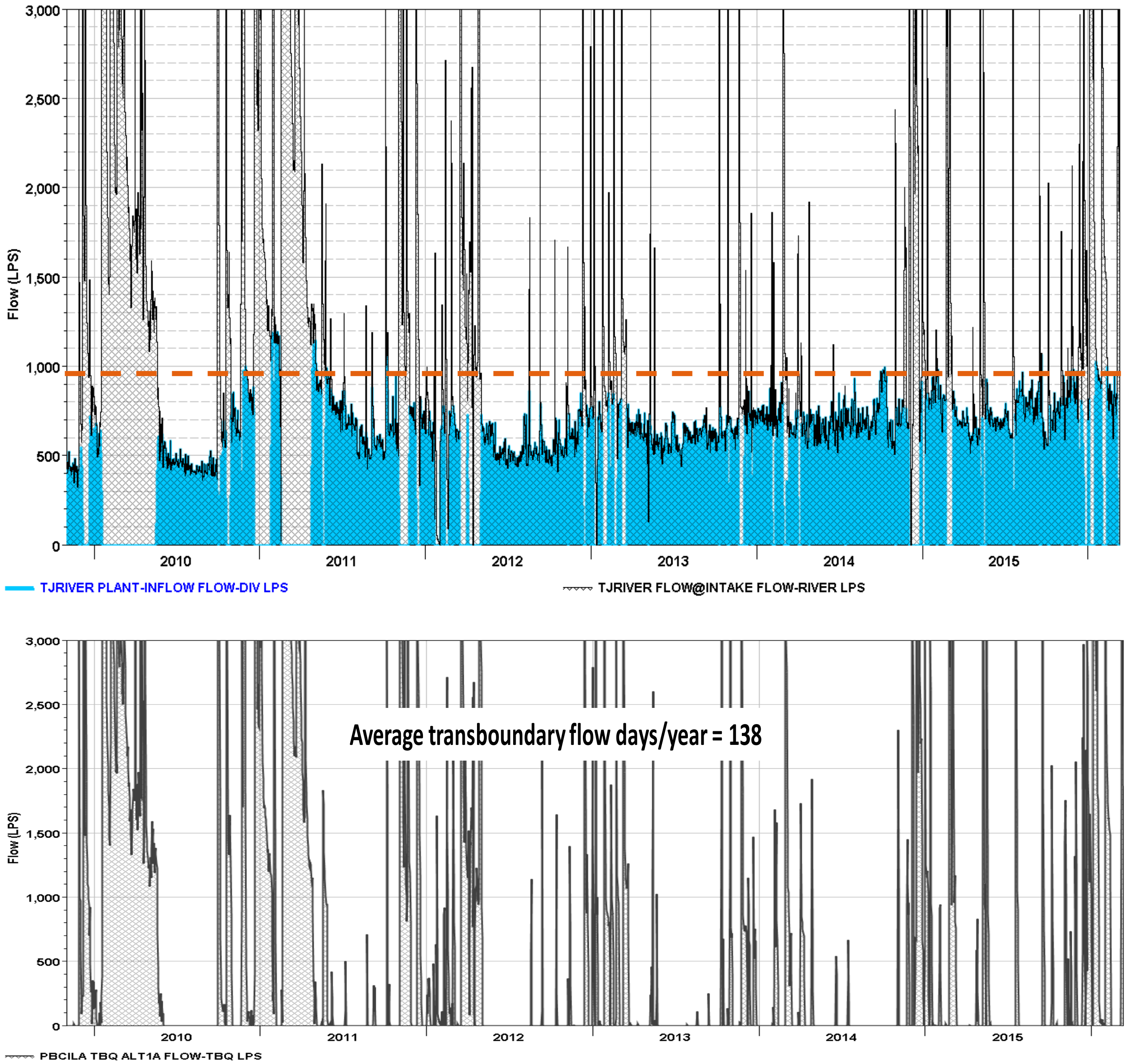


Figure 1-3. Existing (baseline) conditions, November 2009 – March 2016: (Top) Tijuana River daily flows at PBCILA intake (gray crosshatched) and flow diversions (cyan-shaded); (Bottom) Tijuana River flow at International Boundary (USIBWC Gage 11-0133.00)

1.4 Large Storm Flow Accommodation

The current agreement between the U.S. and Mexico is to divert dry-weather flows from the Tijuana River Channel at the PBCILA intake (up to 23 mgd or 1,000 lps), prior reaching the international border. This report focuses on evaluating alternatives that will improve the functionality of the diversion system under dry- and post-wet-weather conditions. While truncated in Figure 1-3, wet-weather flows can be quite large, some measuring up to 9 billion gallons per day (394 cubic meters per second [m^3/s]). Depending on the intensity and duration of rainfall, the time required for the flows in the river to recede below 23 mgd (1,000 lps) following events, when the PBCILA lift station can be restarted and flows are again diverted, can range from a few days to months (as shown by the gray areas in the top graph of Figure 1-3). Increased capacity to a level enabling diversion of large wet-weather flows is impractical., and the largest capacity expansion considered among the six alternatives presented is 60 mgd (2,600 lps). Sediment basins can also play an important role in controlling flows in excess of diversion system capacity from reaching the TRNERR and the Pacific Coast. Due to Tijuana's topography, its canyons naturally drain toward the international border, and the diversion system can do little to stem the large volumes of runoff flowing down to the river channel and into the U.S. Continued efforts to improve Tijuana's wastewater collection system will help to separate wastewater and storm water flows, ultimately reducing beach closures in the U.S. However, this would require significant investments and sustained bilateral coordination to continue diversion improvements.

According to CESPT,[12] Tijuana's wastewater collection and treatment covers 89.5 % of the Tijuana area, exceeding the national average in Mexico. However, the poor condition of critical wastewater collection lines, pumps, and the San Antonio de Los Buenos wastewater treatment plant, which have not been modernized or received sufficient maintenance, result in approximately 30% of Tijuana's wastewater entering the river and/or ocean without treatment. To reduce contamination downstream to the U.S., the USEPA, USIBWC, NADB and others have been collaborating with CESPT, Comisión Nacional del Agua (CONAGUA), CILA and other Mexican entities as a Core Group to improve wastewater collection and treatment throughout Tijuana since Minute 283 was established. These efforts recently include a SAB WWTP preliminary engineering study to define an appropriate technical alternative for the plant rehabilitation and a more appropriate updated treatment technology, additional pump trains in PB1A, backup energy in PBCILA, temporary berms and permanent debris traps within the Tijuana River Channel. Wastewater pipeline replacement by CESPT with support by NADB and USEPA include a 3-mile (4,503 meter) replacement of the Poniente Collector and an upcoming diagnostic of the International Collector to provide adequate capacity of some of the City's main wastewater gravity mains. Population projections estimate that by 2035 flows will surpass International Collectors capacity (Appendix C). CESPT is also investigating wastewater reuse throughout the City of Tijuana via public-private partnerships.

Transboundary flows and beach closures will continue to occur during and after large rain events that surpass the diversion system capacity. The continuous improvement of the wastewater infrastructure within the City of Tijuana should be considered essential to raw wastewater reductions and eventual elimination from the Tijuana River. Wastewater infrastructure will be improved through bi-national strategic planning, water and wastewater engineering support, quality assurance during construction, and adequate O&M implementation.

[12] CESPT – Sanitation and Water Reuse Master Plan for Tijuana and Playas de Rosarito, Baja California 2017 (Plan Integral de Saneamiento y Reúso del Agua en Tijuana y Playas de Rosarito, en El Estado de Baja California, 2017)

2 ANALYSIS OF CURRENT CONDITIONS

2.1 Transboundary Flow Analysis

2.1.1 Objectives

The purpose of the Transboundary Flow Analysis is to measure benefits associated with each alternative by estimating anticipated reduction in transboundary flows days experienced each year. The principal objectives of the analysis are to (1) identify the magnitude, frequency, and potential causes of transboundary flows, and (2) characterize the causes and impacts of transboundary flows. The analysis requires statistical analysis and determination of relationships between transboundary flows, natural Tijuana flows upstream of the U.S. – Mexico border, precipitation, and recorded flow diversions at the PBCILA intake and PBCILA Lift Station. Impacts of transboundary flows include impaired water quality at the TRNERR and closure of San Diego area beach due to pollutant discharges from the Tijuana River.

Specific questions the flow analysis is intended to address were defined in the scope of work as follows:

1. In the last 5 years, how often (days/year) have transboundary flows (at the Tijuana River International Boundary Gage) measured less than 1,000 lps, or exceeded 1,000, 1,300, 1,500, 2,000, and 3,000 lps? What is the frequency distribution (flow-duration relationship) of transboundary flows?
2. How often (days/year) have Tijuana River flow events under 1,000 lps resulted in transboundary flow due to failure or non-operation of the diversion infrastructure?
3. How many days of transboundary Tijuana river flows would have hypothetically occurred if:
    a. The existing infrastructure had no operational failures?
    b. The existing infrastructure were operated at full capacity of 1,300 lps?
    c. Diversion capacity of existing infrastructure were expanded to 1,500 lps?
    d. Diversion capacity of existing infrastructure were expanded to 2,000 lps?
    e. Diversion capacity of existing infrastructure were expanded to 3,000 lps?
4. What is the frequency and source of dry-weather flows in Stewart's Drain?

As described in Section 1.2 of this report, dry- and wet-weather Tijuana River flows are defined as follows:

1. Dry-weather – flows averaging up to 23 mgd (1,000 lps)
2. Wet-weather – flows in excess of 23 mgd (1,000 lps)

It is important to note that the volume of transboundary flows from the Tijuana River can approach levels of 9 billion gallons per day (394 cubic meters per second [m^3/s]) due to storm events, making it impossible to capture and eliminate all transboundary flows. Statistical methods were used because beach closures are influenced by both random and non-random variables, including frequency, intensity, duration, and areal extent of rainfall events, level of river contamination, and direction and strength of nearshore currents. As such analytical determination of impacts of alternatives on beach closures was not within the scope of this study.[13]

[13] Scripps Institution of Oceanography has developed a coastal plume tracking model for the estuary that could be used for such purposes. However, it was not available in time for this study.

2.1.2 Methodology

2.1.2.1 Methods

The following methods were applied in the transboundary flow analysis and development of statistical relationships between PBCILA diversions, precipitation, and beach closures:

1. Flow-duration and screening analysis – used to determine frequency (days/year) of transboundary flows and PBCILA operational failures under dry and wet-weather conditions
2. Annual flow-frequency analysis – used to determine recurrence interval of annual peak transboundary flows
3. Time series conversion – used for daily to monthly, and daily to annual averages and cumulative transboundary flows, precipitation, and beach closure days
4. Linear regression – used for correlation of transboundary flow magnitudes and durations to precipitation, beach closure days to transboundary flows and precipitation
5. One-way analysis of variance (ANOVA) – used to identify differences in means of pre-1991 and post-1991 (pre- and post-CILA operation) transboundary flows and precipitation

Much of the time series database construction, management, mathematical, statistical and graphical analysis for this study was performed using the U.S. Army Corps of Engineers (USACE) HEC-DSSVue utility.[14] Flow-frequency analysis was performed using HEC-SSP,[15] or STATS.[16] Linear regression and ANOVA analysis were performed using Excel spreadsheets.

2.1.2.2 Data

Dated and time-series data available for this study include:

1. Daily and monthly transboundary Tijuana River flows measured at the USIBWC stream gage just downstream of the U.S. – Mexico border, 1962-2016
2. Daily and monthly precipitation gage records within the Tijuana River Basin upstream of the U.S. – Mexico border, various periods of record
3. Beach closure dates for the San Diego County Silver Strand, Carnation Avenue, Imperial Beach Pier, Seacoast, and Border Field Beaches
4. Daily Tijuana River diversion flows at the PBCILA plant, 2009-2016 (made available after September 2018)
5. 2015-2018 reports identifying dates and causes of Tijuana River, Stewart's Drain, Del Sol Canyon, Goat Canyon, and Yogurt Canyon spills

2.1.2.3 Assumptions

Assumptions, and definitions applicable to transboundary flow analysis are subsequently described as follows:

1. **Most recent period:** In place of the 'last 5 years' identified in the scope, the most recent period for which transboundary flow data were developed extends from November 1, 2009 through March 9, 2016. This is the most recent period for which daily transboundary flows (flows at the International Boundary

[14] USACE Hydrologic Engineering Center (HEC) DSSVue (2010). *Data Storage System Visual Utility Engine*, Version 2.0.
[15] USACE Hydrologic Engineering Center (HEC) SSP (2016). *Statistical Software Package*, Version 2.1.
[16] USACE Hydrologic Engineering Center (HEC) (1996). *Statistical Analysis of Time Series Data*.

Gage) and daily PBCILA diversions are simultaneously available, allowing Tijuana River flows upstream of the PBCILA intake to be calculated. These data were made available to Arcadis in September 2018.

2. **PBCILA wet-weather diversion protocols:** Operational Protocol 2 described above is designed to protect the PBCILA intake and pump station against sediment and debris during high-flow events. The protocol can also be defined based on Tijuana River flows and stages on lieu of rainfall, as follows:
   - **Rising river flow and stage at intake**: Pump station shutdown when Tijuana River flow at the intake approaches 1,000 lps
   - **Falling river flow and stage at intake**: Pump station restarted when Tijuana River flow at the intake falls below 1,300 lps.
3. **Operational failure of diversion infrastructure:** For purposes of this study, failure or non-operation is assumed to occur when diversions are less than plant capacity and less than Tijuana River flow at the PBCILA intake. Operational failures are assumed to be attributable to wet-weather operational protocols described above. With only sporadic Tijuana River spill reports available in 2015, statistically significant attribution of diversion failures to causes other than operational protocol (e.g. electrical or mechanical failure, river flow recorder errors, or operator errors) for the 2009-2016 period of analysis was not possible. Diversions less than plant capacity when Tijuana River flows exceed plant capacity are not considered to be operational failures, but pump station shutdowns prescribed by operational protocols when Tijuana River flow exceeds 1,000 lps were.
4. **Diversion capacity:** Diversion capacity is the nominal physical capability to divert Tijuana River flows assuming full function of the PBCILA intake and lift station without restrictions imposed by the operational protocol. Diversion capacity under the current operational baseline is assumed to be 23 mgd (1,000 lps). Under the current operational protocol, the diversion system is shut down when Tijuana River flow exceed 23 mgd (1,000 lps).

2.1.3 Findings

2.1.3.1 Frequency Distribution of Transboundary Flows

Figure 2-1 shows flow-duration curves for the Tijuana River upstream of the PBCILA intake (blue line), diversion flow (green line), and transboundary flow (red line), compiled using daily flow data from November 1, 2009 through March 9, 2016. Average number of days per year of transboundary flows (shown by the red line in Figure 2-1) are listed by category in Table 2-1.

The flow curves in Figure 2-1 show that most of the time, PBCILA had been diverting flows at 1,000 lps. When flows in the Tijuana River are 1,000 lps (23 mgd) or less, transboundary flows occur at an average of 60 days of the year. Spill reports (as in Appendix A) show transboundary days below 20 days per year from 2015 to 2018.

The same Figure 2-1 flow-duration curves show that when flows are above 1,000 lps (23 mgd) transboundary flows occur at an average of 78 days of the year. Total average transboundary flow days are identified as 138 per day on average using data from November 1, 2009 through March 9, 2016.

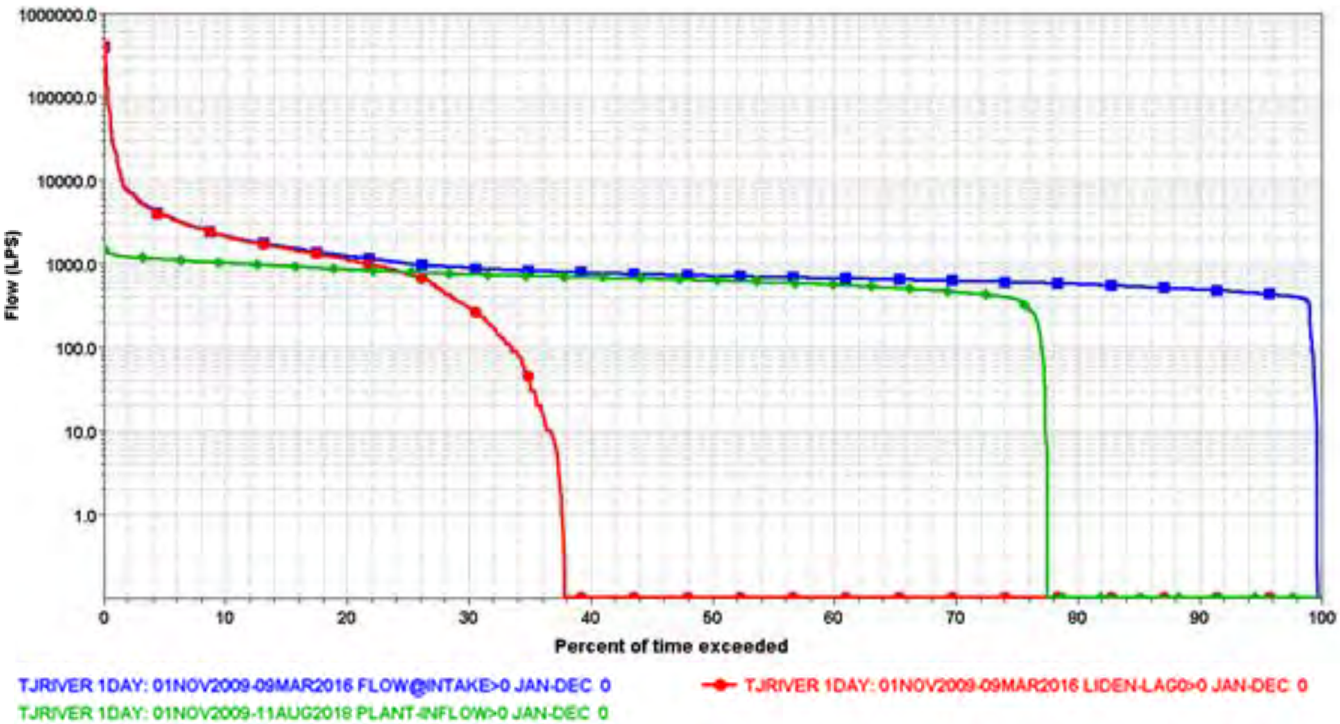


Figure 2-1. Tijuana River flow at PBCILA intake, diversion flow, and transboundary flow-duration curves, November 1, 2009 – March 9, 2016

Table 2-1: Transboundary annual flow-duration data, November 1, 2009 - March 9, 2016

Tijuana River flow (lps)	Average number of transboundary days (days/year)
< 1,000	60
>1,000	78
Total transboundary flow days	**138**

2.1.3.2 Low-flow Diversion Failure Statistics

Figure 2-2 shows PBCILA diversions (blue line) and transboundary flows (red line), when flows in the Tijuana River are less than 1,000 lps upstream of the PBCILA intake from November 1, 2009 through March 9, 2016. Data screening analysis revealed that Tijuana River diversions of 100 lps occurred approximately 9.4% of the time, averaging 34 days per year. Diversion deficits of 1 lps (assumed to be the smallest measurable flow) or more occurred up to 13.3% of the time, or 48 days per year on average. Transboundary flows less than 1,000 lps indicate operations are not fully in compliance with the current PBCILA operational protocol.

Figure 2-2 shows a relation of transboundary flow days with the 2015 sill reports at 15 days during that year.

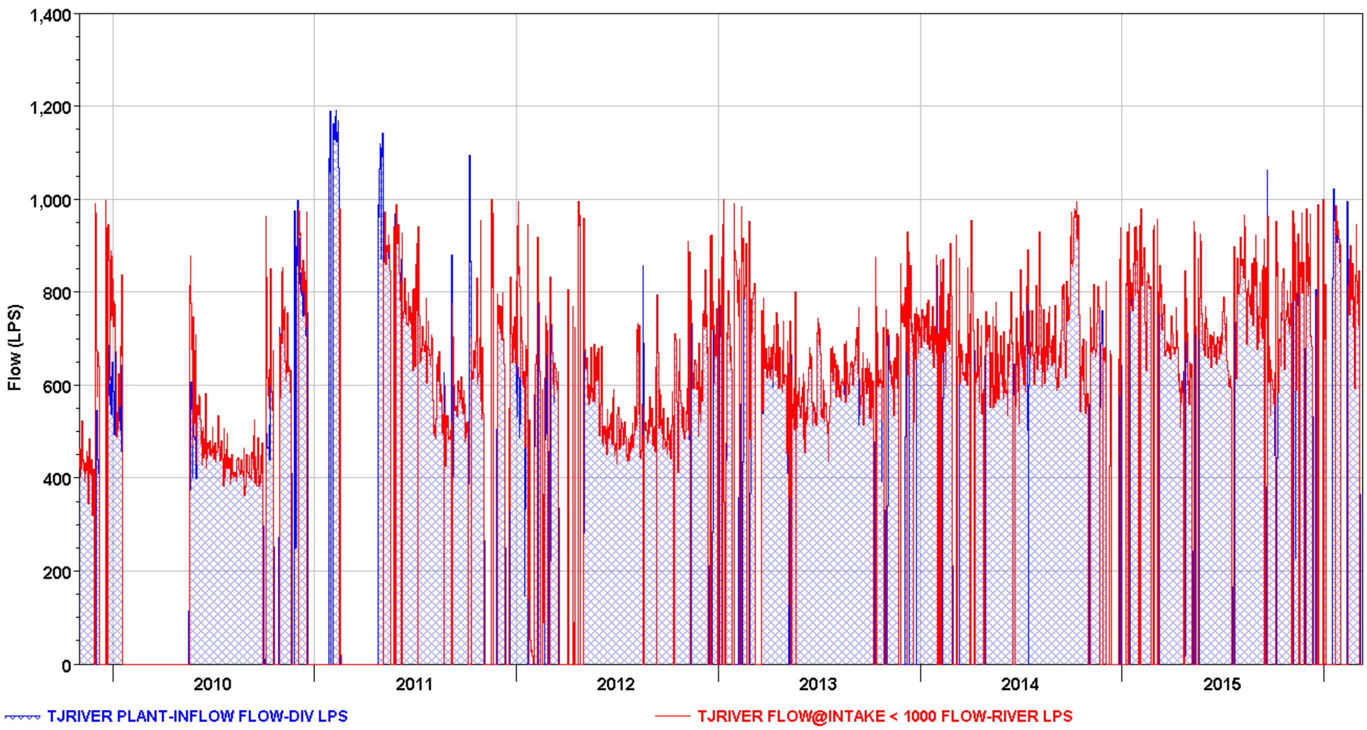


Figure 2-2. PBCILA diversions (blue line) and Tijuana River flows less than 1,000 lps at PBCILA intake (red line), November 1, 2009 – March 9, 2016

2.1.3.3 Full-Capacity and Protocol-Compliant Diversion Operation

Full-capacity operation assumes that diversions are always made up the PBCILA intake and lift station capacity of 1,000 lps (23 mgd) or flows at the Tijuana River, whichever is less. Protocol-compliant operation assumes diversions are made up PBCILA intake and lift station capacity when flows in the Tijuana River flow at the intake are less than or equal to PBCILA capacity, otherwise no diversions are made. Operational failure (or non-operation) was also previously defined for purposes of this study as diversions less than required by operational protocol. Figure 2-3 shows daily Tijuana River flows at the PBCILA intake (black, crosshatched shading) and diversions (cyan shaded) from November 1, 2009 through March 9, 2016 following current diversion protocols at existing installed diversion capacity (1,000 lps). Figure 2-4 shows daily Tijuana River flows at the PBCILA intake (black, crosshatched shading) and diversions (cyan shaded) from November 1, 2009 through March 9, 2016 with full-capacity operation as defined above. Volumes of transboundary flows and diversions are represented respectively by the black crosshatched area lying above diversion flow and the cyan-shaded areas below diversion flow shown in Figures 2-3 and 2-4.

Figure 2-3 shows that PBCILA diversion has reached up to 1,300 lps during 2011 and has remained at 1,000 lps or less from that point on until March 9, 2016.

Figure 2-4 shows an ideal PBCILA scenario when all flows below 1,300 lps are diverted at all times from the Tijuana River.

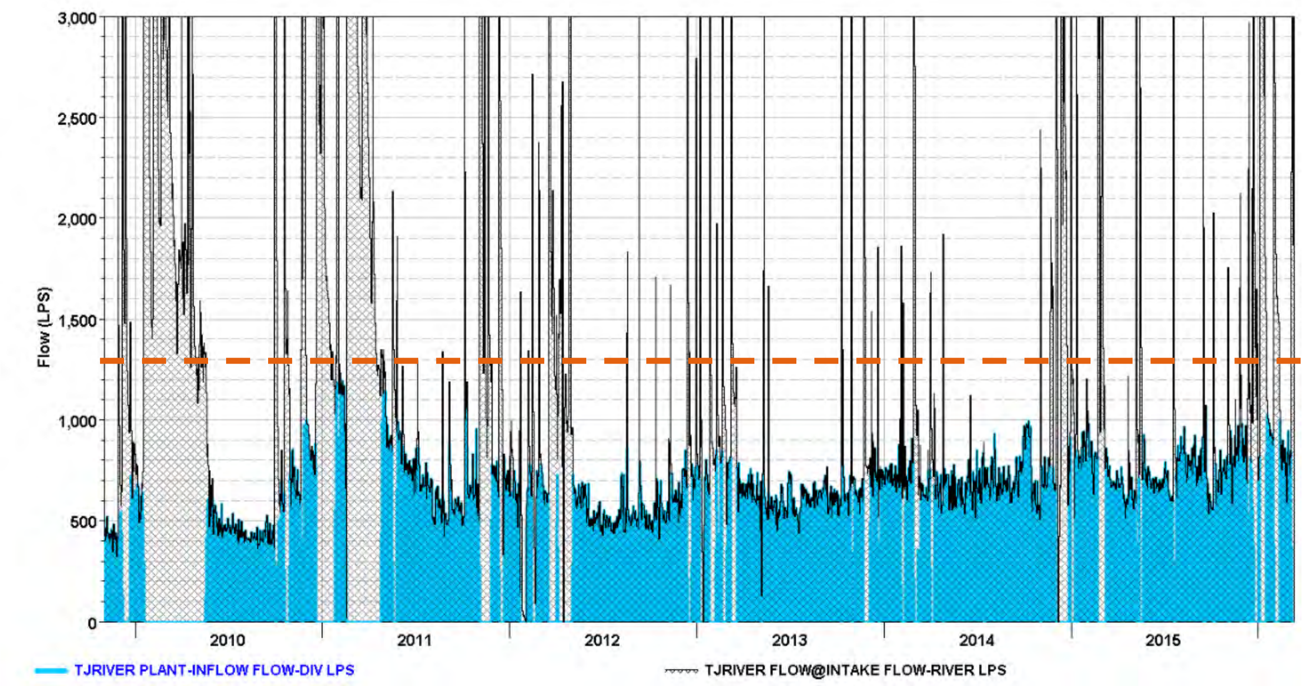


Figure 2-3. Daily Tijuana River flow at PBCILA intake and diverted flow following existing diversion protocol, November 1, 2009 – March 9, 2016

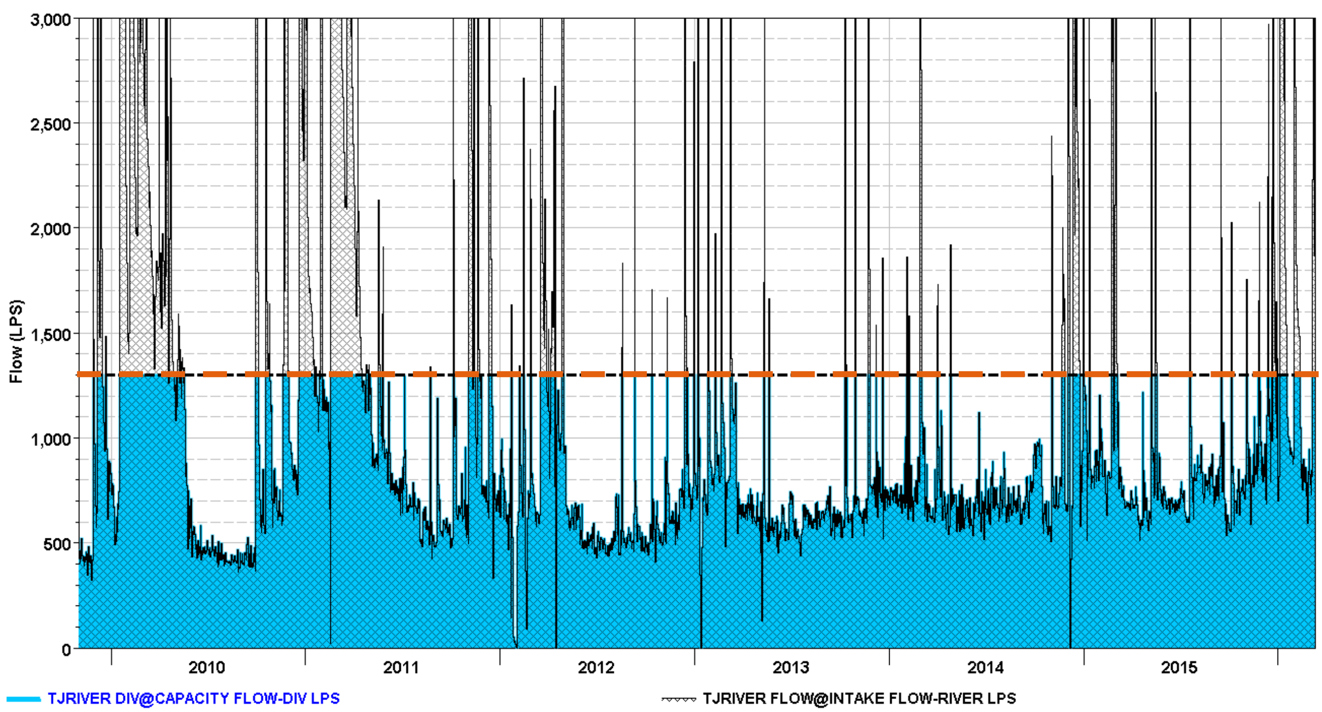


Figure 2-4. Daily Tijuana River flow at PBCILA intake and diverted flow with existing full-capacity (1,300 lps) operation, November 1, 2009 – March 9, 2016

Table 2-2 compares average number of days of transboundary flow per year for diversion capacity expansions with existing diversion capacity (1,000 lps) when operated under the current protocol, adjusted for installed capacity. Above a diversion capacity of 1,300 lps, the marginal reduction in number of days of transboundary flow (shown in Table 2-2) diminishes as installed capacity increases, due to the nearly vertical rise and fall of Tijuana River flows during high-flow events shown in Figures 2-3 and 2-4.

Table 2-2. Transboundary flow days vs. installed capacity and diversion protocol, November 1, 2009 - March 9, 2016

PBCILA diversion capacity[1]	Average number of transboundary flow days/year
≤ 1,000 lps, no action (historical baseline)	138
≤ 1,000 lps	90
≤ 1,300 lps	69
≤ 1,500 lps	58
≤ 2,600 lps	30

[1]Other than the historical baseline, diversion capacities reflect a protocol-compliant operation, which, when analyzed using existing data (November 1, 2009 – March 9, 2016), result in the average number of transboundary flow days per year shown.

2.1.3.4 Dry-weather flow in Stewart's Drain

The only data available for Stewart's Drain were four single-day spill event reports filed in 2016 and 2017. Determination of frequency and source of dry-weather flows in Stewart's Drain was not possible based on these data alone. The four reports listed causes of spills as un-recorded, power failure, line break, and operational miscommunication (Appendix A).

2.1.3.5 Influence of precipitation on transboundary flows

For purposes of correlation of transboundary flows with precipitation, flows were categorized as follows:

- **Low:** Transboundary flow less than 1.0 m^3/s (1,000 lps)
- **Medium:** Transboundary flow from 1.0 – 1.5 m^3/s (1,000 – 1,500 lps)
- **High:** Transboundary flow greater than 1.5 m^3/s (1,500 lps)

Data used for analysis of influence of precipitation on transboundary flow included daily flow at the Tijuana River International Boundary Gage from 1991 – 2016, the 25-year period since PBCILA was placed into operation. Also included were monthly precipitation depths at the La Puerta, Rio Tecate Station (021) within the Tijuana Basin upstream of the U.S.- Mexico border for the same period. Monthly precipitation data were aggregated to total annual values and regressed to number of days per year of transboundary flows in total and in the low, medium, and high categories described above. The raw data and computed coefficients of determination (R^2) are shown in Figure 2-5. Scatter plots and trendlines are shown in Figure 2-6. Coefficients of determination ranged from extremely poor (0.01) for low transboundary flows (less than 1,000 lps) to fair (0.62) for high transboundary flows (greater than 1,500 lps).

Figure 2-5 and 2-6 show that the is a good correlation between medium trasboundary flows and beach closures and precipitation.

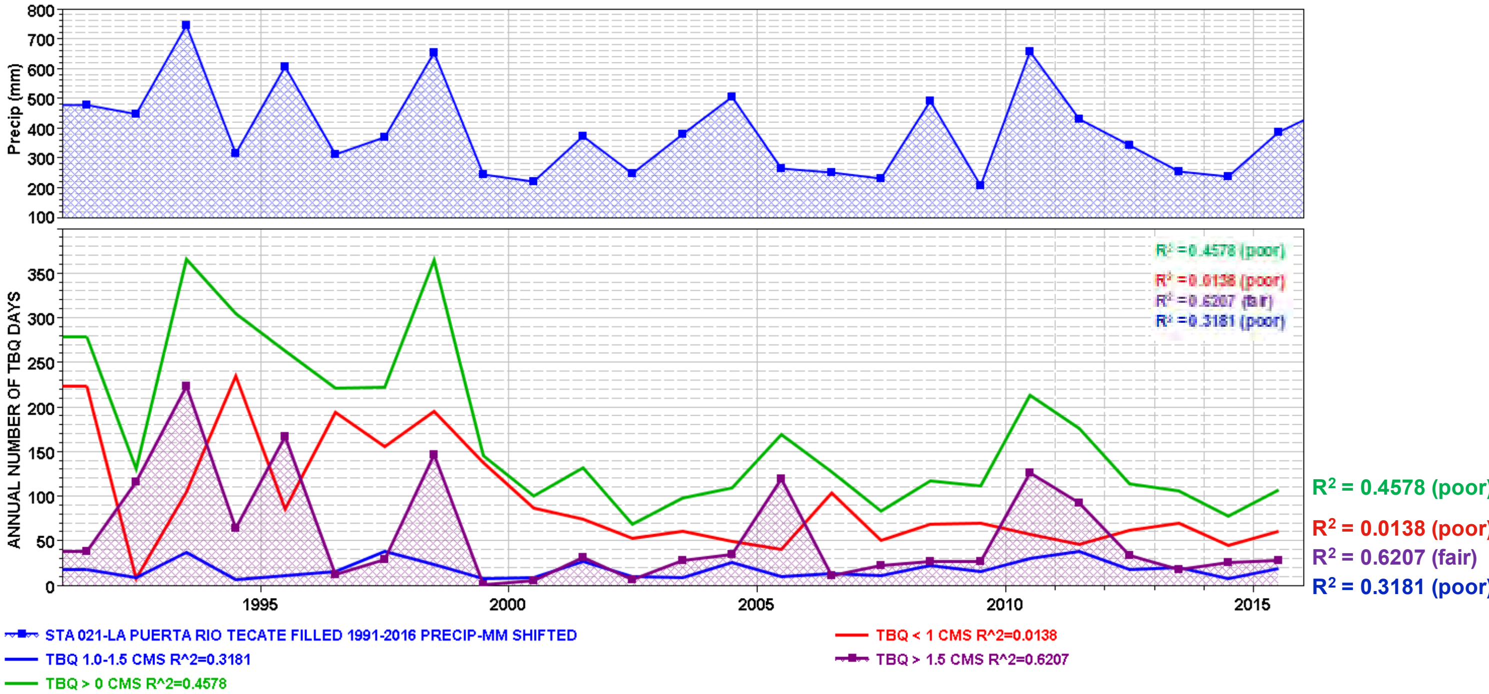


Figure 2-5. Annual number of days of transboundary flow by category and annual precipitation at Rio Tecate La Puerta (Station 021), 1991 – 2016 flows

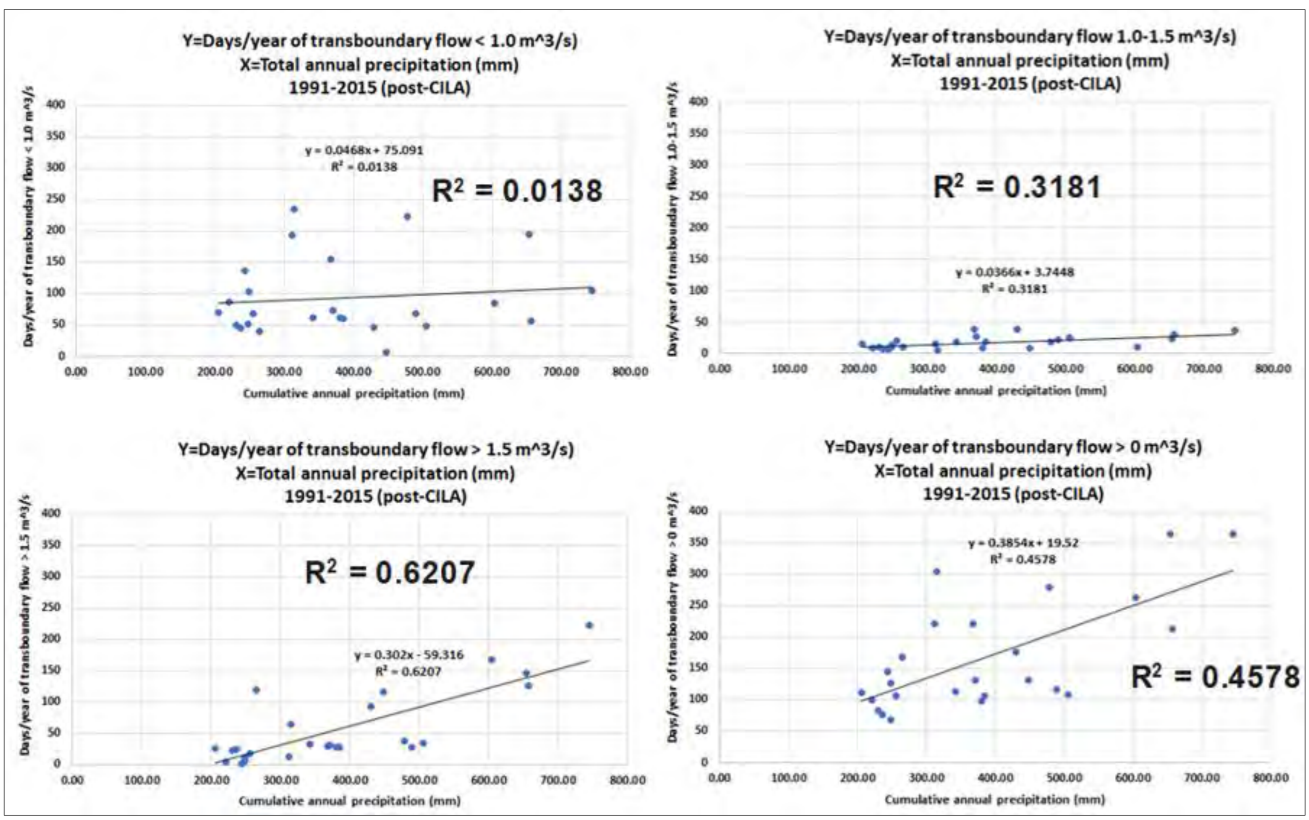


Figure 2-6. Scatter plots and trendlines of annual number of days of transboundary flow by category and annual precipitation at Rio Tecate La Puerta (Station 021), 1991 – 2016

2.1.3.6 Influence of Transboundary Flows on Beach Closures

Water contact closures are issued when sewage-contaminated flows from the Tijuana River enter the United States and adversely impact beach water quality. Beach water quality impacts and associated unhealthful conditions are common near the Tijuana River outlet during and after transboundary flow events. Tides, wind, near-shore ocean currents, and other factors determine how far north poor water quality conditions may extend and need for closure of beaches to the north. San Diego County beaches and facilities that have historically been closed due to poor water quality are shown in Figure 2-7.

Figure 2-7. San Diego County beaches subject to closure due to polluted Tijuana River discharges

A major source of pollutants contributing to San Diego County ocean beach closures has been runoff from the Tijuana River watershed and transboundary flows from the Tijuana River. Consequently, it is reasonable to expect that a reduction in transboundary flow volume and/or improvement in Tijuana River water quality will reduce the frequency and duration of beach closures.

Limited data were available for statistical correlation of beach closures to transboundary flows. In this case, number of days the Silver Strand, Carnation Avenue, Imperial Beach Pier, Seacoast, and Border Field Beaches were closed each year from 2002-2015 were available. Coincident average annual transboundary flows and cumulative annual precipitation at the Rio Tecate La Puerta station were also available for this period. Because most dry-weather flows do not reach the ocean and wet-weather flows do, Figure 2-8 and 2-9 show less correlation of beach closures with transboundary flows (R^2 = 0.37) than with precipitation (R^2 = 0.52), as shown in Figure 2-10 and Figure 2-11.

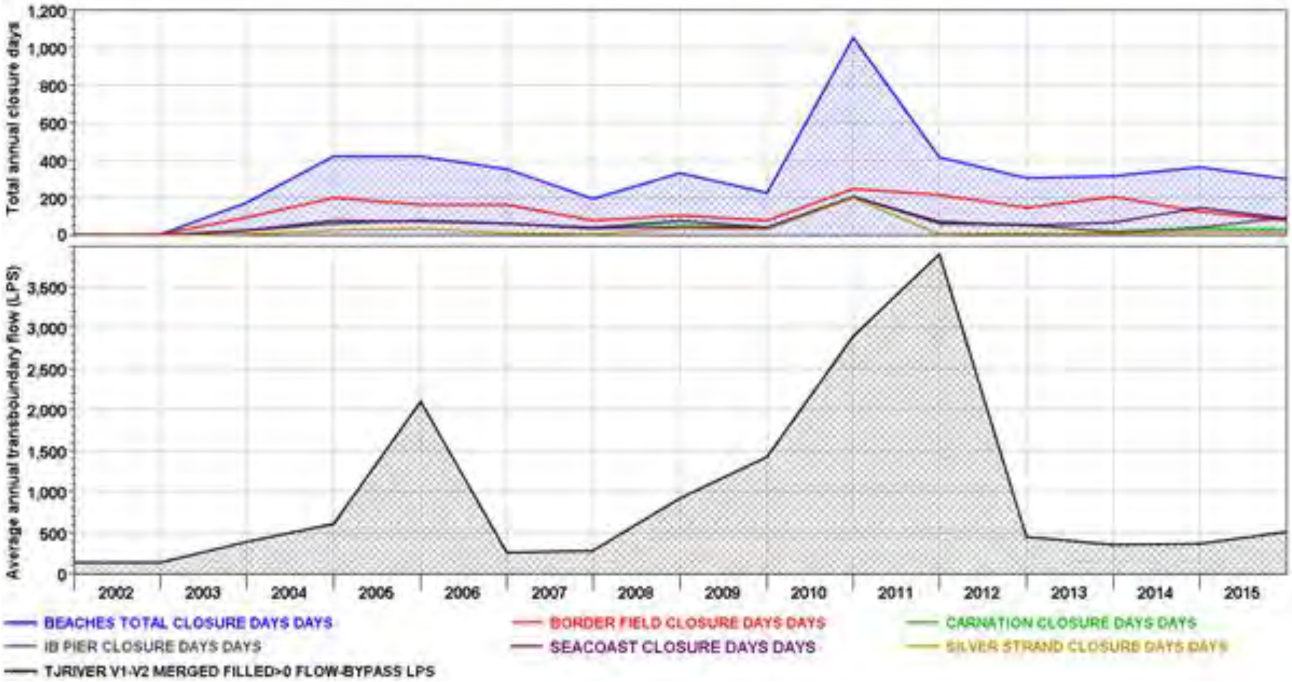


Figure 2-8. Annual San Diego beach closure days and average annual transboundary flows, 2002-2015

Figure 2-9. Scatter plot and trendline, total annual San Diego beach closure days (y-axis) and average annual transboundary flow (x-axis), 2002-2015

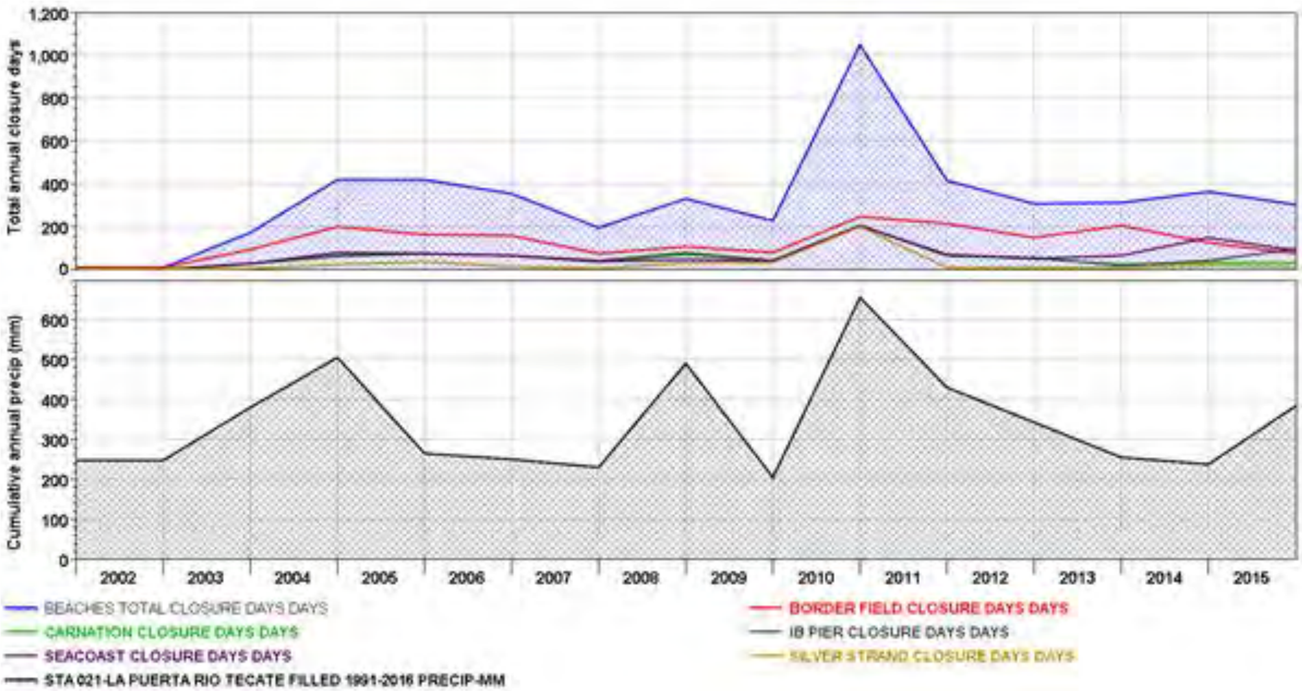


Figure 2-10. Annual San Diego beach closure days and cumulative annual precipitation at Rio Tecate La Puerta station, 2002-2015

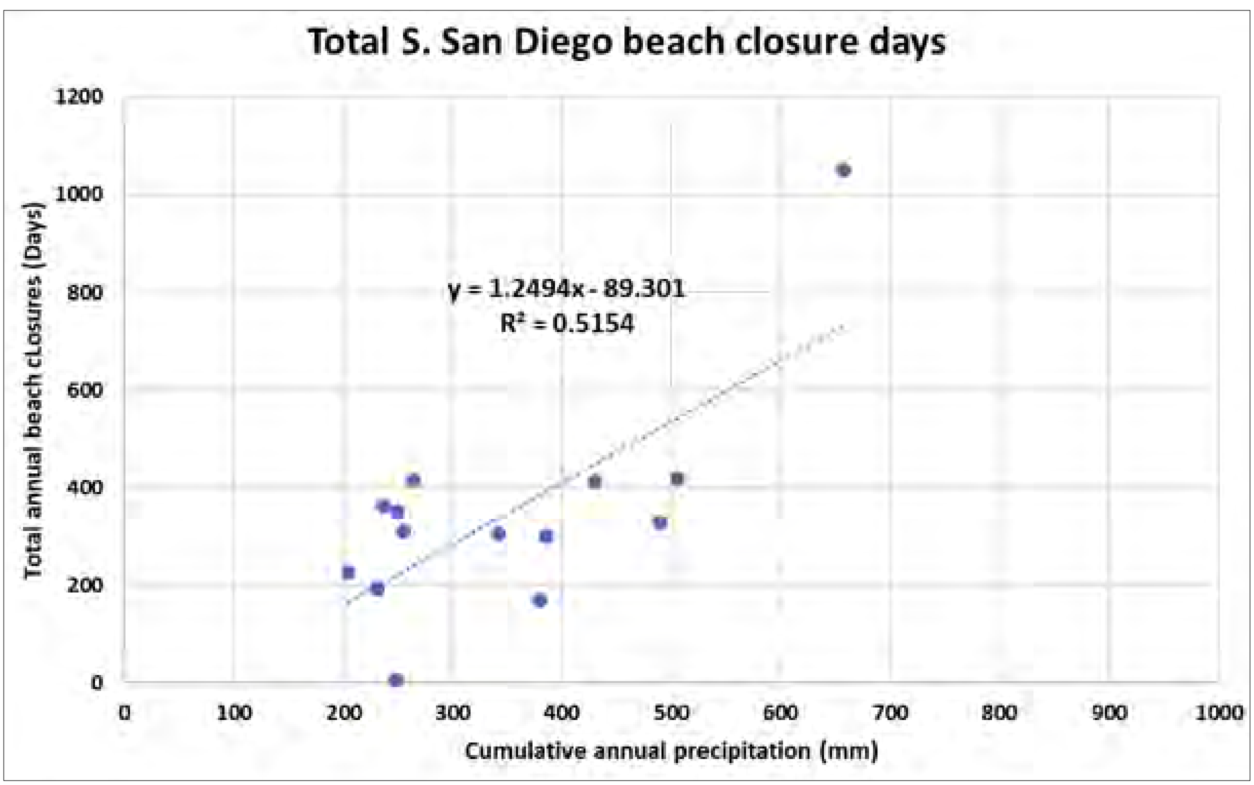
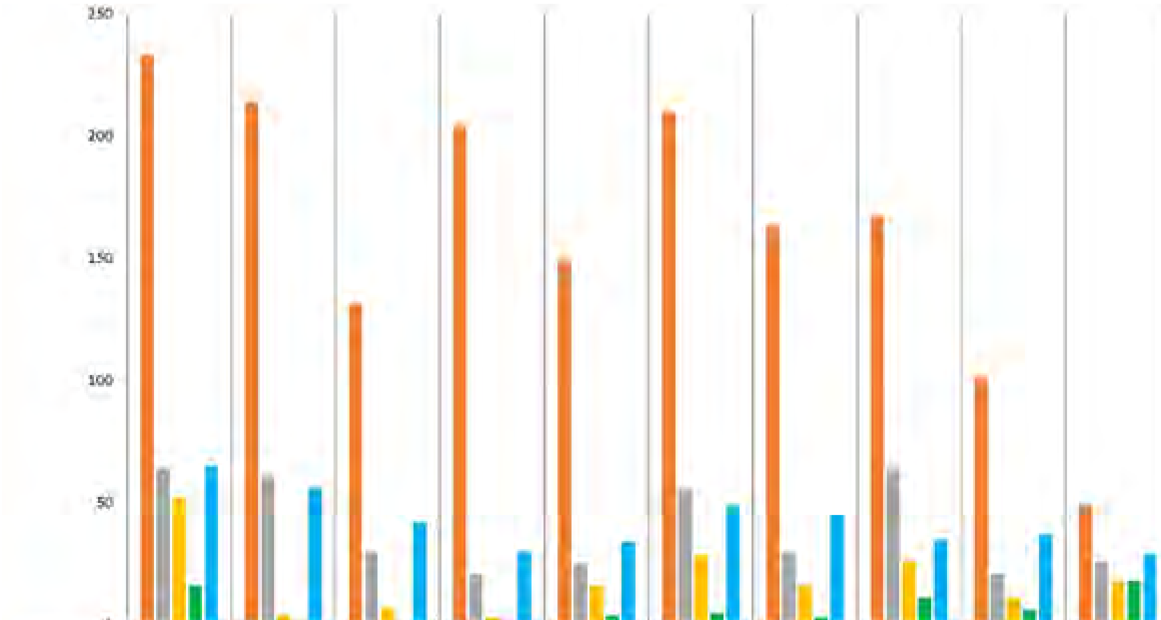


Figure 2-11. Scatter plot and trendline, total annual San Diego beach closure days (y-axis) and cumulative annual precipitation at Rio Tecate La Puerta station, 2002-2015

Effects of transboundary flows on San Diego beach closures were also estimated based on correlations between number of rainfall days per year and number of days per year beaches were closed in response. The Tijuana Slough, Imperial, Silver Strand, and Coronado Beaches were considered in the analysis of effects of rainfall events, the 2010-2018 raw data along with data for the first few months of 2019 for which are shown in Figure 2-12. During this period, Figure 2-13 shows poor to fair ($R^2 \approx 0.5$) correlation of total annual beach closure days to annual rainfall days. While sample size is limited, Imperial Beach appears to be most sensitive ($R^2 \approx 0.45$) to storm events, followed by Tijuana Slough and Silver Strand Beaches; Coronado Beach is relatively unaffected by the number of storm events per year.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Tijuana Slough	233	214	131	204	149	210	163	167	101	50
Imperial Beach	64	61	30	21	25	56	30	64	21	26
Silver Strand	52	4	7	3	16	29	16	26	11	18
Coronado	16	0	0	0	4	5	3	11	6	18
Rain Days	65	56	42	30	34	49	45	35	37	29

Figure 2-12. South San Diego beach closure days and number of rain days per year, 2010-2018 (San Diego County)

Figure 2-14 shows a stronger correlation ($R^2 \approx 0.6$) between total number of beach closure days and transboundary flow days for 2010 - 2015 – the period of record with coincident and complete annual records of both variables. As with rainfall days, Imperial beach was most strongly affected ($R^2 \approx 0.64$) by transboundary flow events, followed by Tijuana Slough, Coronado, and Silver Strand Beaches. The slope of the regression line in Figure 2-14 also indicates that, on average, there is a roughly one-to-one correspondence of beach closure days to transboundary flow days.

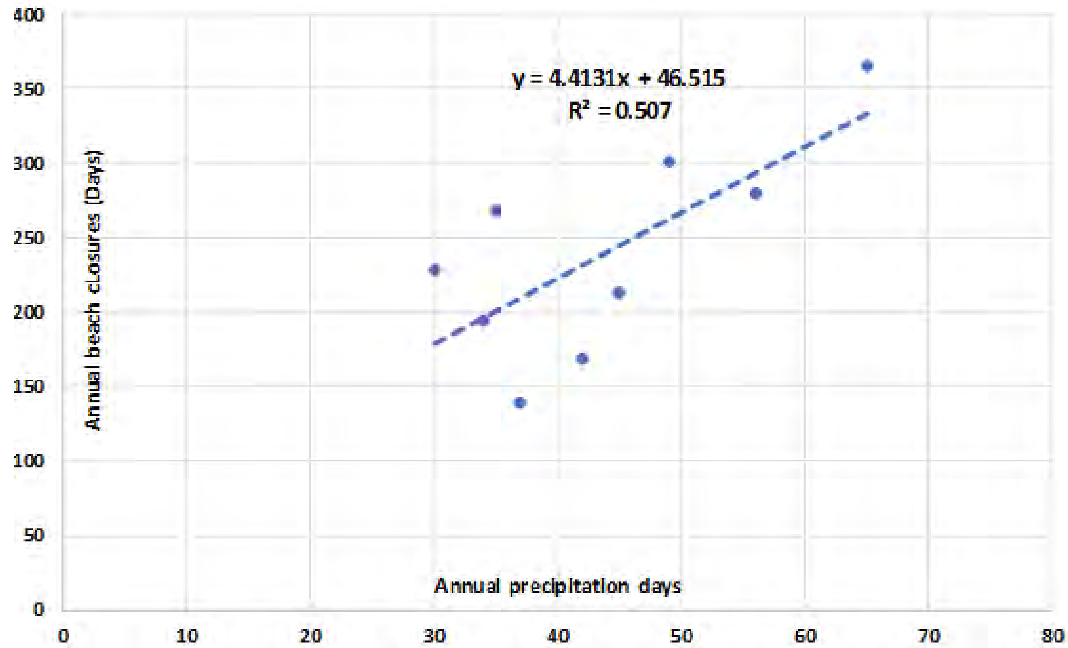


Figure 2-13. South San Diego beach closure days and number of rain days per year, 2010-2018 (From County of San Diego)

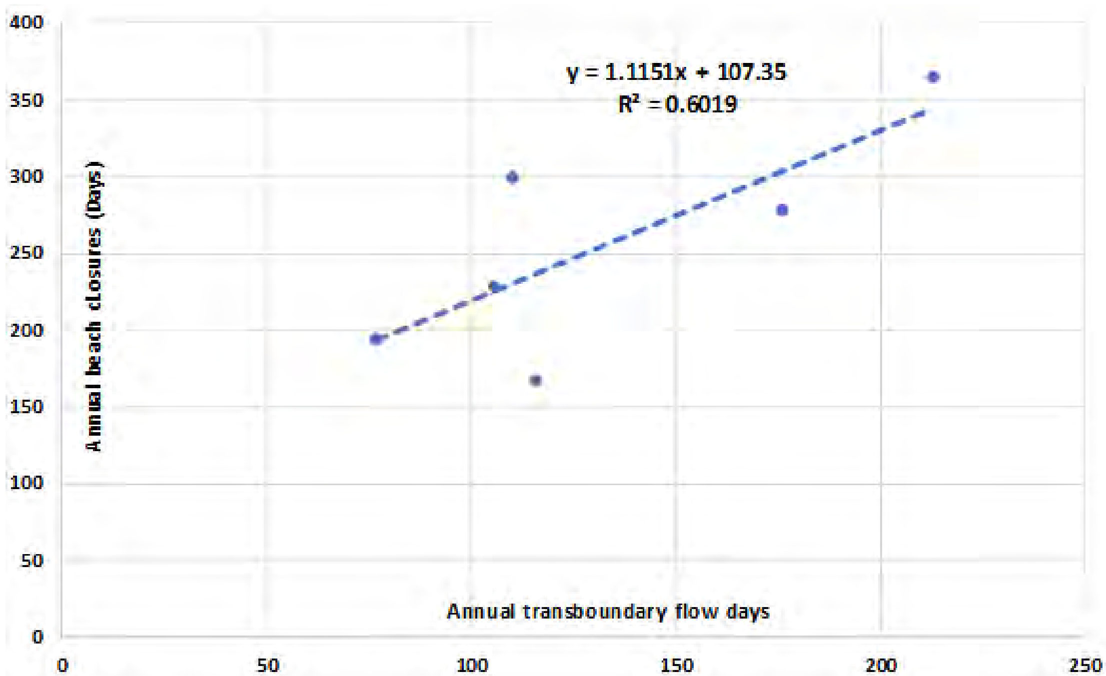


Figure 2-14. Correlation of total South San Diego beach closure Days with number of transboundary flow days per year, 2010-2015

2.1.4 Flow Analysis – Conclusions

The following conclusions are drawn from the above analysis:

1. From November 2009 to March 2016, transboundary flows occurred on average 138 days per year, about two-thirds of which are associated with wet weather and one-third due to operational failures as previously defined.
2. Improvements in reliability to enable full compliance with the existing operating protocol would reduce transboundary flow days to 90 days per year on average – a 35% reduction.
3. On average, there are approximately 60 transboundary flow days per year when Tijuana River flows are less than 1,000 lps – the threshold for cessation of pumping under the current operational protocol. Transboundary flows less than 1,000 lps – many of which are small – are nonetheless assumed to constitute operational failures (non-compliant operation), whether associated with rainfall events or not. The number of transboundary flow days below 1,000 lps is determined based on the difference in transboundary flow days under the baseline (Alternative 1a) and protocol-compliant operation of existing facilities (Alternative 2a).
4. Very low small flows (less than 100 lps) occur 9.4% of the time, or 34 days per year on average under the baseline condition (Alternative 1a).
5. On average, there are approximately 138 days per year of transboundary flow events less than existing PBCILA diversion capacity (1,300 lps).
6. Average number of days of transboundary flows decrease from 78 days to 24 days per year for flows diverted above 1,000 lps and above 3,000 lps, respectively.
7. Full-capacity (1,300 lps) and protocol-compliant operation dramatically reduces the annual number of transboundary flow days in comparison to existing operation – by more than half (from 138 to 65 days per year), and by more than 80% with plant capacity expanded to 3,000 lps (from 138 to 24 days per year on average) and appropriately modified protocol-compliant operation.
8. Annual rainfall predictably affects the number of days of high (greater than 1,500 lps) transboundary flows.
9. Because dry-weather transboundary flows often do not reach the ocean, wet weather – indicated by days of rainfall or number of transboundary flow days – are better indicators of beach closures than magnitude of transboundary flows. From 2010-2015, the analysis shows a roughly one-to-one correspondence between transboundary flow days and total beach closure days.

The most important conclusion of the transboundary flow analysis is that improvements to the PBCILA intake and the existing diversion system to allow it to reliably operate at full installed capacity and in compliance with operational protocol offers the greatest potential for reduction of transboundary flow occurrences and associated impacts on San Diego County beaches.

2.2 Diversion System Infrastructure and Operations Diagnostic

The diversion system infrastructure and operations diagnostic determined the condition of approximately 170 assets of the existing diversion system and potential consequences of asset failure in order to prioritize the capital needs and a rehabilitation and replacement of assets.

All assets eventually reach the end of their useful life where the asset condition and risk of failure is unacceptable, they can no longer function at design capacity, become technically obsolete, or infeasible to continue to repair, operate and maintain. The purpose of the infrastructure and operations diagnostic is to determine the existing condition of lift stations, treatment facilities and other conveyance infrastructure. This task is used to determine the remaining life of assets and identify whether assets should be repaired, rehabilitated, or abandoned.

Arcadis completed site visits, interviews, and condition assessment of 170 assets within the existing diversion system to evaluate personnel, O&M funding and maintenance practices, and performance.

2.2.1 Methodology

The infrastructure and operations diagnostic methodology was split into four steps, as shown in Figure 2-15. The field assessments were completed between June 18 through 22, 2018 by an Arcadis team consisting of a project manager, task leader, two technical staff members, and a local subconsultant. A photo log of the field assessment has been created as part of Appendix D. Visits were scheduled following submittal to and approval of a written request to CESPT. The Arcadis team completed site visits to complete assessments of the PBCILA intake, PBCILA lift station, PB1A and PB1B lift stations, Stewart's Drain, SBIWTP, SAB WWTP, and the International Interceptor and Parallel Conveyance System.

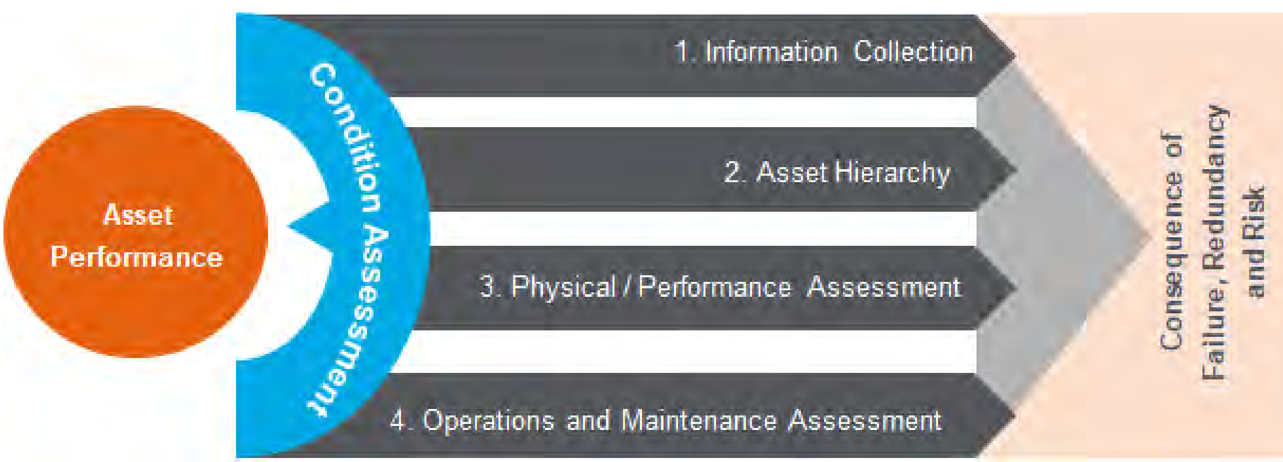


Figure 2-15. Asset diagnostic methodology

Step 1 - Information collection: A critical step in the overall assessment is the identification of existing information, maintenance records, asset failures, operational failures, and other historical data for the organization. A compilation of asset information was collected by questionnaire sent to CESPT prior to the field inspections, providing baseline information. The submitted and answered questionnaire is provided in Appendix E.

Step 2 – Asset hierarchy: The next step was to create an Asset Hierarchy, used to organize assets into an appropriate framework to support capital planning work. A key benefit of hierarchical organizations is that it provides for effective roll-up of cost, condition, and risk data across the complete asset base.

The hierarchy is a systematic classification of work groups, stakeholders, utilities, processes, systems, and equipment into generic groups based on upon various factors such as location, use, etc. The hierarchy was created by identifying components, rolling them up and testing these against the organization’s needs. The asset hierarchy for this study consists of the following levels:

1. Organization
2. Site location / systems
3. Water type
4. Division
5. Facility
6. Process
7. Asset group
8. Individual asset

A workflow of the Tijuana asset hierarchy is shown in Figure 2-16 and Figure 2-17.

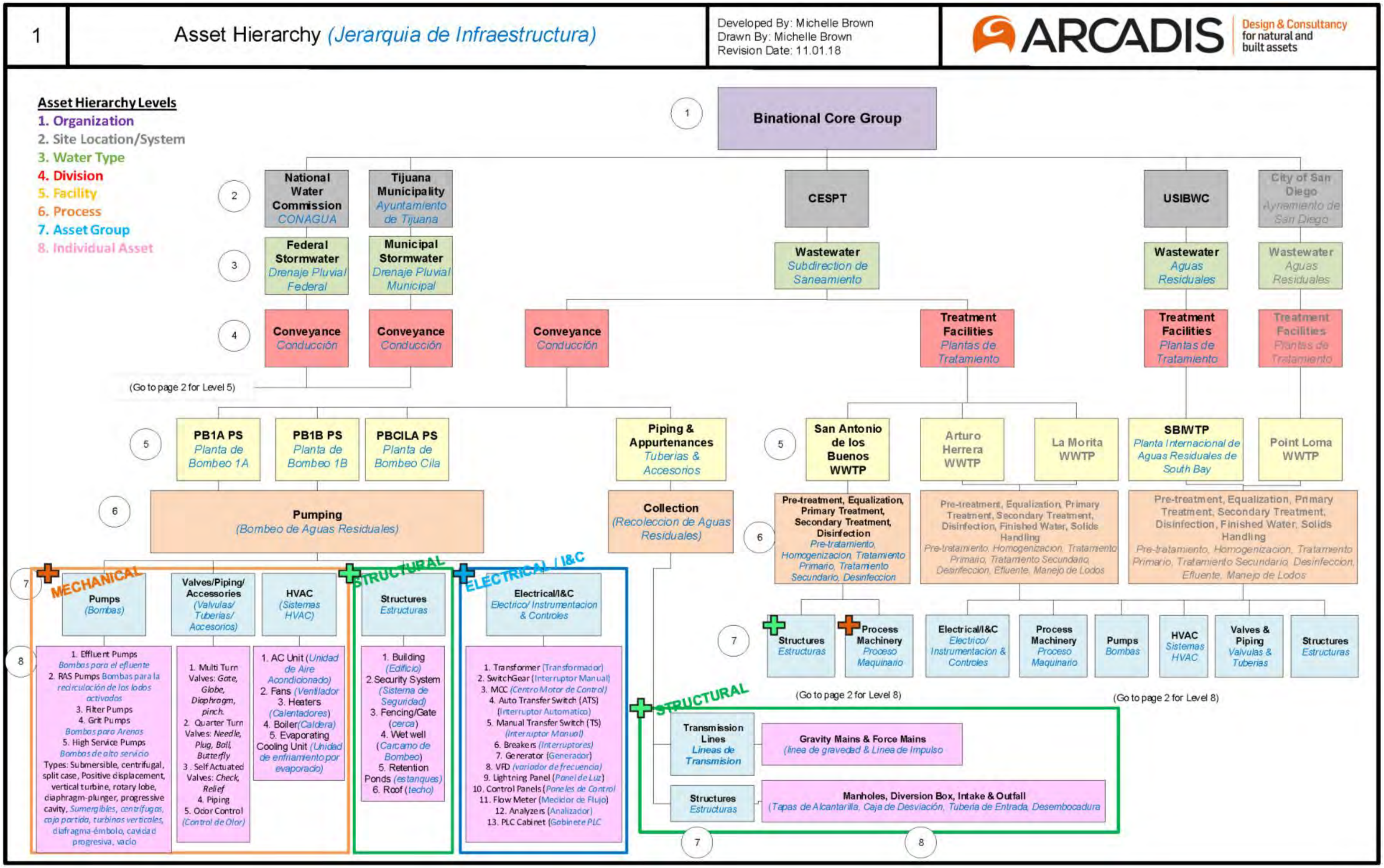
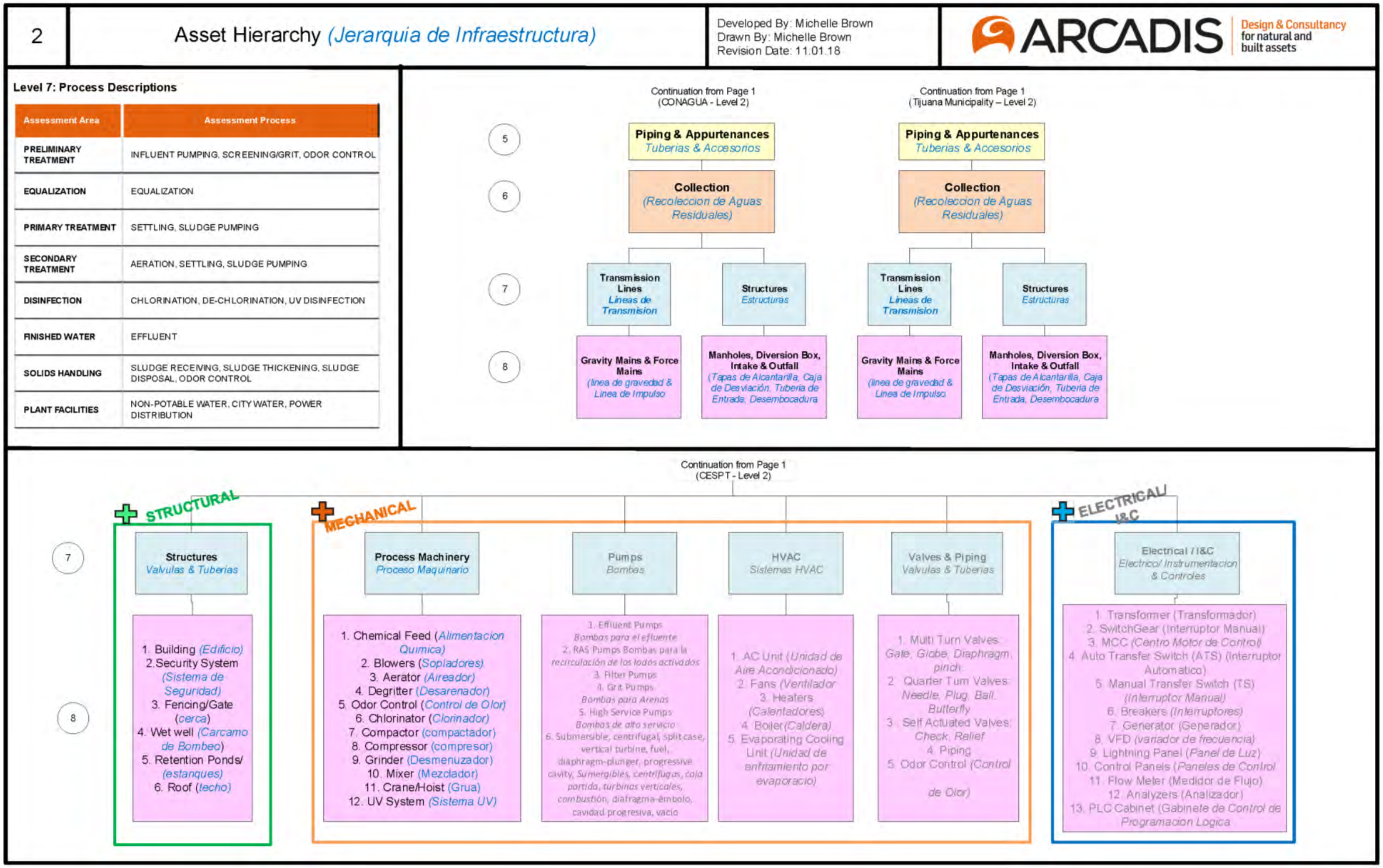


Figure 2-16. Tijuana River Diversion asset hierarchy



Assessment Area	Assessment Process
PRELIMINARY TREATMENT	INFLUENT PUMPING, SCREENING/GRIT, ODOR CONTROL
EQUALIZATION	EQUALIZATION
PRIMARY TREATMENT	SETTLING, SLUDGE PUMPING
SECONDARY TREATMENT	AERATION, SETTLING, SLUDGE PUMPING
DISINFECTION	CHLORINATION, DE-CHLORINATION, UV DISINFECTION
FINISHED WATER	EFFLUENT
SOLIDS HANDLING	SLUDGE RECEIVING, SLUDGE THICKENING, SLUDGE DISPOSAL, ODOR CONTROL
PLANT FACILITIES	NON-POTABLE WATER, CITY WATER, POWER DISTRIBUTION

Figure 2-17. Tijuana River Diversion asset hierarchy (continued)

Step 3 – Infrastructure condition assessment: This is an asset condition scoring exercise accounting for risk and asset criticality. The exercise is performed using the collected data to ascertain the “as-is” condition of assets on an overall level in comparison to the baseline condition. Once the condition of the system has been established, condition assessment becomes a continuous process of assessing assets to keep track of changes in their condition.

There are two components of condition assessment:

- Physical condition
- Performance condition.

Physical condition refers to the current state of repair and operation of an asset, as influenced by age, historical maintenance, and operating conditions. Performance condition refers both to the current state of performance and the ability of the asset to meet operational requirements in the future.

To evaluate asset condition, we used a 1 to 5 scale, where 1 is excellent and 5 very poor for comparative ranking of assets. The overall condition score of an asset is the maximum of the core physical and performance condition criteria (Appendix F contains table descriptions of classifications).

During the site visits, the Arcadis team used the Arcadis AssetHound™ mobile data collection software and field tablets for data entry. AssetHound™ field tablets were configured with the core and ancillary criteria from Steps 1 and 2. The field tablets were used to visually inspect the 170 assets with photographic observations, and record asset attributes and existing conditions information.

Step 4 – Operations and maintenance (O&M) assessment: This exercise was conducted in the course of site visits by face-to-face conversations with the List Station Area Manager, who oversees the operations of PBCILA, PB1A and PB1B lift stations, and other sites as well. Best management practices (BMPs) along with the PBCILA protocol and the O&M budget were reviewed with CESPT.

Step 5 – Consequence of failure, redundancy, and risk: Risk and criticality are fundamental to asset management. Understanding what drives expenditure and the causes of asset failure helps to effectively target maintenance programs and prioritize assets. Under this step, we reviewed the consequence of failure, redundancy, and risk for each of the assets (see Appendix G for consequence of failure, redundancy and risk descriptions of criteria and score descriptions).

2.2.2 Infrastructure Findings and Results

A total of 170 vertical assets under three main disciplines – electrical, mechanical, and structural – were assessed at each visited facility, summarized in Table 2-3.

Table 2-3. Number of assets assessed by facility and asset type

Asset type	Facility							Total
	La Morita WWTP	PBCILA	PB1A	PB1B	SAB	San Antonio de los Buenos WWTP	Tijuana River	
Electrical	-	7	12	3	-	-	-	22
Mechanical	-	41	33	43	-	8	-	125
Structural	1	3	10	2	6	-	1	23
Total	**1**	**51**	**55**	**48**	**6**	**8**	**1**	**170**

Our Steps 3 and 4 assessment findings for the vertical assets and operations observations indicate that the diversion system is experiencing several O&M-related problems (noted in detail in section 2.2.2.1) due to (1) limited personnel, (2) limited O&M budget, (3) limited preventive maintenance practices, and (4) physical and performance condition, briefly described as follows:

- **Limited personnel** – for operation and maintenance, CESPT has a total of 12 mechanics and 2 electricians for 148 sites: 20 treatment plants, 80 potable water facilities, and 48 sewer lift stations.
- **Limited O&M budget** – our conversations with CESPT staff confirmed that yearly budget is approximately one-third of the annually requested budget, this represent a burden on the assets, elevating the risk matrix zone.
- **Limited preventive maintenance practices** – our conversations with CESPT staff along with site observations, denoted that there is no preventative maintenance in place, since there are no personnel available for it and no budget to perform. The condition ratings will denote the years of preventive maintenance absence, it will significantly reduce physical and performance condition ratings (CR) of assets
- **High-risk physical and performance condition** – our observations of the physical and performance condition problems were noted as a routine in each facility.

High-risk physical and performance condition – Our observations noted the following physical and performance problems.

- At the diversion intake, the structure appears not to have an adequate design under current conditions for sufficient trash and debris removal and prevention of sediment deposition in the Tijuana River at the intake during dry-, wet- and post-wet weather; specific issues were noted as follows:
  - *PBCILA Intake capacity is limited to flows under 29 mgd or 1,300 lps.*
  - *Construction materials have deteriorated and require replacement.*
  - *Location and sizing of intake is not optimal to efficiently capture flows.*
  - *Settling area seems insufficient in the Tijuana River to promote further sedimentation.*
  - *Intake screens appear to have an inadequate design and setup for debris and removal.*
  - *Intake design should consider the variation of water surface elevations for dry- and wet-weather.*
  - *An automated mechanical system could alleviate O&M manual requirements.*

- At the lift stations, physical and performance condition problems indicate that:
  - *No preventive maintenance program is in place to protect assets.*
  - *PBCILA limited capacity, operational protocol limits diversion of flows to under 23 mgd (1,000 lps).*
  - *No energy backup system is in place.*
  - *Mechanical failures occur without backup equipment or available personnel to rapidly resolve the issue.*
  - *Power capacity is limited at PB1A and PB1B to 500 kilo-volt-ampere (kVA) each, permitting only three pump systems to be running simultaneously at both lift stations with a total capacity of up to 36 mgd (1,577 lps).*
  - *Power capacity at PBCILA is 300 kVA, however this is sufficient to operate at full design capacity.*

- At SAB WWTP, physical and performance condition problems indicate that:
  - *Partial wastewater treatment occurs, less than design capacity*
  - *Water quality does not meet design quality of effluent*
  - *No preventive maintenance program has been implemented*
  - *No energy backup system is in place*
  - *Vandalism*
  - *Aerators malfunction without repairs*
  - *Lagoon systems without dredging, observed a 2-meter depth of sludge*
  - *No apparent solids management plan*

Total CR, calculated as the maximum of the condition and performance ratings for each asset at the facilities, are shown in Figure 2-18 – Figure 2-23.

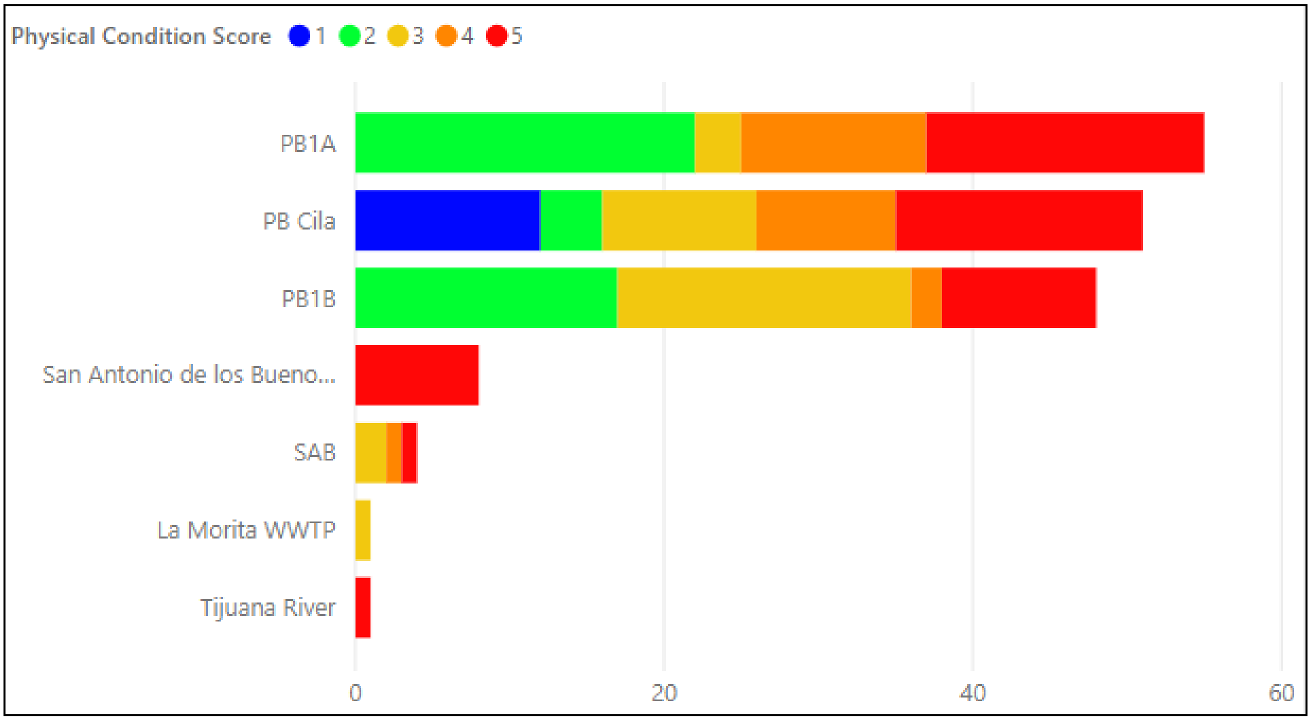


Figure 2-18. Physical condition score by facility

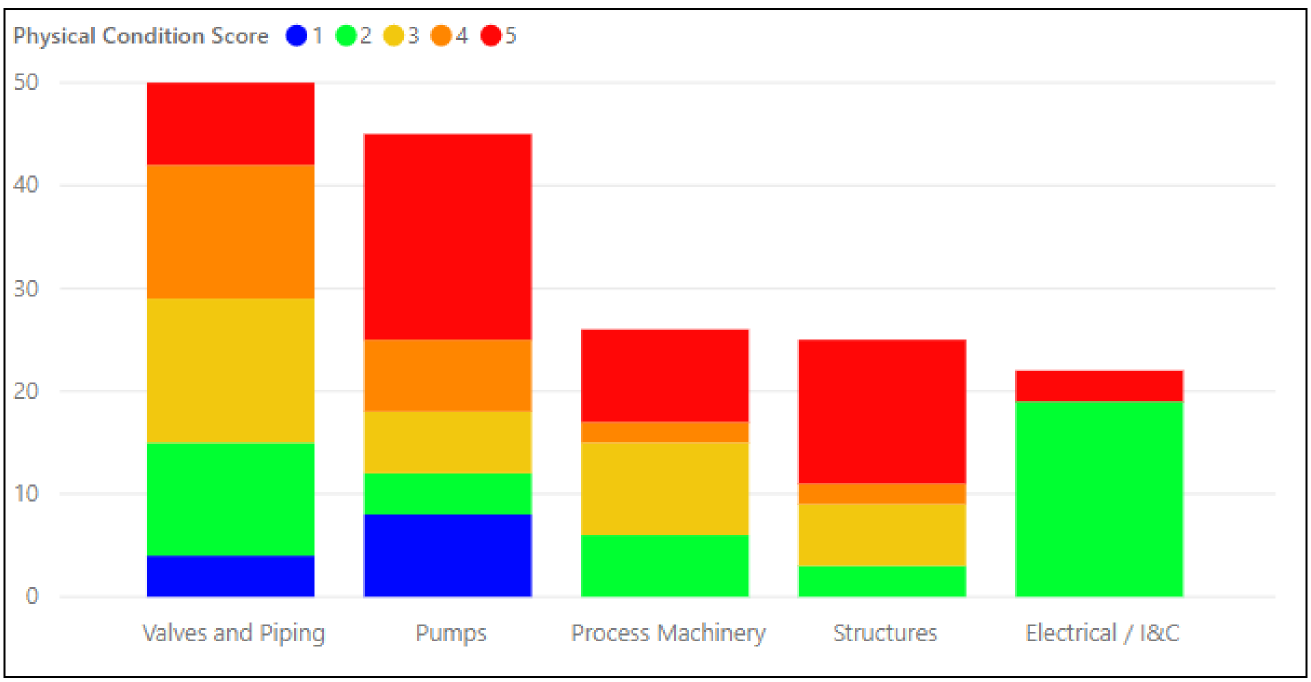


Figure 2-19. Physical condition score by asset type

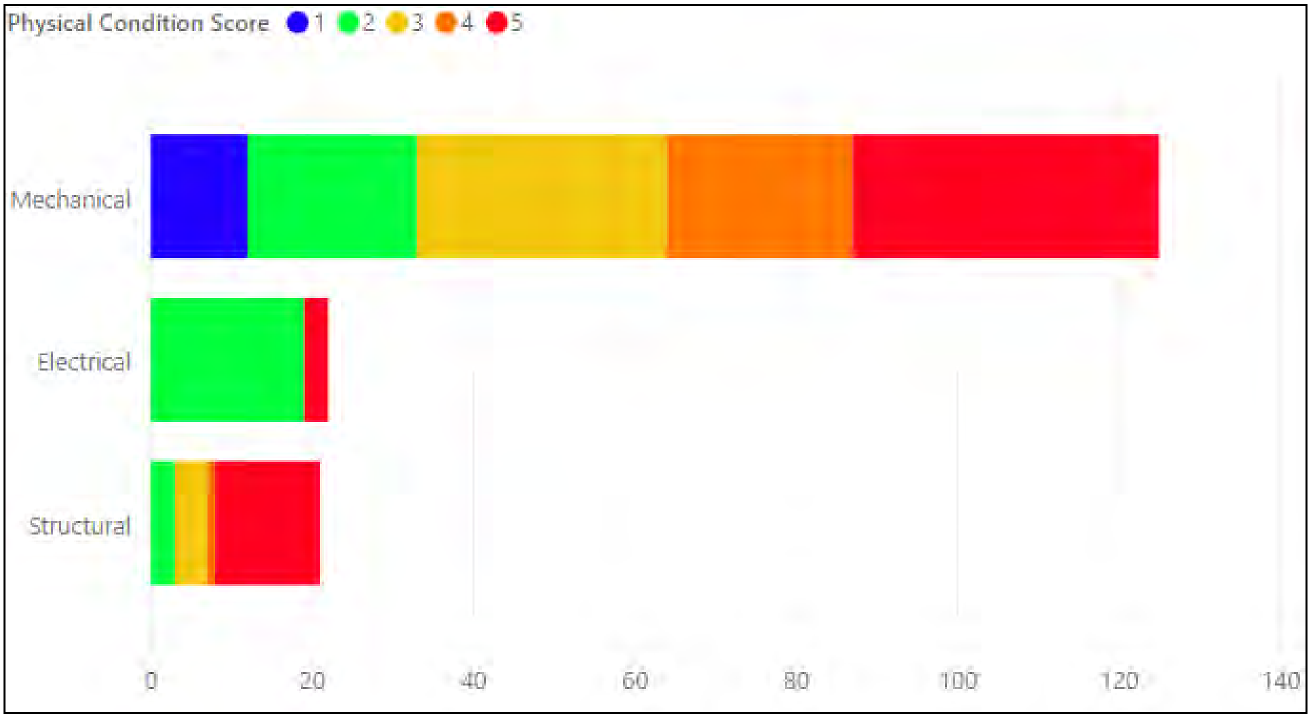


Figure 2-20. Physical condition score by asset group

The performance CR scores break down as follows:

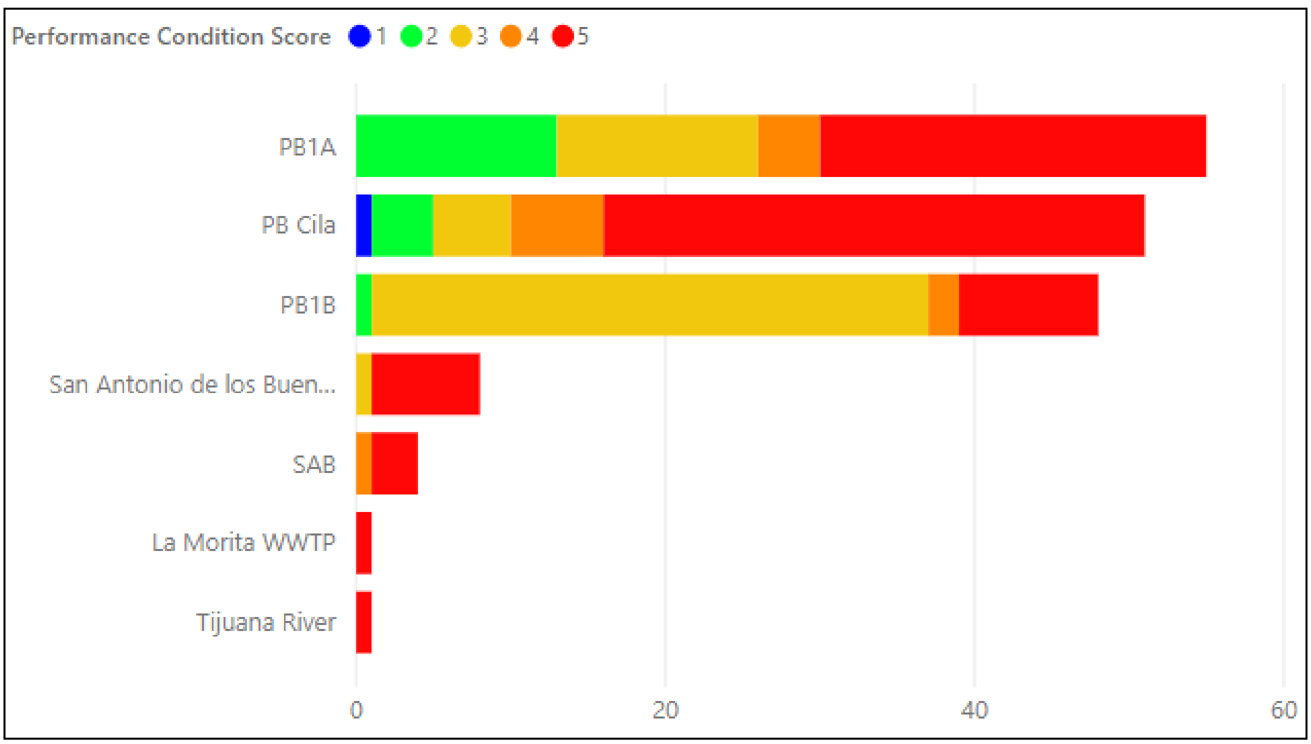


Figure 2-21. Performance condition score by facility

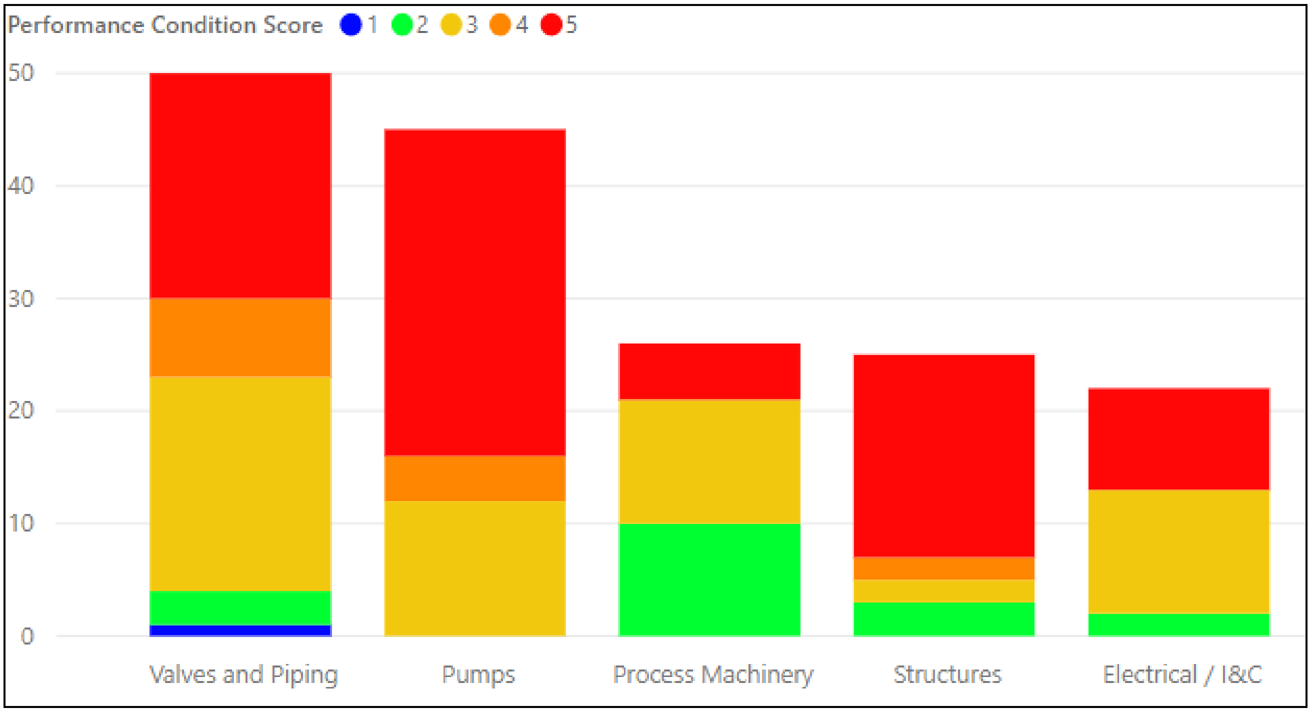


Figure 2-22. Performance condition score by asset type

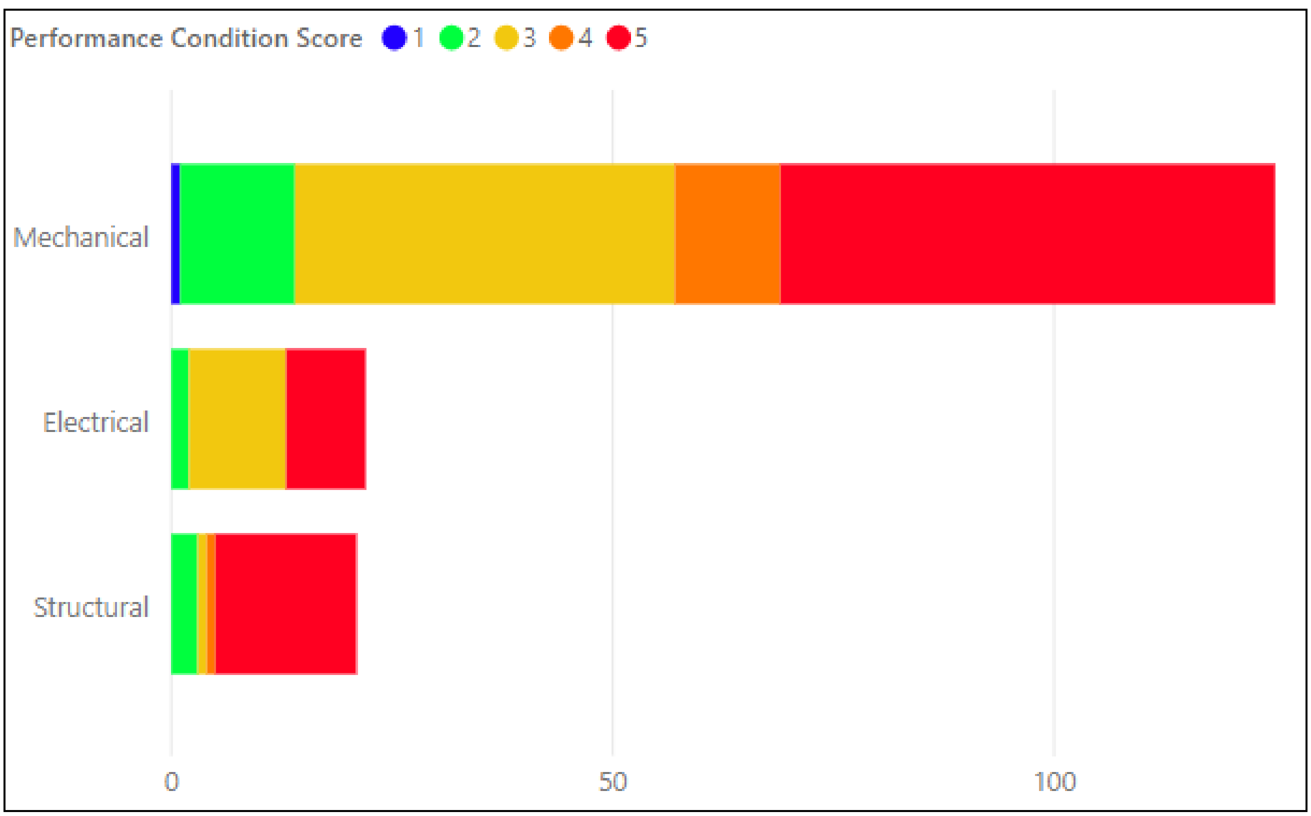


Figure 2-23. Performance condition score by asset group

2.2.2.1 BMPs and O&M budgets

BMPs: As defined by the California Stormwater BMP handbook, A BMP is any program, technology, process, siting criteria, operating method, measure, or device which controls, prevents, removes or reduces pollution. During the site visits and through the information review we observed existing BMPs and sites with a need of BMP implementation.

During our field assessments completed between June 18 through the 22 (Photologs in Appendix D), the team performed an evaluation of existing BMPs at the following sites: La Morita WWTP, Arturo Herrera WWTP, PBCILA intake, PBCILA Lift Station, PB1A & PB1B lift station, Stewart's Drain, SBIWTP, SAB WWTP, International Interceptor, Parallel Conveyance System. Our field observations resulted in BMP assessments for sites throughout the diversion system. We observed the following existing BMPs:

- ***PBCILA Operational Protocol –*** describes operational phases of the intake and lift station and conditions for shutdown (see Section 1.3.2 of this report).
- ***Sediment removal –*** efforts by CESPT to screen for trash and debris at selected locations along the Tijuana River Channel
- ***SBIWTP operations*** – effective management of 25 mgd of wastewater flows, meeting the National Pollutant Discharge Elimination System (NPDES) discharge permit
- ***La Morita WWTP –*** Effective management of wastewater flows, producing reclaimed wastewater at an average flow rate of 6 mgd (250 lps)
- ***Herrera Solis WWTP –*** Effective management of 6 mgd of wastewater flows, producing reclaimed wastewater at an average flow rate of 6 mgd (250 lps)
- ***SAB Lift Station –*** This site showed some preventive maintenance to the discharge piping; experienced personnel were on duty on a 24-hour basis. With one out of six pumps in operation, pump in service can meet plant capacity and wastewater collection system discharges.

The following conditions could be addressed with appropriate BMP activities:

- ***Dry-weather flow diversion through the current system –*** Although the PBCILA has an international protocol in place that describes 4 phases of operations, the goal of the lift station should be to remain in service at all times, working to its design capacity irrespective of river flows exceeding protocol requirements (23 mgd or 1,000 lps). While the frequency of transboundary flows would not change in comparison to protocol-compliant operation, transboundary flow volume would be significantly reduced.
- ***PBCILA intake daily operations –*** Intake operation follows the PBCILA operational protocol about two thirds of the time but is subject to interruption for a variety of reasons otherwise. We observed an accumulation of trash during dry-weather flow conditions. Metal intake screen bars showed significant corrosion and the concrete box showed clear signs of deterioration with cracks around the walls. Additional protection of the intake is needed to enable more continuous operation during dry- and wet-weather flow conditions, and to reduce accumulation of trash and sediment that requires shutdown to avoid damage to the pumps during wet-weather events.
- ***PBCILA lift station daily operations –*** Preventive maintenance of PBCILA is noticeably deficient; pumps 2, 3, and 4 are frequently out of service without backup; pump 6 had a regularly leaking air release pipe-valve discharging wastewater on the ground at the lift station on a daily basis; equipment showed significant deterioration and signs of internal and substrate corrosion; the master control center (MCC) was outdated and left open with several controls inoperable. An inflow meter had been installed but was not operational and was not scheduled for repair. We did not observe trash and debris collection at the lift station during our visit, and no Supervisory Control and Data Acquisition (SCADA) systems were apparent. No backup power source was found, though recent coordination efforts between CESPT

and CONAGUA have enabled the installation of an emergency generator at PBCILA to increase operational reliability at the lift station.

- ***PB1A lift station daily operations –*** Preventive maintenance of PB1A is also deficient, with only one pump train in service during our visit and a second backup train not operational due to the inability to isolate it for maintenance. Significant health and safety concerns are apparent in moving trash by wheelbarrows on single sheets of plywood placed over wastewater influent channels. Trash is dumped at the side of the station and left for days before removal. Equipment showed significant deterioration and signs of internal and substrate corrosion and some MCC controls were inoperable. Mechanical racks show corrosion and were not in working order. Influent channel concrete lining conditions show clear signs of deterioration. Evidence of water intrusion through cracks in walls and floors of the building was observed, and leakage has accelerated corrosion and structural deterioration of the building. The PB1A lift station raises the temperature of a control room; the single desktop computer intended to monitor operations at PBCILA was not functional.
- ***PB1B lift station daily operations –*** PB1B shows effects of limited preventive maintenance practices. Similar to PB1A, trash is moved by wheelbarrows on single sheets of plywood placed over wastewater influent channels, dumped at the side of the station and left for days until removed. Equipment showed some deterioration and signs of substrate corrosion, and MCCs had some inoperable controls. Influent channel concrete lining showed clear signs of deterioration. Evidence of water intrusion through cracks in walls and floors of the building was observed, and leakage has accelerated corrosion and structural deterioration of the building. No SCADA systems were found.
- ***Stewart's Drain daily Operations*** – The concrete drain does not show significant signs of distress. However, the existing diversion drain seems inadequate for higher dry-weather flow events, and collection capacity expansion of the existing concrete flume appears to be needed.
- ***SAB WWTP daily operations*** – This facility requires immediate attention due to limited preventive maintenance. There is no apparent sludge management plan; minimal aeration and sludge accumulation in ponds, infrequent cleanup results in only partial treatment of inflows. The facility can only handle about 10 mgd (450 lps) of inflows. Excess inflows are bypassed as ponds have only about one meter of depth left for partial biological treatment, and only three mixers are operational. Due to limited treatment capacity, it is apparent that plant effluent may not be meeting its discharge permit in accordance with the SEMARNAT NOM-001-ECOL-1996 Mexican regulation for surface water discharge.
- ***CESPT lift station O&M program and budget –*** More formal O&M policies and programs are needed, with a written O&M plan that provides schedules for inspections, preventive maintenance checklists, management, and budgeting on an annual basis. Our conversations with CESPT revealed that lift station annual O&M budgets are typically small in comparison to requested funding in order to meet other demands for improved levels of service elsewhere. After storm events, PBCILA is brought back into operation once Tijuana River flows are below 1,300 (29 mgd) and no rain is forecast during the next 3 days. This requires cleaning of the wet well for trash and sediment removal, which is completed manually and with a vac-truck if needed, typically with 2 labors and up to two technicians (one mechanical and one electrical), since only 6 mechanics and 2 electricians are available. The technicians will service the pumps, motors, electrical conduits and MCCs. CESPT does not have a team for motor repairs, any issues have to be repaired by contractors. CESPT cleans the motors and pumps, and changes the gears, in house, but they don't have a machine shop to support more self-sufficient maintenance.

- ***Wastewater main breaks from CESPT's wastewater collection system*** – This appears to be a recurring problem that could be due to pipe material, insufficient quality control during construction, and the natural topography of Tijuana that conveys flows to the Tijuana River or Stewart's Drain.
- ***Solid waste collection in Tijuana* –** Trash was observed at every site visited in Tijuana, including the primary clarifiers at La Morita and Herrera Solis WWTP, at the Tijuana River, at the PBCILA Intake, at all lift stations, at SAB WWTP, and at Stewart's Drain. Collection appears inadequate to prevent solid waste from entering the wastewater collection and treatment facilities.

2.2.3 Infrastructure Diagnostics – Conclusions

2.2.3.1 Vertical assets

Vertical assets are buildings and facilities comprising the diversion, conveyance, and treatment system. Analysis of likelihood (total condition assessment) and consequences of failure yields the scatter plot shown in Figure 2-24. From this analysis it is apparent that the majority of the assets surveyed need rapid – if not immediate – attention. Most of the assets are located in the Category 5 (high) risk zone. Twenty-three of the vertical assets evaluated displayed conditions in the top two risk groups for failure. The investment costs for replacement or repair of these high-priority assets is estimated to be in excess of $32 million which relate to the improvements presented as part of alternative 2b.

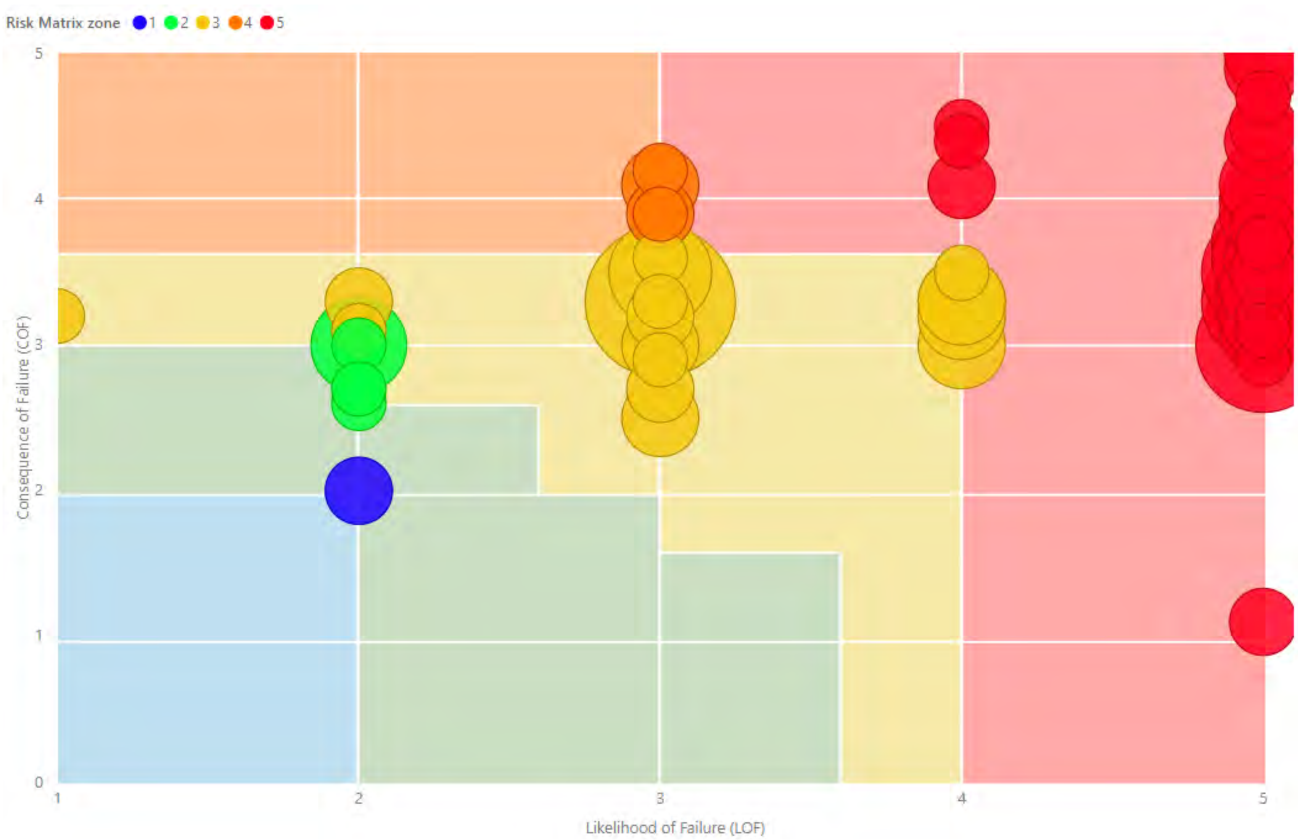


Figure 2-24. Consequence of failure and likelihood of failure

A list of recommended assets that require immediate attention are provided in Table 2-4 below. This list is prioritized based on risk score, which considers current performance and physical condition, as well as the consequences of failure.

Table 2-4. Recommended priority assets (Risk Groupings 4 and 5)

Facility	Asset Type	Process	Asset Group	Individual Asset	LoF	CoF	Risk Score	Replacement value	Repair cost
PBCILA	**Structural**	Wastewater Pumping	Structures	Building	5	5	25	$450,000.00	$75,000.00
	Mechanical	Wastewater Pumping	Valves and Piping	Pump 1 Piping	5	5	25	$750,000.00	--
	Mechanical	Wastewater Pumping	Valves and Piping	Pump 5 Piping	5	5	25	$750,000.00	--
	Mechanical	Wastewater Pumping	Valves and Piping	Pump 6 Piping	5	5	25	$750,000.00	--
	Structural	Wastewater Pumping	Structures	PBCILA Intake structure	5	5	24	$55,000.00	$15,000.00
	Structural	Wastewater Pumping	Structures	Stormwater screen (Trash barrier)	5	4	20	$15,000.00	--
	Mechanical	Wastewater Pumping	Pumps	Pump 5	5	5	23	$290,000.00	--
	Mechanical	Wastewater Pumping	Pumps	Pump 6	5	5	23	$290,000.00	--
	Electrical	Wastewater Pumping	Electrical / Instrumentation and Controls (I&C)	Pump 2 Master Control Center (MCC)	5	4	20	$150,000.00	--
	Electrical	Wastewater Pumping	Electrical / I&C	Pump 3 MCC	5	4	20	$150,000.00	--
	Electrical	Wastewater Pumping	Electrical / I&C	Pump 4 MCC	5	4	20	$150,000.00	--
PB1A	**Structural**	Wastewater Pumping	Structures	Building	5	5	25	$400,000.00	--
	Mechanical	Wastewater Pumping	Pumps	Pump 3A and 3B	5	4	21	$750,000.00	--
	Mechanical	Wastewater Pumping	Pumps	Pump 4A and 4B	5	4	21	$750,000.00	$45,000.00
	Mechanical	Wastewater Pumping	Hoist System	Hoist monorail and crane system	5	5	25	$250,000.00	--
PB1B	**Structural**	Wastewater Pumping	Structures	Building	5	5	25	$460,000.00	--
	Mechanical	Wastewater Pumping	Pumps	Pump 2B	5	4	21	$375,000.00	$25,000.00
	Mechanical	Wastewater Pumping	Pumps	Pump 3B	5	4	21	$375,000.00	$25,000.00
	Mechanical	Wastewater Pumping	Pumps	Pump 5A and 5B	5	4	21	$750,000.00	$45,000.00
	Mechanical	Wastewater Pumping	Hoist System	Hoist monorail and crane system	5	4	21	$250,000.00	--
SAB	**Structural**	Plantwide System	Structures	Electrical Building	5	4	22	$1,000,000.00	--
	Structural	Secondary Treatment	Aerators	Aerators (52 Total)	5	5	22	$2,000,000.00	--
	Structural	Secondary Treatment	Structures	Aerobic lagoons	5	4	22	$5,000,000.00	$100,000.00

2.2.3.2 Linear assets

Table 2-5. Recommended priority assets and actions for linear assets Linear assets are defined by length, e.g. roads, rail lines, pipelines, etc. for which operation and maintenance costs are generally proportional to length as well. Table 5 lists the assessed linear assets of the diversion system, which, based on estimated remaining useful life (RUL), are potentially in need of attention. Where concrete lines in Tijuana don't have an inner coat for gases released by wastewater or sulfates, RUL is likely to be less than the design 50 years. More than $80 million is needed to improve linear assets in the diversion system with estimated RUL less than 3 years. Only a portion of these investment needs are incorporated into the estimated costs of technical alternatives to address transboundary flows. Consequently, additional funding sources will be needed to maintain or replace linear assets critical to the overall function of the system.

Table 2-5. Recommended priority assets and actions for linear assets

Location	Internal Pipe Corrosion	External Pipe Corrosion	Estimated Useful Life (EUL)	Remaining Useful Life (RUL)	Recommendations	Replacement value	Repair cost
PBCILA intake	4	4	**50***	**3**	A new project needs to be implemented in accordance with the new flows that are a combination of storm drains, treated wastewater, and non-treated wastewater.	$55,000.00	$5,000.00
Gravity main from PBCILA intake	4	4	50	3	A new project will be required (see Alternative 3a) in accordance with the new flows that are a combination of storm drains, treated wastewater, and non-treated wastewater. CIPP required for repair.	$2,000,000.00	$1,000,000.00
Junction Box 1 to SBIWTP	3	3	**50***	**7.6**	Capacity seems working. Needs corrosion protective cover	$95,000.00	$25,000.00
Junction Box 2 to SBIWTP	3	3	50	7.6	Capacity seems working. Needs corrosion protective cover	$95,000.00	$25,000.00
Primary Effluent Return Connection (PERC)	3	3	75	22.4	Upon internal corrosion, CIPP may be required.	$8,000,000.00	$1,300,000.00
International Collector (gravity main)	4	4	50	2.85	It is important for CESPT to share the utilities yearly general planning with the Binational Core Group to understand raw wastewater methodologies for treatment and disposal and flow diversions between SBIWTP and La Morita and Herrera Solis WWTPs. This	$15,000,000.00	$9,000,000.00

Location	Internal Pipe Corrosion	External Pipe Corrosion	Estimated Useful Life (EUL)	Remaining Useful Life (RUL)	Recommendations	Replacement value	Repair cost
					will give the Core Group the understanding on the future fluctuation of wastewater flows in the future.		
PBCILA forcemain to PB1A	4	4	75	9.9	Mechanical joint restrained and corrosion protection are recommended to ensure pipe integrity is not jeopardized from any water damage. CIPP required for repair.	$6,000,000.00	$3,000,000.00
PBCILA forcemain to International Collector	4	4	75	9.9	Not a recommended material used for pressured lines. Restrained joints should be in place. A line replacement needs to be implemented in accord with the combined stormwater, treated and raw wastewater.	$2,000,000.00	$1,000,000.00
Parallel Ocean Outfall Pipeline System (older)	4	3	**50***	**2.7**	This outfall needs to be rehabilitated, especially in the siphons and concrete lines. However, it is necessary to have a plan to place these assets out of commission and focus instead on increasing the capacity for PITAR. Check pump conditions to confirm.	$65,000,000.00	--
Parallel Ocean Outfall Pipeline System (newer)	4		60	6.45	Check the pump operating conditions at PB1a and PB1B. Additional flows will require a new parallel line	$65,000,000.00	--

Location	Internal Pipe Corrosion	External Pipe Corrosion	Estimated Useful Life (EUL)	Remaining Useful Life (RUL)	Recommendations	Replacement value	Repair cost
Abandoned wastewater pipe to Point Loma WWTP	4	4	75	3.75	It is necessary to review if there is additional capacity to add flows from Tijuana to the Point Loma outfall given the development of San Diego. In addition to that how much Mexico would have to pay for the additional infrastructure and operational costs. These costs will need to be compared to the costs of increasing treatment capacity at SBIWTP.	--	--
Stewart's Drain	3	3	100	22.8	For dry weather flows, the design seems fair. This drain is not designed for trash and debris. A larger capture area is required	--	$1,400,000.00

2.2.3.3 Existing operation and management

Sites listed in Table 2-5 should be included in a comprehensive O&M strategy designed to improve existing and future operations by maintaining current levels of service (achieve the performance targets), mitigating risks, and minimizing costs by implementing a balanced program of planned and reactive works. The diversion system does not currently have a formal or adequately-funded O&M program, as noted in our site assessment. These shortcomings create additional risk and likelihood of failure of both vertical and horizontal assets. A system-specific sewer management plan should be developed by CESPT to include goals such as:

- Provide adequate preventive maintenance to all facilities as required by equipment manufacturers
- Maintain and improve the condition of the wastewater collection system, including lift stations and pipelines
- Upgrade capacity at the system's lift stations and conveyance pipelines as population continues to grow
- Reduce the frequency of breaks and impacts of sewer runoff to the Tijuana River
- Develop contingency plans for mitigation of impacts of sewer main breaks city-wide
- Implement public education and recycling programs to reduce trash and debris in the wastewater collection system

Overall, investments and operating procedures should be developed to ensure compliance of treatment facilities with NOM-001-ECOL-1996 surface water discharge standards.

3 EVALUATION OF TECHNICAL ALTERNATIVES TO ADDRESS TRANSBOUNDARY FLOWS

As shown in Table 2-2, transboundary flow days can be reduced by half (from 138 to 69 days per year on average) by upgrading of existing facilities to enable diversions of up to 1,300 lps in compliance with an appropriately-modified operational protocol. Increasing diversion capacity to 1,500 lps will further reduce transboundary flow days by 58% (from 138 to 58 days per year on average). The transboundary flow analysis indicates that extreme high-flow events (greater than 1 billion gallons per day or 50,000 lps) occur infrequently and tend to be only a few days in duration. Investments needed to capture stormwater flows and achieve meaningful levels of flood protection would likely be infeasible, and consequently the range of capacity expansion alternatives considered in this study is limited to 60 mgd (2,600 lps) for control of dry-weather and very small (less than two-year recurrence interval) storm events.

The condition assessment presented in Section 2.2 of this report documents conditions at existing facilities. The knowledge gained in the assessment has helped to develop capital and O&M costs for implementation of each alternative. Capital costs presented in Section 3.1.2 of this report indicate that significant investments will be required for construction of new facilities and to rehabilitate facilities in poor condition due to growing demand and years of limited maintenance.

3.1 Basis of Alternatives Development

Alternatives evaluated under the scope of work (SOW) were formulated based on an understanding of problems and issues affecting the diversion of Tijuana River flows, enabled by analysis of operational data and the results of site assessments. The focus of the technical alternatives is to optimize the existing diversion system with options that will allow to achieve better functionality during dry-weather conditions, allow for some diversion capability during small wet-weather conditions and resume operations quickly following storm events. Five categories of alternatives are identified from the scope of work, each of which may include several alternatives, each comprised of improvements to the existing diversion system or new infrastructure. The full system is shown in Figure 3-12, the major components of which are described as follows:

- **PBCILA intake:** Diverts flow from the Tijuana River to PBCILA lift station for conveyance to treatment facilities; peak capacity is 29 mgd (1,300 lps). A view of PBCILA Intake is shown in Figure 3-1. View of PBCILA Intake within the Tijuana River and Figure 3-2.

Figure 3-1. View of PBCILA Intake within the Tijuana River

Figure 3-2. View of PBCILA Intake along with temporary berm efforts

- **PBCILA lift station:** The main lift station within the existing diversion system, the function of which is to convey flow to either the International Collector or to PB1A/PB1B. The station pumps on average 11.5 mgd (500 lps) to the International Collector and 11.5 mgd (500 lps) to PB1A, for a total of 23 mgd (1,000 mgd). The lift station is operated in accordance with the existing PBCILA operational protocol. A view of PBCILA lift station is shown in Figure 3-3.

Figure 3-3. View of PBCILA Lift Station

- **International Collector:** The collector is a 72-inch pipeline that conveys flows from the Poniente and Oriente collectors and Tijuana's wastewater collection system, plus flows from the PBCILA lift station. Approximately 25 mgd (1,100 lps) is conveyed to SBIWTP, and 23 mgd (1,000 lps) to PB1B. Maximum conveyance capacity is 75 mgd (3,300 lps). A view of a repair of a junction box at the International Collector is shown in Figure 3-4. Junction box repair at International Collector

Figure 3-4. Junction box repair at International Collector

- **PB1A lift station:** The station assists in pumping flow discharged by PBCILA to the ocean through the parallel conveyance system by boosting total dynamic head to approximately 492 feet (150 meters). The station has one working pump train with a dual set of pumps in series. Total station pumping capacity is 12 mgd (525 lps). Train 3 at PB1A is shown in Figure 3-5.

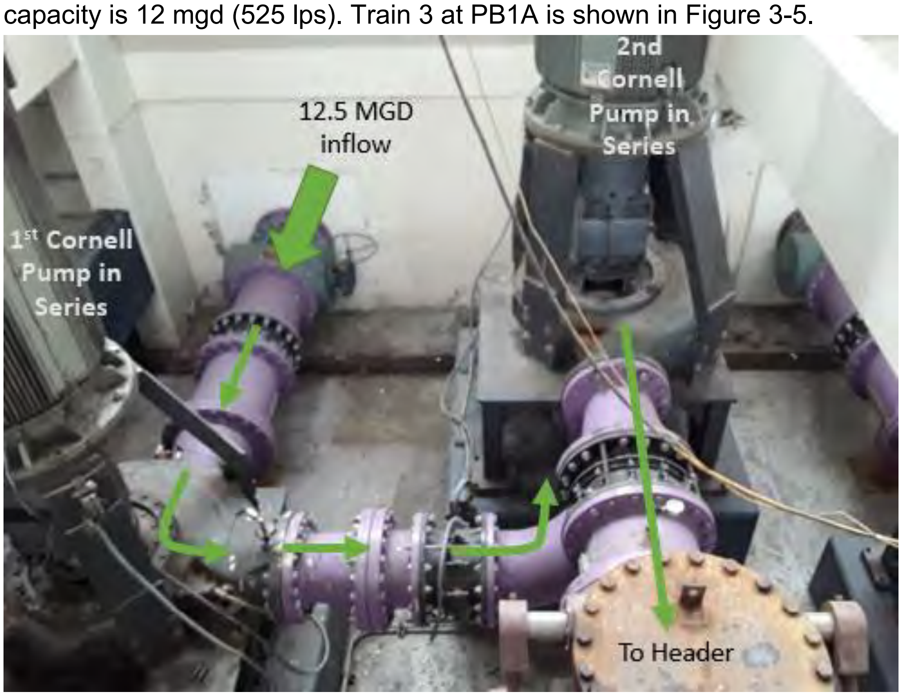


Figure 3-5. Train 3 in operation at PB1A

- **PB1B lift station:** Functions in the same way as PB1A, except with two parallel pump trains, each with a dual set of pumps in series. Total station pumping capacity is 23 mgd (1,000 lps). Train 2 at PB1B is shown in Figure 3-6.

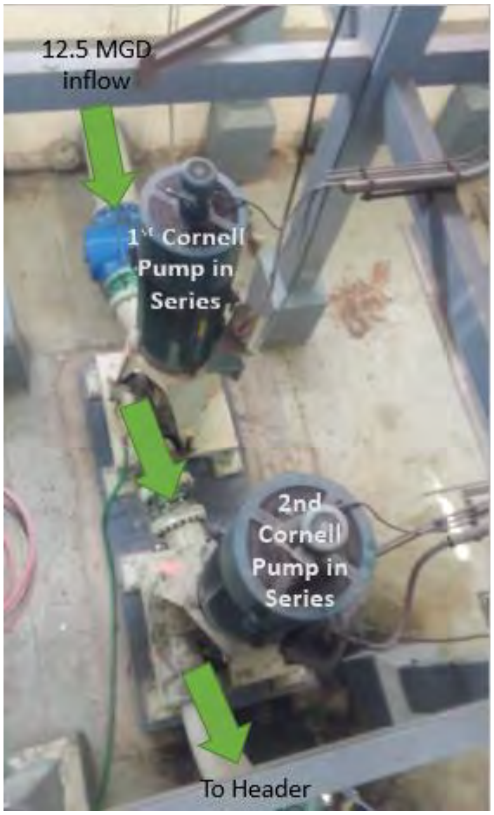


Figure 3-6. Train 2 in operation at PB1B

- **Stewart's Drain:** The drain is a low point within the City of Tijuana and San Diego County, conveying approximately 5 gpm (80 lps) to SBIWTP; it also serves as a drain from the City of Tijuana to the Tijuana River during wet-weather conditions. Stewart's drain is shown in Figure 3-7.

Figure 3-7. Stewart's Drain view from the U.S. towards Mexico.

- **SBIWTP:** A treatment plant for flows from the International Collector; treatment capacity is 25 mgd (1,100 lps). A general view of SBIWTP from the border is shown in Figure 3-8.

Figure 3-8. A general view of SBIWTP from the border.

- **SBOO:** The South Bay Ocean Outfall discharges approximately 25 mgd (1,300 lps) of treated flows from SBIWTP to the ocean; conveyance capacity is 100 mgd (4400 lps). A graphic of the SBOO is shown in Figure 3-9.

Figure 3-9. A graphic aerial view of the of the SBOO.

- **SAB WWTP:** This plant partially treats wastewater flows from the Parallel Conveyance System; treatment capacity is 10 mgd (450 lps). A view of the facultative lagoon is shown in Figure 3-10 and a view of the sludge handling piles is shown in Figure 3-11.

Figure 3-10. Overview of the lagoon system at SAB WWTP.

Figure 3-11. Overview of Sludge piles at SAB WWTP.

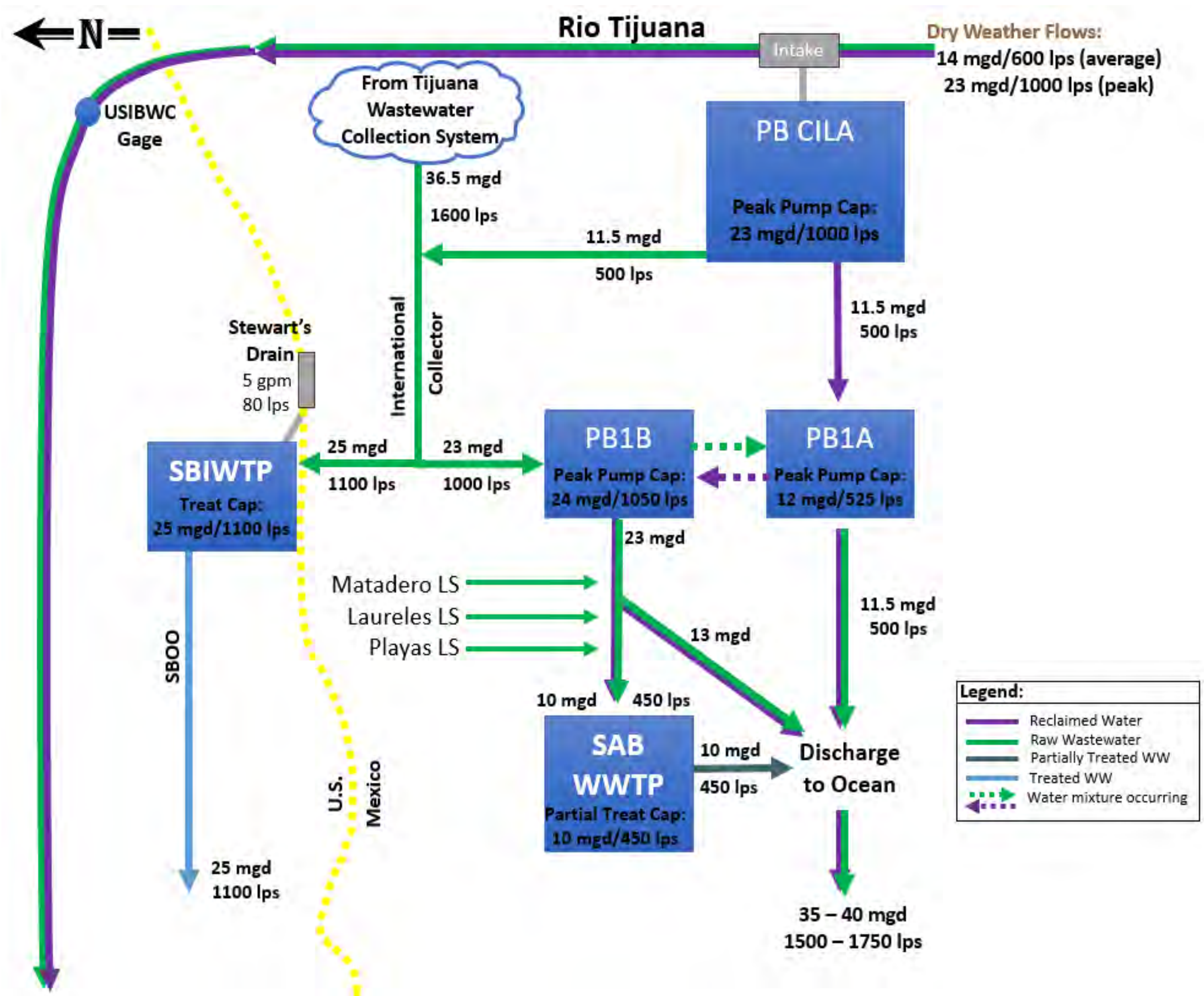


Figure 3-12. Simplified diversion system schematic with daily flows as obersed by Arcadis.

3.2 Definition and Analysis of Technical Alternatives

Fourteen alternatives, described in Section 3.4, have been identified and grouped as follows:

- **Category 1 – No Action (baseline)**
- **Category 2 – Optimization of existing diversion facilities in Mexico**
- **Category 3 – Expansion of existing diversion facilities in Mexico**
- **Category 4 – New diversion facilities in the U.S.**
- **Category 5 – Combined diversion facilities in the U.S. and Mexico**

Alternatives, grouped into each category, are listed in Table 3-1. List of all technical alternatives for analysis

Table 3-1. List of all technical alternatives for analysis

Category		Alternative
NO ACTION	1a	No action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	2a	Optimize existing facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps
	2b	Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability
	2c	Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements
	3a	Diversion capacity expansion: Diversion system expansion in Mexico up to 2,600 lps (60 mgd)
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4a	New U.S. diversion infrastructure: New lift station to discharge directly to SBOO without treatment
	4b	New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for primary treatment only
	4c	New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for full treatment
	4d	New U.S. diversion infrastructure: New lift station to discharge to Point Loma WWTP
	4e	New U.S. diversion infrastructure: Gravity flow to the SBOO
	4f	New U.S. diversion infrastructure: Single inflatable dam or permanent weir on US-side of the Tijuana River
COMBINED U.S. - MEXICO DIVERSION FACILITIES IMPROVEMENTS UP TO 29MGD (1,300 LPS)	5a	Gravity reclaimed water pipeline from Tijuana's WWTPs to SBOO
	5b	Gravity reclaimed water pipeline system from Tijuana's WWTPs to Point Loma WWTP
	5c	Gravity reclaimed water pipeline system from Tijuana's WWTPs to Punta Bandera
	5d	New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP up to 35 mgd (1,500 lps)

3.2.1 Description of Proposed Infrastructure Alternatives

Category 1, Alternative 1a – No Action (Baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016

Alternative 1a assumes no action and consequently no diversion system or operational improvements, i.e. existing diversion system components, schematically diagrammed in Figure 3-12, will continue as currently operated. A mix of treated wastewater, stormwater runoff, wastewater and other uncontrolled discharges will continue to flow through the Tijuana River Channel. PBCILA will continue to operate without flow metering, electric power outages, and a limited number of pumps in operation and not as originally designed. A significant lack of preventive maintenance, as observed during Arcadis' condition assessment site visits will continue. The system will continue to deteriorate through the years and as shown in Section 2.2 several assets show a high-risk rating and a relatively small remaining useful life. This will likely result with more coinciding spill reports due to increasing system failures and an inability to continue to intercept the growing dry-weather flows.

PB1A and 1B will also continue to operate in current status, with significant deteriorations observed and no preventive maintenance, limited O&M planning and strategy, weakened buildings, manual trash handling in major lift stations without operators' health and safety considerations, weakened concrete channels without corrosion protection, limited pumping capacity due to aged equipment and limited power availability. SAB WWTP will continue to function without adequate O&M and effluent flows not meeting discharge limits, with average influent flows of 29 million gallons per day (mgd) or approximately 1,300 lps. SAB WWTP operates with limited partial treatment capacity at approximately 10 mgd or 450 lps with a significant scarcity of preventive maintenance throughout the facility. The ocean discharge flows composed of mostly raw sewage averaging 40 mgd or 1,750 lps will continue to reach the Pacific Ocean, approximately 7 miles south of the U.S.-Mexico border.

Figure 3-13 below reflects current operation conditions with an existing diversion system operating at 1,000 lps. Transboundary flow events are expected to continue at an average of 138 days per year with this alternative.

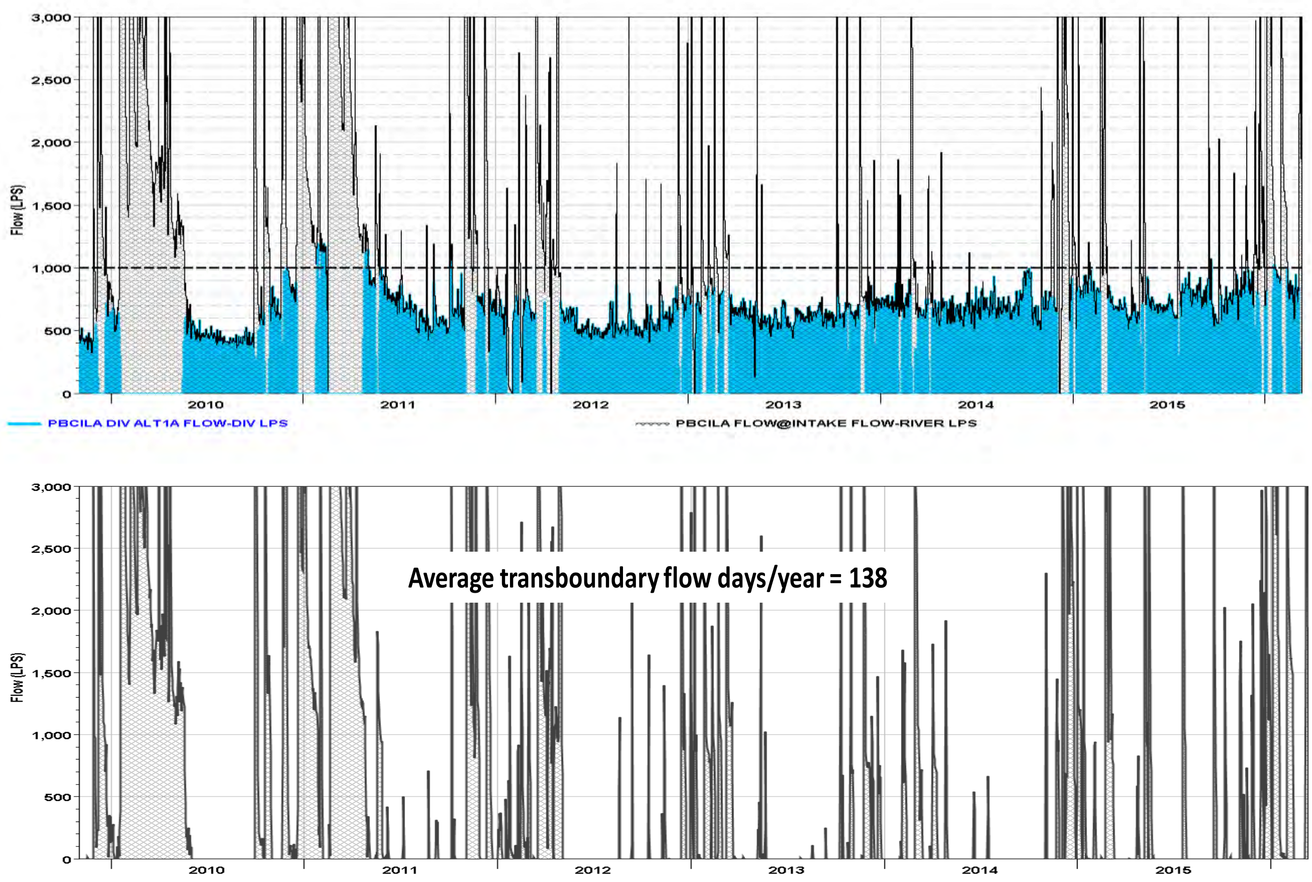


Figure 3-13. Baseline (Alternative 1a) Tijuana River flows and Diversions at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

Category 2, Alternatives – 2a through 2c - Optimization of existing diversion system in Mexico

Category 2 involves optimization of existing diversion system facilitates in Tijuana to ensure that operation of the system at design capacity and in accordance with operational protocols during dry- and wet-weather conditions and following storm events.

Alternative 2a - Optimize existing facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps

This alternative, depicted in Figure 3-14, will increase reliable operations of the existing diversion system. All dry-weather flows through the Tijuana River, up to 1,000 lps will be diverted by the existing system. It includes improvements to PBCILA, PB1A and 1B to have operational facilities that capture dry weather flows up to 23 mgd or 1,000 lps by following the USIBWC/CILA protocol as described in the document. Due to deteriorating conditions, facility improvements include:

- Concrete work where the integrity of the structure has deteriorated and applying an epoxy cover for wastewater abrasiveness protection
- New sedimentation traps at the river channel upstream of PBCILA intake
- Adding a new trash rack to PBCILA intake
- Decommissioning and replacing pumps in PBCILA, PB1A and PB1B
- Replacing piping, valves and appurtenances
- Replacing electrical conduits and a significant update of the SCADA system
- Addition of new transformers (350 and 1,300 kVA) to PBCILA and PB1A/PB1B respectively

Figure 3-14. Optimization of existing facilities (Alternatives 2a-2b)

Figure 3-15 reflects operating conditions with an existing diversion system operating at 1,000 lps in full compliance to the USIBWC/CILA protocol. Transboundary flow events are expected to occur at an average of 90 days per year – a 48-day reduction in average annual transboundary flow days from the no-action baseline (Alternative 1a).

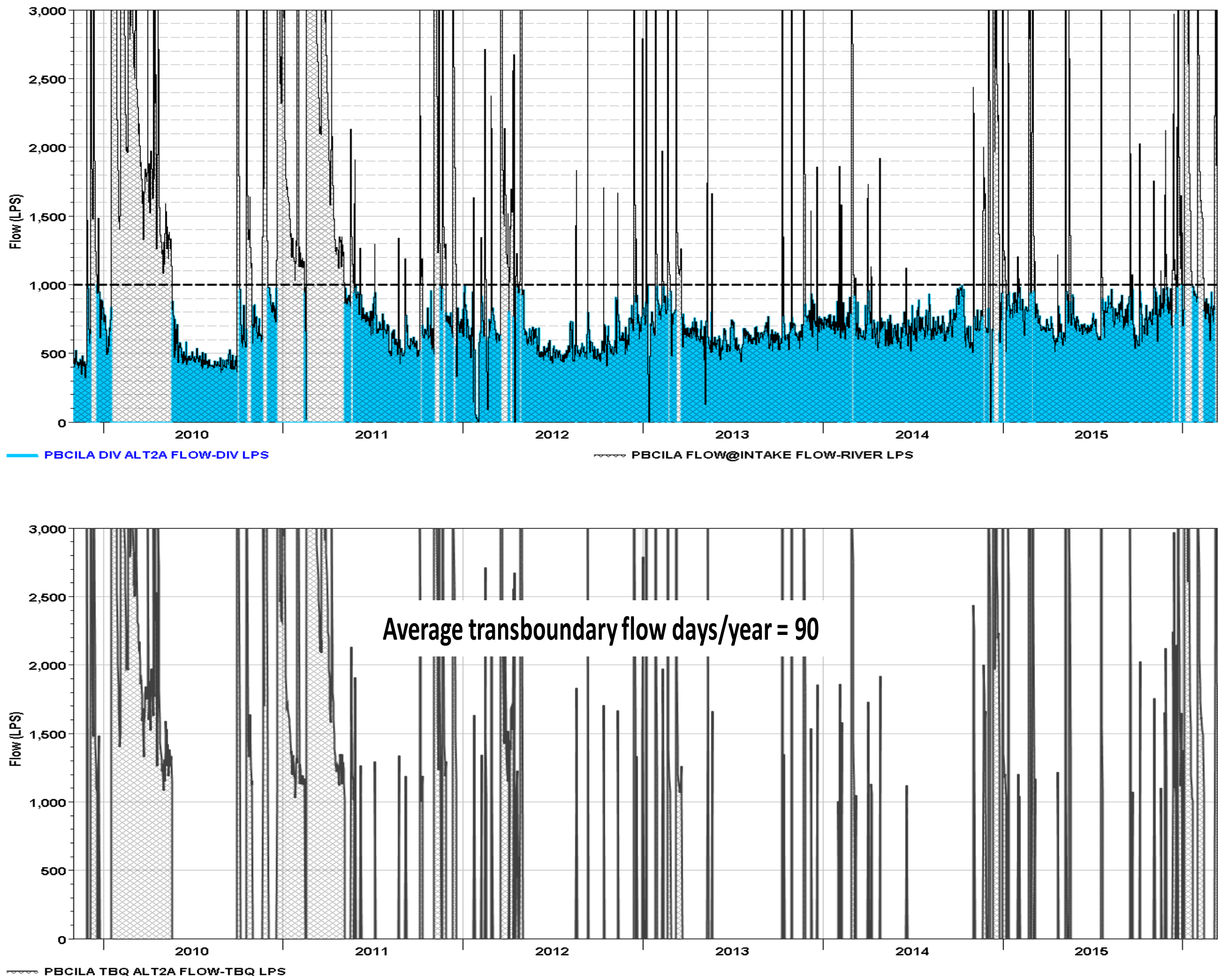


Figure 3-15. Alternative 2a Tijuana River flows and diversions at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

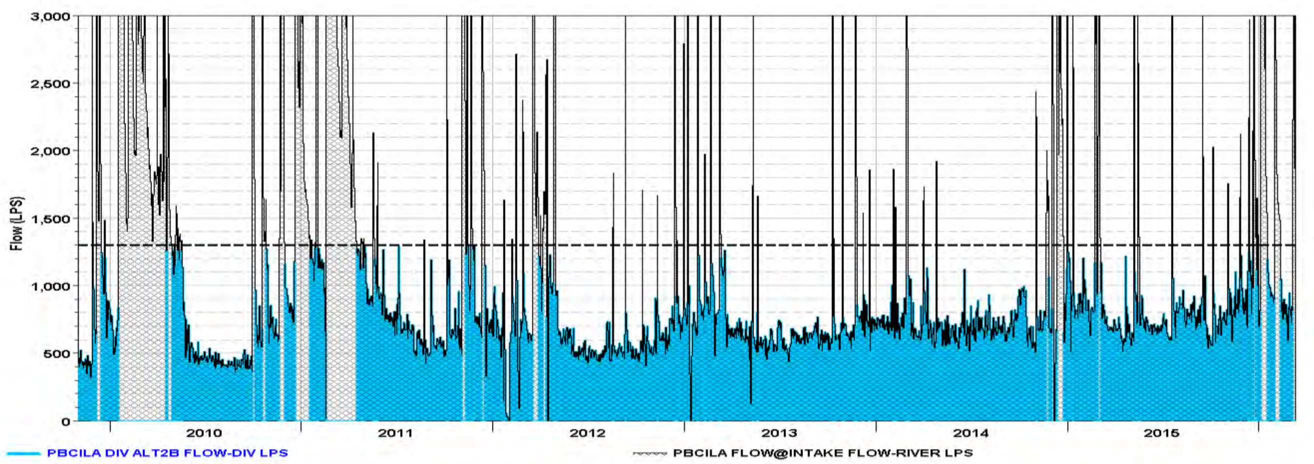
Alternative 2b - Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability

This alternative will intercept all the dry-weather flows with the capability to continue operations during small storm events (wet weather flows less than 1,300 lps or 29 mgd), additionally it will be designed to bring the diversion system lift stations in Figure 3-14 back into service with a quick start-up post-storm event, and once flows have normalized in the Tijuana River. Current protocol requiring shutdown to avoid sediment and debris from entering the system and damaging equipment will be incremented to allow up to 1,300 lps. Improvements and operational modifications for post storm operation includes:

- Alternative 2a improvements

- PBCILA intake re-design based on model-assisted performance evaluations of configurations for effective trash and debris removal, and more efficient flow capture
- Coarse and fine bar mechanical screens at PBCILA and PB1B for sediment removal
- Replacement of the PBCILA pump station wet well
- Addition of an emergency generator for all three pump stations for faster start-up and backup power
- USIBWC/CILA protocol update to allow flows of up to 1,300 lps or 29 mgd to be diverted into PBCILA and pumped throughout the existing diversion system

Figure 3-16 reflects operation conditions with an existing diversion system operating at 29 mgd (1,300 lps) in compliance with an updated USIBWC/CILA protocol that allows for diversion rates of 1,300 lps. Transboundary flow events are expected to occur at an average of 69 days per year. Alternative 2b represents a 69 days average transboundary flow day reduction from the no action baseline (Alternative 1a). Appendix H contains manufacturer product information specific to pumps and standby generators for PBCILA, PB1A and PB1B lift stations.



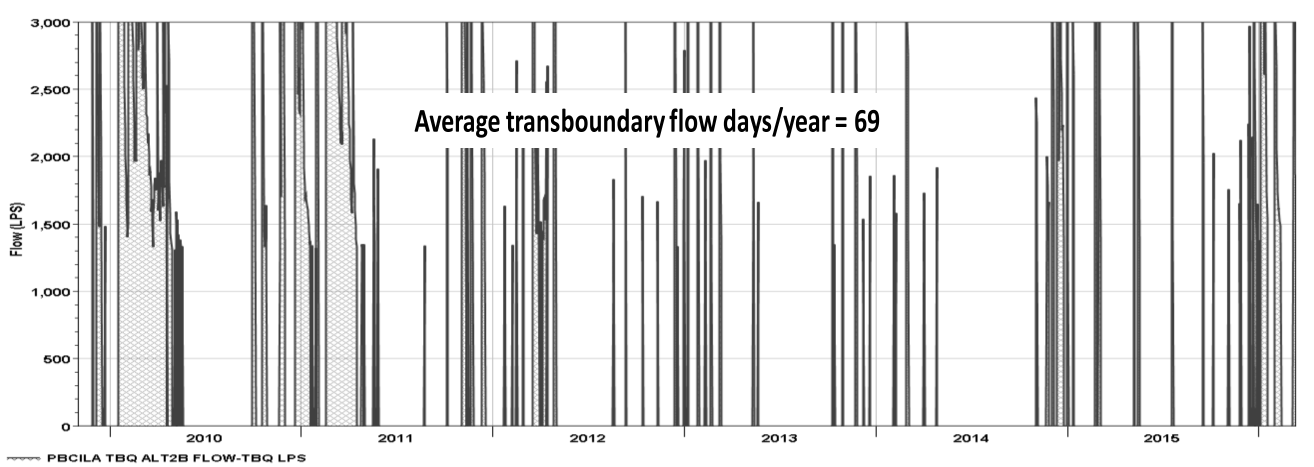


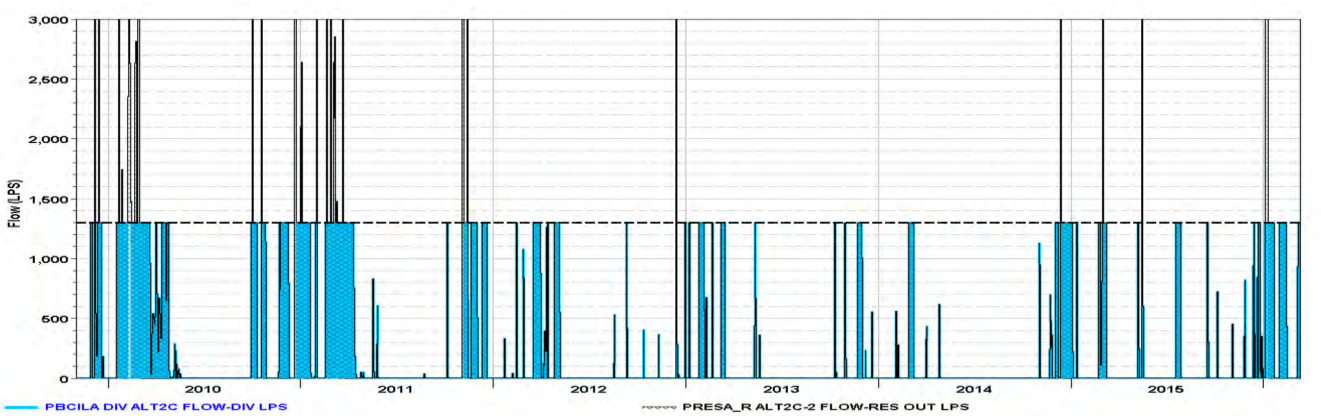
Figure 3-16. Alternative 2b Tijuana River flows and diversions at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

Alternative 2c - Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements

Alternative 2c is comprised of improvements and operational modifications to allow for diversions during wet weather operations, permitting the diversion system a longer capture time, see Figure 3-18. The objective is having functional equipment at PBCILA, PB1A and PB1B during a smaller scale storm event (2-year flood or smaller), while utilizing inflatable dams at selected locations throughout the Tijuana River Channel, adding a composite storage capacity of approximately 1.3 million m^3 or 1,052 acre-feet. Stormwater would be stored and released at a controlled rate of 29 mgd (1,300 lps) to allow the diversion system to operate at its full capacity for more of the time than would naturally be the case. This alternative includes improvements made in Alternative 2b in addition to the inflatable dams.

- Alternative 2b improvements
- 4 inflatable dams throughout different locations within the Tijuana River Channel
- A bypass system allowing 29 mgd (1,300 lps) to flow to the PBCILA intake

Figure 3-17 reflects operation conditions with an improved diversion system (1,300 lps capacity) and four inflatable dams releasing at a constant rate of 1,300 lps during low-flow periods. Transboundary flow days with this alternative would be reduced to 11 days per year on average, representing a 92% (127-day) reduction in number of transboundary flow days from the no-action baseline (Alternative 1a).



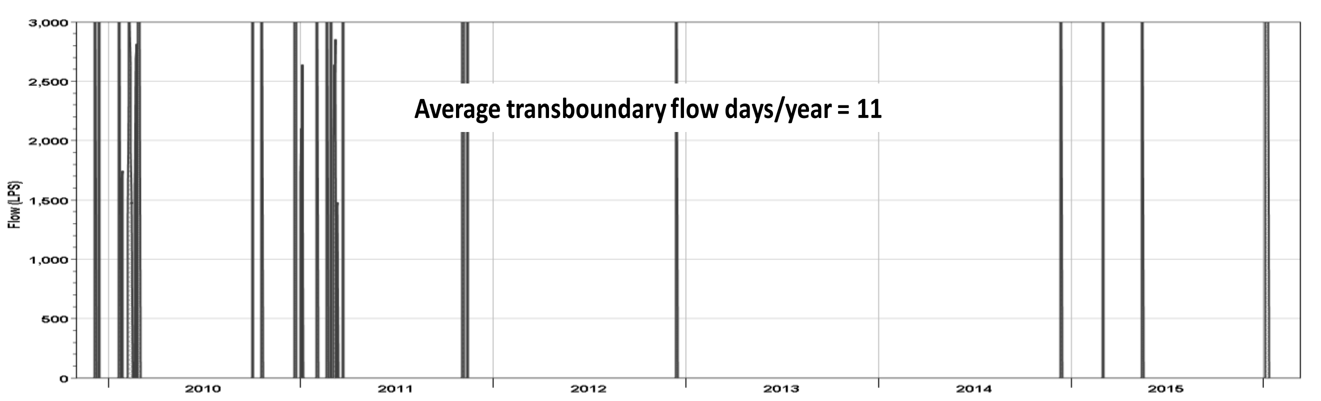


Figure 3-17. Alternative 2c Tijuana River flows and diversions at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

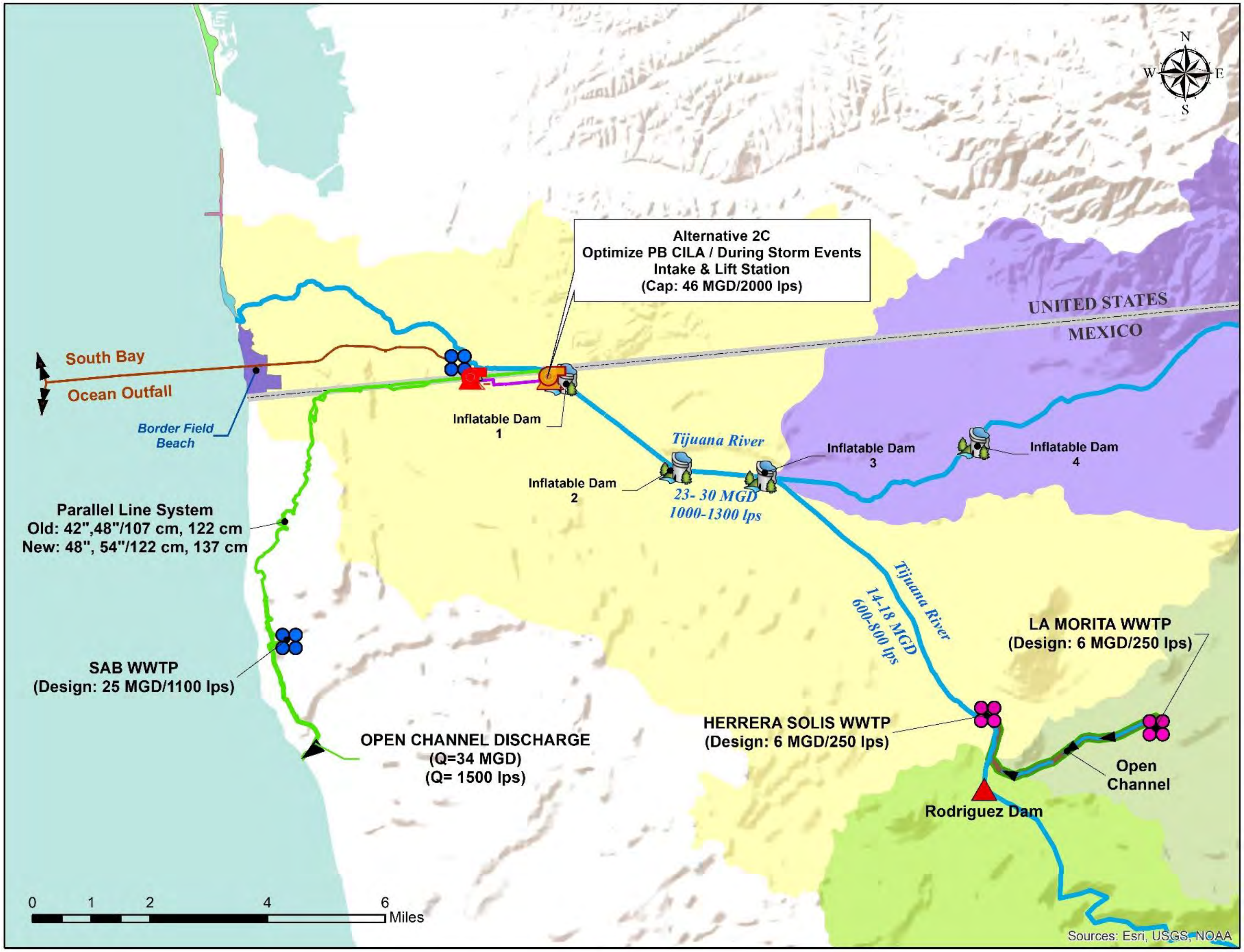


Figure 3-18. Optimize Existing Facilities: Modifications for storm event operations (Alternative 2c)

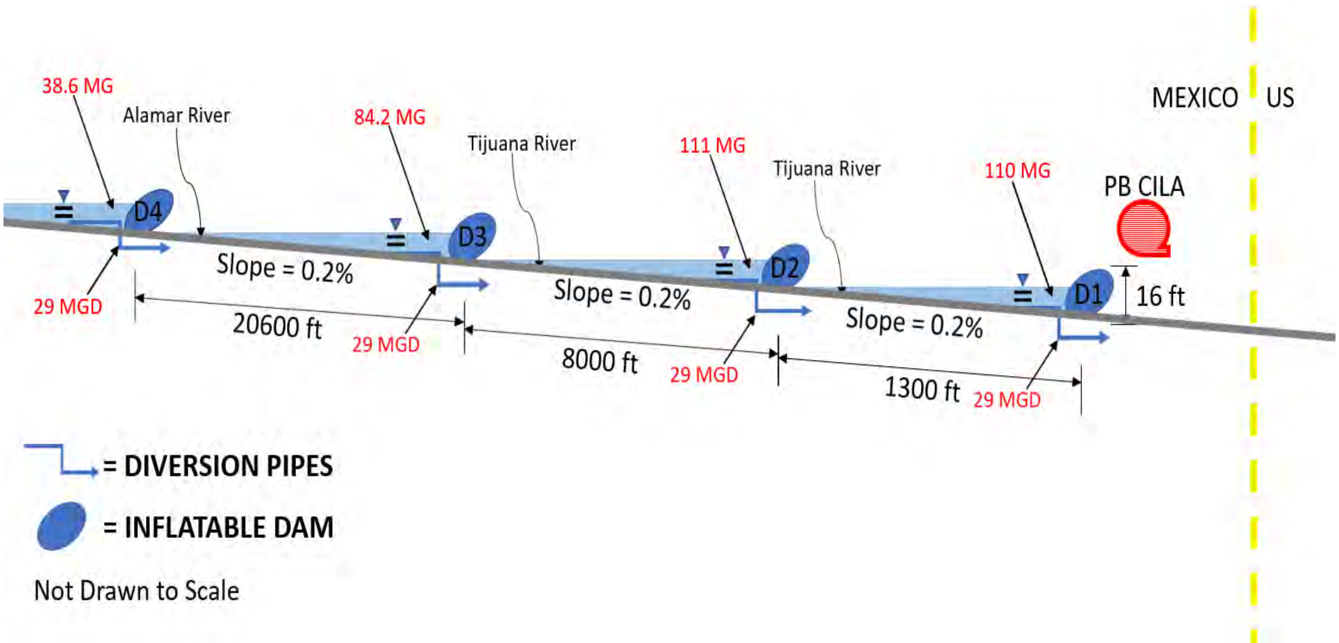


Figure 3-19. Profile View of Proposed Inflatable Dam Systems (Alternative 2c)

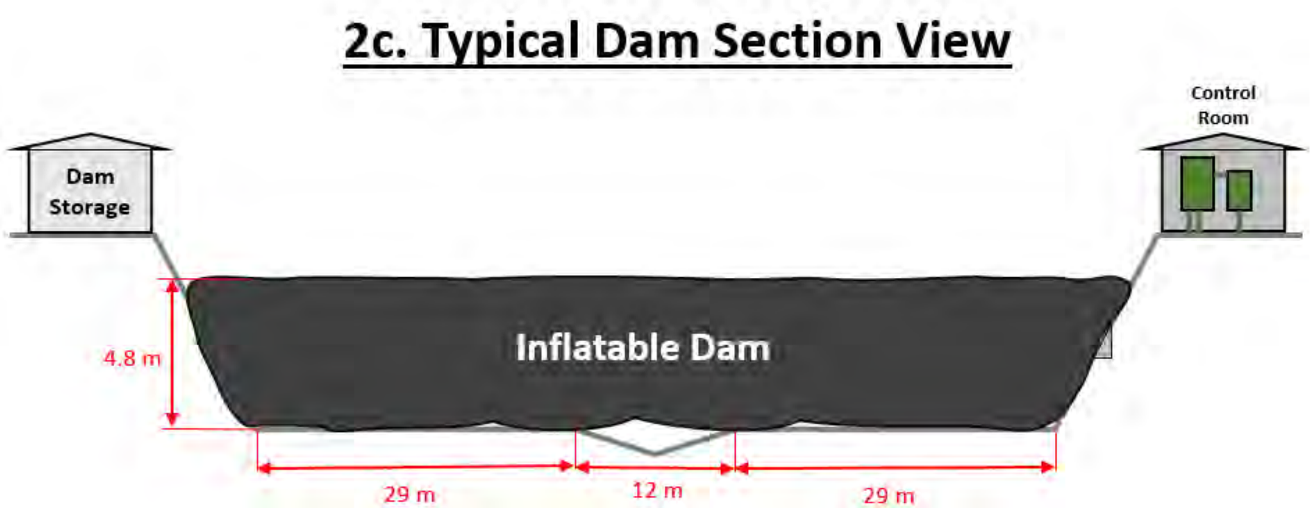


Figure 3-20. Typical Section of Inflatable Dam Systems (Alternative 2c)

Alternative 2c, as shown in Figure 3-19 and Figure 3-20 offers a conceptual option to control flows within the Tijuana River, which could relieve the continuous pressure during high flow volumes at the diversion in-take and mitigate transboundary discharges; however, this type of infrastructure improvement is under the authority of CONAGUA. As such, CONAGUA has advised that obstructions within the Tijuana River Channel could represent flooding concerns to adjacent areas during wet-weather conditions and create a risk for vandalism during dry-weather periods. Therefore, the option was no longer considered feasible for this study.

Category 3, Alternative – 3a, expansion of existing diversion facilities in Mexico

Category 3 encompass the expansion of the existing facilities in conjunction with facility optimization in Mexico to increase pumping and conveyance capacity from 23 to 60 mgd (1,000 lps to 2,600 lps).

Alternative 3a - Diversion system expansion in Mexico up to 2,600 lps (60 mgd)

Alternative 3a, shown in Figure 3-22, includes the improvements listed in Alternative 2b with the addition of the items below:

- Addition of a separate intake box at PBCILA to expand handling an additional capacity of 30 mgd (1,300 lps)
- PBCILA forcemain expansion from PBCILA to PB1A
- Increasing capacity at pump stations downstream PB1A and PB1B incrementing their capacity to handle an additional 30 mgd of flows
- An additional pipeline added to the parallel system pipelines to handle the flows from PB1A and PB1B to tie-in to SAB lift station and WWTP.

Figure 3-21 reflects operation conditions with an expanded and improved diversion system intercepting flows of 60 mgd (2,600 lps). Transboundary flow events are expected to occur at an average of 30 days per year. Alternative 2c represents a 108 days average transboundary flow day reduction from the no action baseline (Alternative 1a).

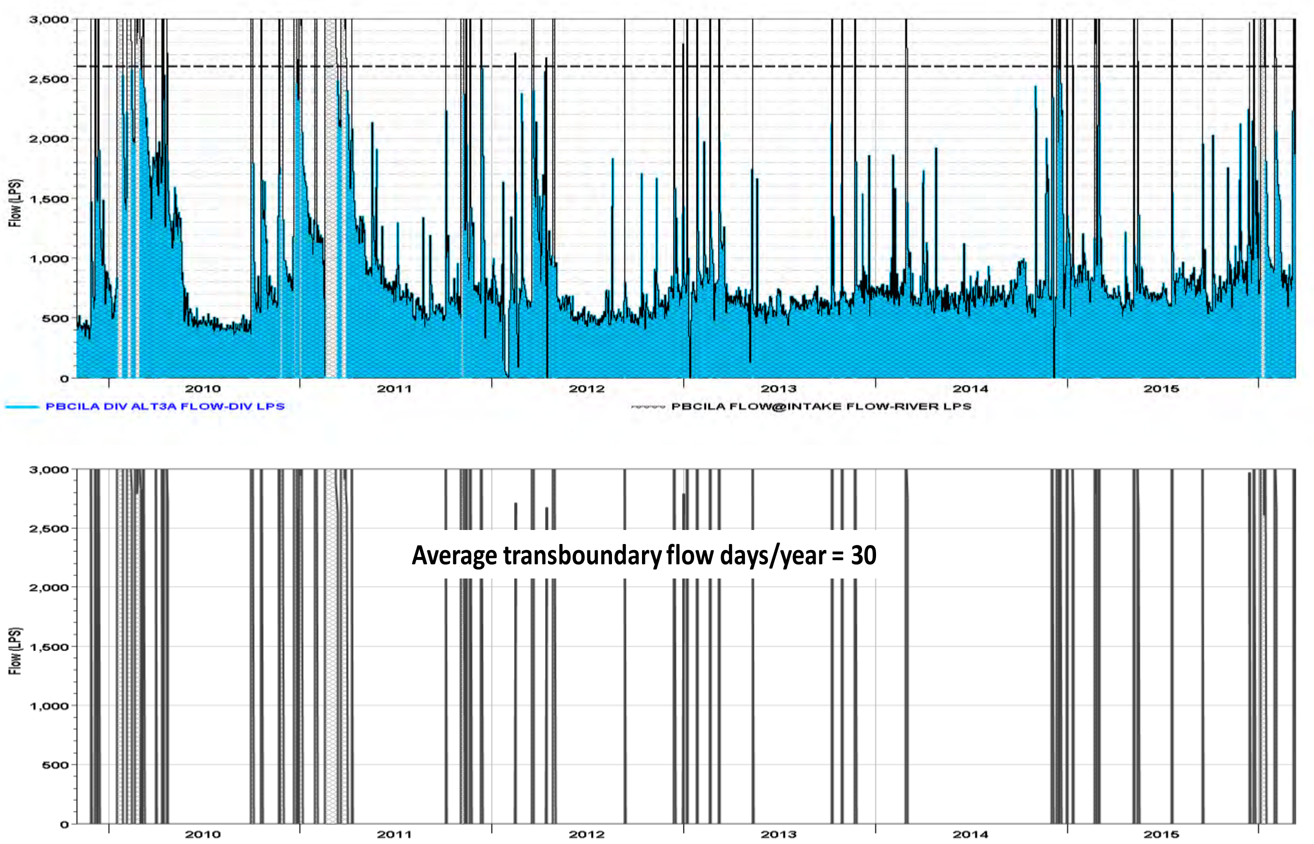


Figure 3-21. Alternative 3a Tijuana River flows and diversion at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

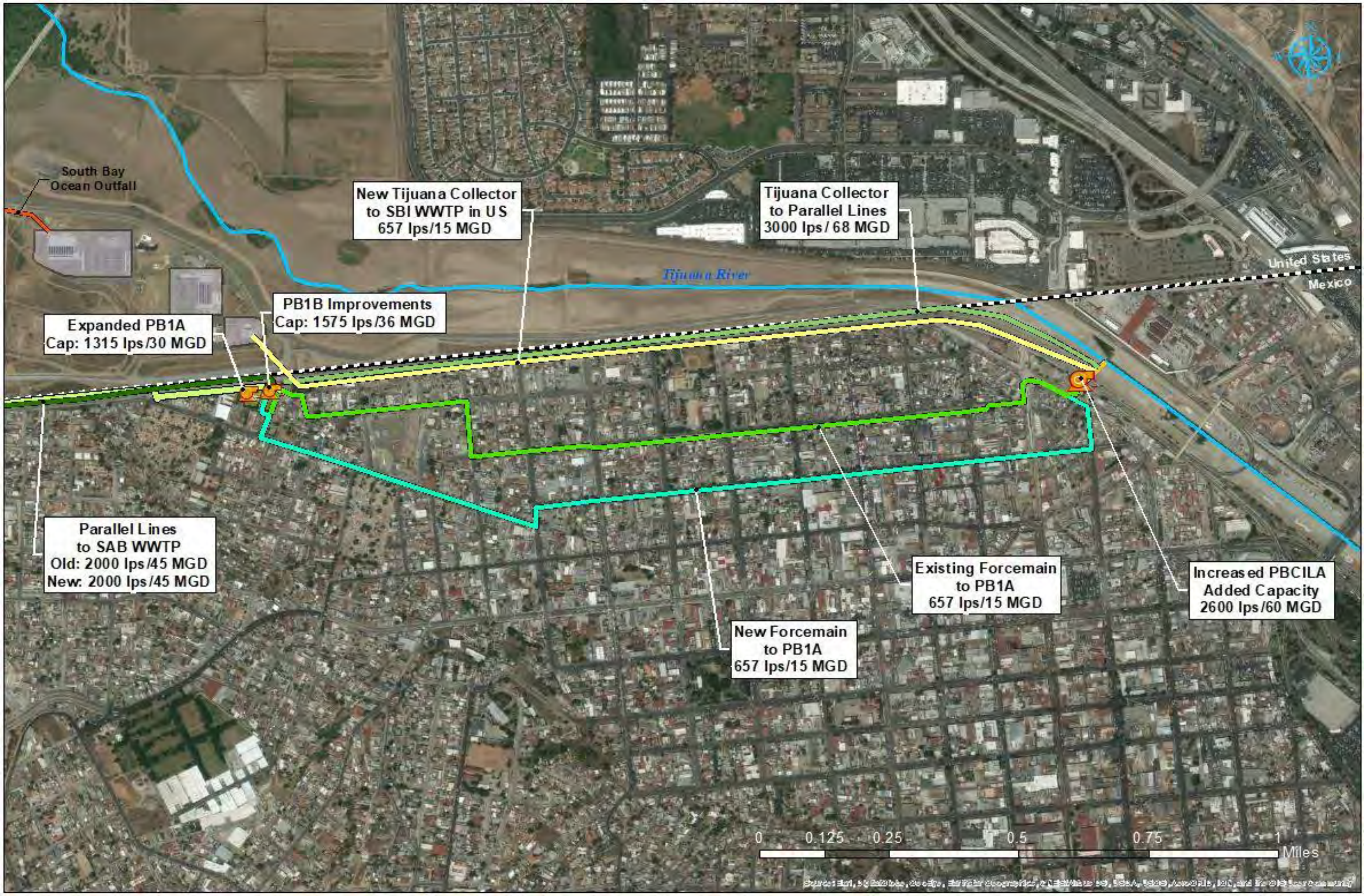


Figure 3-22. Capacity Increase (Alternative 3a)

Category 4, Alternatives– 4a through 4f, new diversion facilities in the U.S. up to 1,500 lps (35 mgd)

Category 4 consists of U.S.-based alternatives to divert flows from the Tijuana River as a counterpart to PBCILA. Category 4 alternatives include a new diversion point flowing either via gravity or via a new lift station from the Tijuana River in the U.S., with an average design flow of 35 mgd (1,500 lps) and diversion capacity to serve as a small wet-weather event diversion infrastructure or as a back-up or redundant system to the diversion infrastructure in Mexico. All U.S. based alternatives are assumed to be operated during existing diversion system failure at PBCILA intake or lift station, or operational/mechanical failures at PBCILA, PB1A or PB1B, or when wet-weather flows under 35 mgd (1,500 lps) exceed PBCILA's capacity. Flows beyond 35 mgd (1,500 lps) at the river will not be diverted.

It is estimated that Category 4 alternatives will be operating approximately 85 days per year on average (using the average number of transboundary flow days/year). Alternative 4f will serve as a temporary or permanent dam for dry-weather flows.

Alternative 4a - New lift station to discharge directly to SBOO without Treatment

A new intake and diversion lift station will intercept transboundary flows in the U.S. side, will bypass treatment at the SBIWTP, discharging directly to the SBOO as shown on Figure 3-24. in green. This Alternative will have no additional treatment and will require an agreement with the California Regional Water Quality Control Board (CRWQCB), San Diego Region, since it may result in exceedances of the NPDES permit for the SBIWTP.

Main components for the new lift station will include:

- The new concrete intake structure, suction and discharge pipelines
- A new wet well sized to withhold a minimum volume of 5 minutes pump running time
- New 35 mgd lift station with pumps, electrical controls, drivers and station housing

Alternative 4b - New lift station to discharge at SBIWTP for primary treatment only

Alternative 4b will take diverted flows to a lift station from the Tijuana River then convey them to the headworks, grit chamber and primary clarification basins at SBIWTP, this would require additional chemicals and disinfection, this option bypasses any secondary treatment. Discharges will flow into the SBOO after disinfection; primary treated flows will blend with the full plant effluent at the blending structure then discharge into the SBOO. This alternative requires:

- A new lift station as described in Alternative 4a
- Retrofitting headworks, grit chamber, the primary clarifiers and sludge handling processes to have high rate primary treatment capabilities with additional chemical enhancement during small storm events or when the new diversion and lift station is operating.
- Additional chemical coagulants, such as ferric and anionic polymer, along with equipment replacement, instrumentation and controls replacement/upgrades throughout the primary treatment unit process.
- An additional disinfection station for additional flows

This Alternative will require agreements and close coordination with CRWQCB to ensure NPDES permit is in compliance for SBIWTP.

Figure 3-24. shows Alternative 4b in light orange; which will discharge at SBIWTP and run through the primary treatment process only, then blend with the full plant effluent and discharge to the ocean through the SBOO.

Alternative 4c - New lift station to discharge at SBIWTP or SBWRP for full treatment

Alternative 4c (shown on Figure 3-24.) aims at having diverted flows from a new intake/lift station for full treatment at SBIWTP before discharging at the SBOO. This alternative requires retrofitting the primary treatment with equipment, instrumentation and control replacement and upgrades similar to Alternative 4b. Improvements at the secondary treatment will require:

- Modifications/expansion to the activated sludge, secondary sedimentation and equalization basins
- Waste activated sludge expansion
- Expansion of the thickening facility/sludge storage area/dewatering building to handle the added 35 mgd
- Hydraulic and process modeling for analysis for expansion
    - This option may disrupt the existing activated sludge, both a hydraulic and process model should be used to determine additional flow capacities at the facility.

The main components for the new lift station remain similar to Alternative 4a, however as shown in Figure 3-24. Alternative 4c reroutes the transboundary flow discharges from the new lift station to run throughout the entire plant process.

Alternative 4d - New Lift Station to Discharge at Point Loma WWTP

With this alternative, flows from the Tijuana River would be diverted at the proposed lift station to an existing collection system and wastewater pipeline that connects to Point Loma WWTP. Approximately 5,600 linear feet (LF) of the existing line has been abandoned, and consequently a replacement line with tie-in into the existing collection system is included under this Alternative. As shown in Figure 3-24., diverted flows will then be treated before reaching the ocean at the Point Loma WWTP. This Alternative requires an agreement with the CRWQCB San Diego Region for an emergency discharge permit amendment for the additional flows and the resulting water quality level after the blending with the wastewater collection system occurs. Availability to send flows to Point Loma WWTP may require coordination with phase 1 of the San Diego Pure Water Project taking place in the central area of the city.

The lift station system will take flows from the Tijuana River Channel and discharge them into the abandoned pipeline directing flow into Point Loma WWTP. Figure 3-24. shows the re-routing in pink. This option will not discharge any flows through the SBOO, since it will be diverting the flows north to Point Loma WWTP and eventually discharge into the Point Loma Ocean Outfall.

Alternative 4e - Gravity flow to the SBOO

Alternative 4e utilizes gravity to divert flows from the Tijuana River to a proposed junction box with screening prior to tie-in into the SBOO without any additional treatment. Diverted flows will blend with the full plant effluent at the SBOO. As shown on Figure 3-24., this alternative adds approximately 4000 LF of 48-inch gravity main with trash screens at a junction box to impede any large debris and limit sediment from reaching the SBOO for pipe protection. Further analysis deemed this design as not meeting minimum slope requirements for gravity flow from the Tijuana River to the SBOO blending box and therefore deemed as not technically feasible.

Figure 3-23 reflects operation conditions with a new U.S. component to the diversion system operating at a diversion flow of 35 mgd (1,500 lps). Transboundary flow events are expected to occur at an average of 58 days per year. Implementing one of the alternatives 4a to 4e represents an 80-day average transboundary flow reduction from the no action baseline (Alternative 1a).

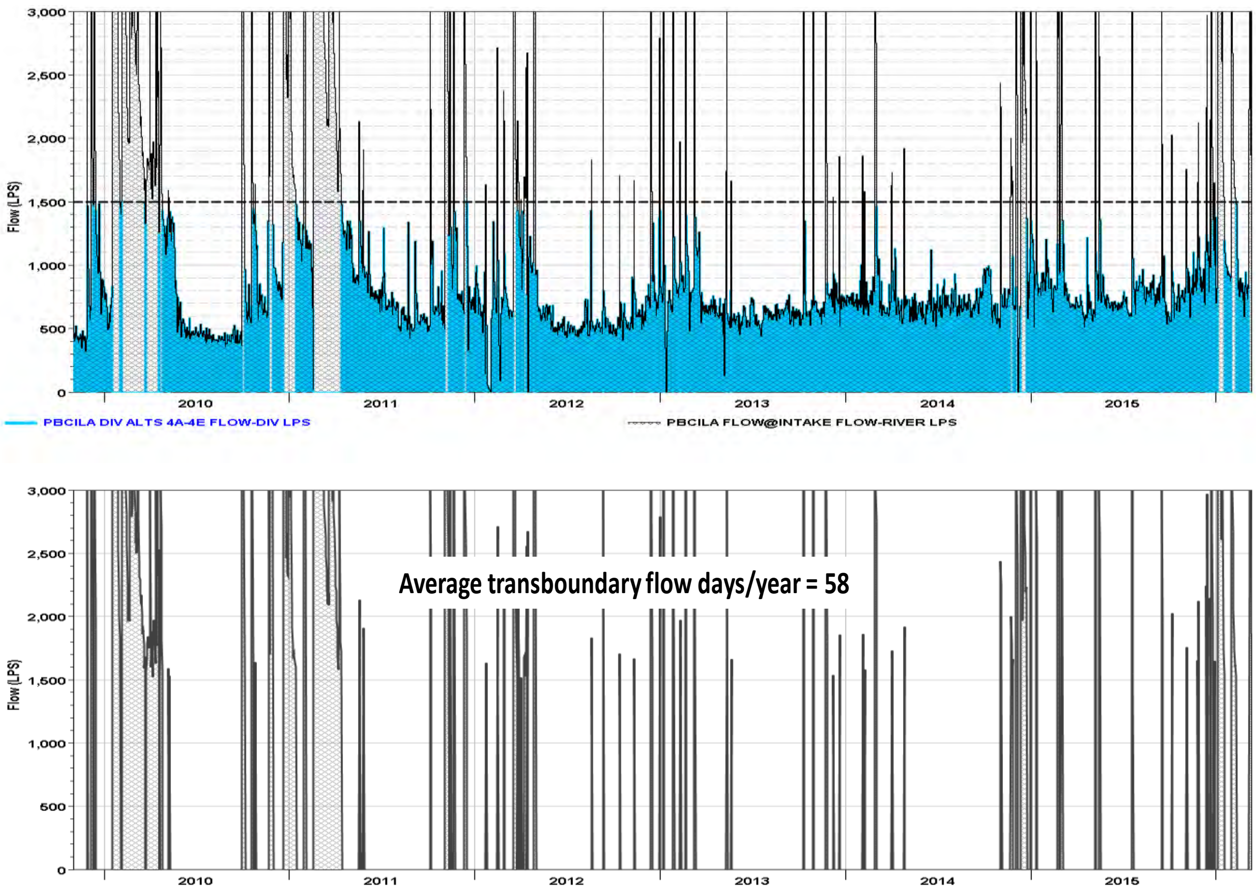


Figure 3-23. Alternatives 4a-4e and 5d Tijuana River flows and diversions at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

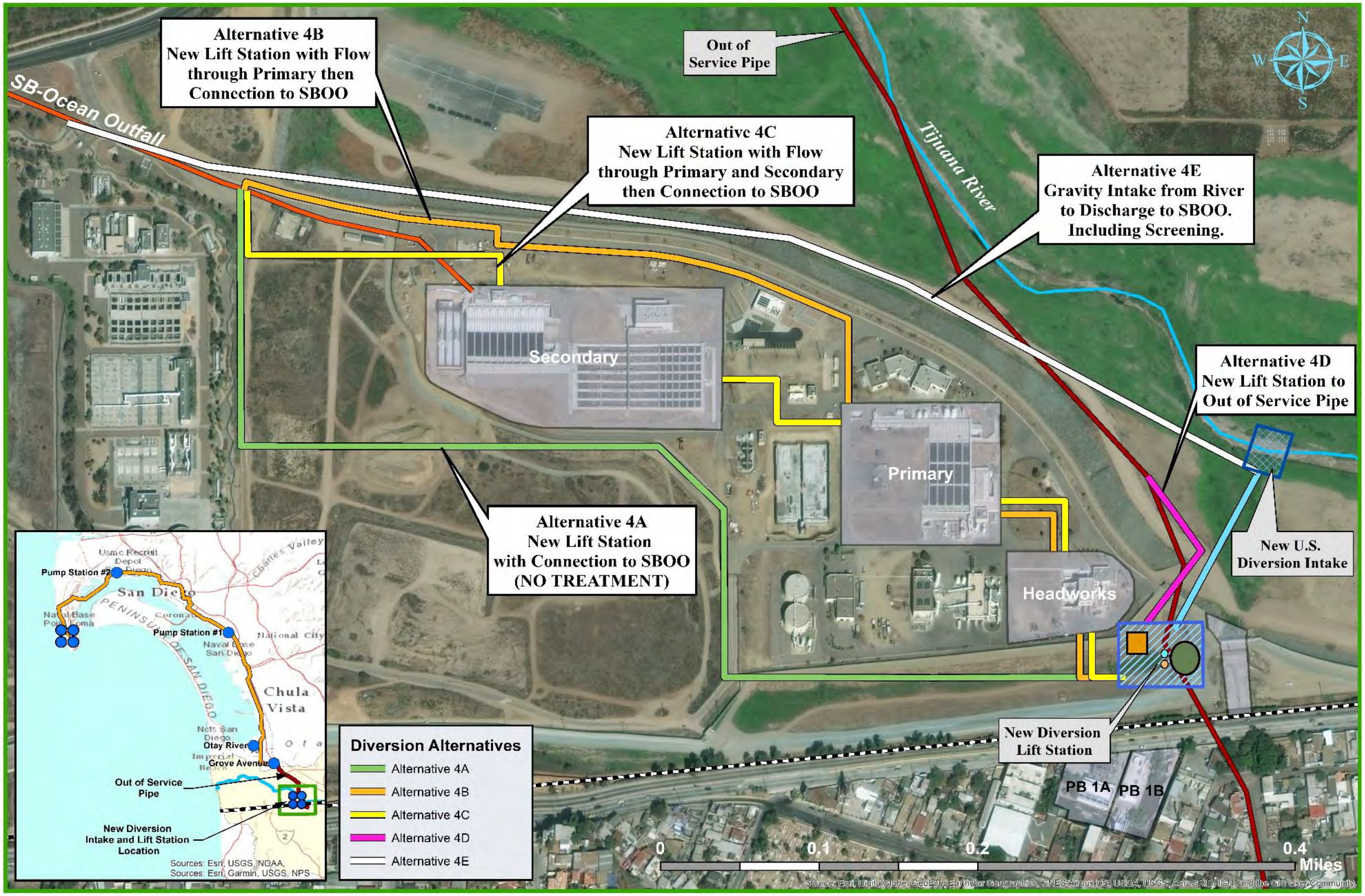


Figure 3-24. Category 4 Infrastructure Improvements in the U.S. (Alternatives 4a-4e)

Alternative 4f - Single inflatable dam or permanent weir on US-side of the Tijuana River

Alternative 4f derived from current operations from USIBWC by placing a temporary earthen weir at the international border, approximately 1,300 feet from the PBCILA intake. The dam is comprised of an inflatable dam that can regulate small dry-weather flows resulting from water or wastewater pipeline breaks or and urban runoff from the City of Tijuana. This single temporary dam can be set at a selected location, as shown in Figure 3-25 within 2,300 feet from the PBCILA to maximize a storage capacity of approximately 60,300 m^3 or 49 acre-feet. This alternative will function independently from Alternative 2c, and while its recommended to place the dam as far northwest as possible within the existing channel, maximizing the storage capacity, this temporary dam can also be placed at the international border line.

Figure 3-25. Alternative 4f – Single inflatable dam downstream of PBCILA

Category 5, Alternatives– 5a through 5d, Combined U.S. – Mexico Diversion Facilities Improvements

Category 5 alternatives utilize a bilateral effort to divert flows from the Tijuana River. Alternatives 5a to 5c propose a reclaimed water pipeline system to carry discharges from La Morita and Herrera Solis WWTPs away from the Tijuana River to open capacity at the Diversion System. This new "purple" pipeline could be advantageous for the City of Tijuana, for future non-potable use. The purpose of alternatives 5a to 5c is to: (1) remove approximately 12 mgd (525 lps) of reclaimed wastewater currently discharging to the Tijuana Diversion system (PBCILA, PB1A, PB1B and either SAB WWTP or SBIWTP), and; (2) preserve the reclaimed water quality gained at the treatment processes at both La Morita and Herrera Solis WWTPs, currently conveyed through the open channel at the Tijuana River. Presently, both WWTPs discharge into the concrete-lined Tijuana river mixing with flows from other sources that likely impair the reclaimed water quality. For pipe diameter selection purposes, options considered under Category 5 account for future conditions with peak flows of approximately 20 mgd from each WWTP, totaling 40 mgd. Appendix C shows the estimated population growth conditions from the Tijuana River sub-basins with a potential flow impact to the diversion system from 2018 until 2050.

Alternative 5a - Gravity reclaimed water pipeline from WWTPs to SBOO

Approximately 12 mgd of reclaimed water flows will be conveyed via a new reclaimed water pipeline system from La Morita and Herrera Solis WWTP for about 16 miles through Tijuana, as shown in Figure 3-26. The new reclaimed water pipeline system with flows from the two treatment facilities will tie-in to the SBOO for ocean discharge.

Alternative 5b - Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP

Reclaimed water flows from La Morita and Herrera Solis WWTP would be carried to the Point Loma WWTP. Reclaimed flows from the treatment facilities will tie into an existing wastewater line in place to carry flows to the Point Loma WWTP; however, the interior conditions of the out of service pipeline are unknown. Since this segment has been out of service for more than 10 years and is no longer functional, an open-cut method to replace approximately 5,600 LF of 30-inch reinforced concrete pipe would be required and is included as part of this alternative. Discharge from Point Loma WWTP would be required to meet the water quantity and quality requirements established by the California Ocean Plan. Because the additional influent water will be coming from La Morita and Herrera Solis WWTPs at a reclaimed wastewater quality level, the Point Loma plant should be expected to continue meeting discharge permit conditions. Additionally, treatment capacity should be made available to receive flows from La Morita and Herrera Solis WWTPs with the reuse water re-direction under Phase 1 of the San Diego Pure Water Project. A schematic of the proposed pipeline location is shown on Figure 3-26.

Alternative 5c – Gravity Reclaim Water Pipeline System from La Morita and Herrera Solis WWTPs to Punta Bandera (Ocean Discharge)

Reclaimed water flows from La Morita and Herrera Solis WWTPs will be conveyed via a new 48-inch reclaimed water pipeline system for about 15 miles through Tijuana. These flows will tie into the ocean open channel outfall from SAB WWTP at Punta Bandera. This alternative includes all pipelines for reclaimed water in Tijuana with appurtenances. A schematic of the proposed pipeline locations is in Figure 3-26.

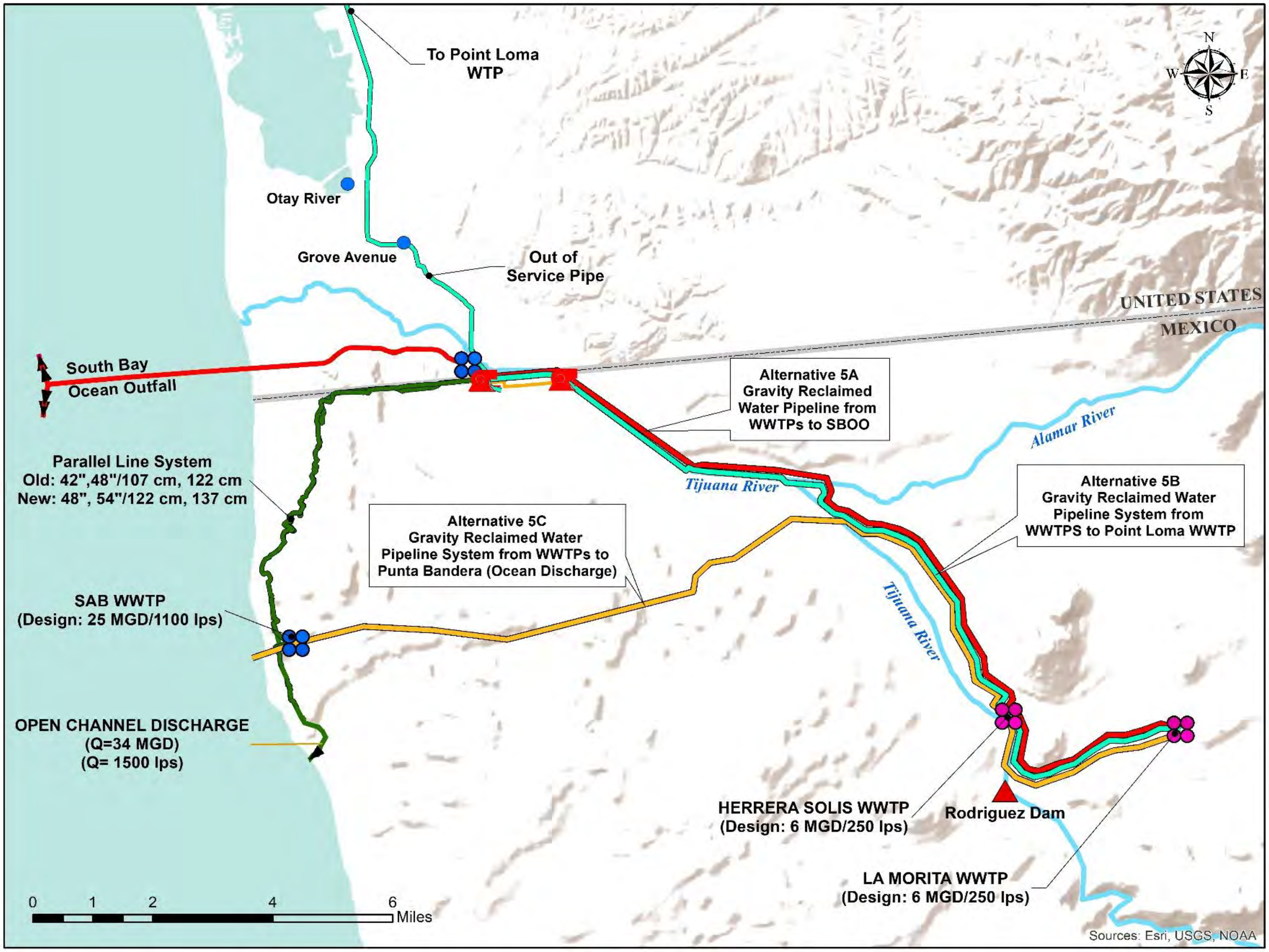


Figure 3-26. Category 5 Combined U.S. and Mexico Infrastructure (Alternative 5a-5c)

Figure 3-27 below reflects operation conditions when removing 12 mgd (525 lps) of flows from the Tijuana River and the diversion system. Transboundary flow events are expected to occur at an average of 42 days per year. Implementing one of the alternatives 5a to 5c represents a 96-day average transboundary flow reduction from the no action baseline (Alternative 1a).

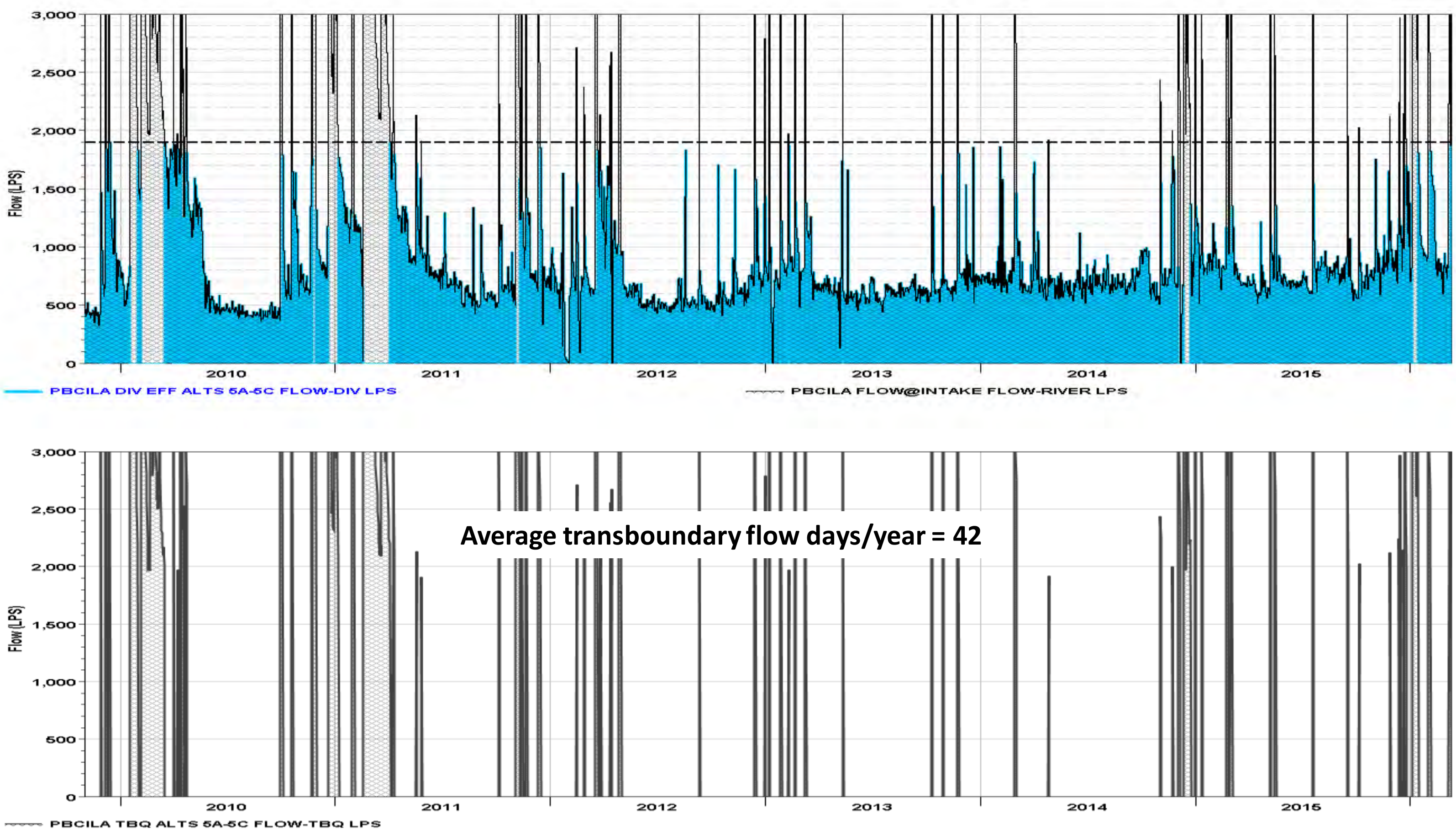


Figure 3-27. Alternatives 5a-5c Tijuana River flows and diversions at PBCILA intake (top), transboundary flows (bottom), November 2009 - March 2016

Alternative 5d - New Lift Station to Divert Flow in the U.S. with Discharge to the PERC and treatment at SAB WWTP

Transboundary flows will be intercepted via a new U.S. intake and diversion lift station that will bypass treatment at the SBIWTP, this system will discharge directly to the PERC as shown in Figure 3-28. This alternative will not have any additional treatment at SBIWTP. After being diverted in the US, it will be redirected into the abandoned PERC line. The PERC will then divert the flows back into the PB1B influent channel and through the lift station. All flows will be directed via a new forcemain/gravity combined parallel system to SAB WWTP. This alternative does not include the improvements to SAB WWTP. Proposed improvements on SAB WWTP are currently being developed by CESPT, under a project titled in Spanish as "Proyecto de Construcción y Rehabilitación de la PTAR San Antonio de los Buenos" (SAB WWTP Construction and Rehabilitation Project).

Main components include:

- A new concrete intake structure, suction and discharge pipelines with all required fittings and appurtenances,
- A new wet well sized to withhold a minimum volume of 5-minute pump running time similar to Alternative 4a and a 35 mgd lift station.
- PERC will have to be rehabilitated for usage and capacity to PB1B will have to be upgraded to handle the additional flows.
- Capacity at PB1A and PB1B will have to increase to an additional 35 mgd
- A new 10-mile-long forcemain/gravity main 48-inch line is included as part of this alternative connecting additional flows from PB1B to SAB WWTP.

Performance for alternative 5d is shown in Figure 3-28. This alternative's operation conditions with a new U.S. component to the diversion system operating at a diversion flow of 35 mgd (1,500 lps) will send flows to SAB WWTP. Transboundary flow events are expected to occur at an average of 58 days per year, representing an 80-day average transboundary flow reduction from the no action baseline (Alternative 1a).

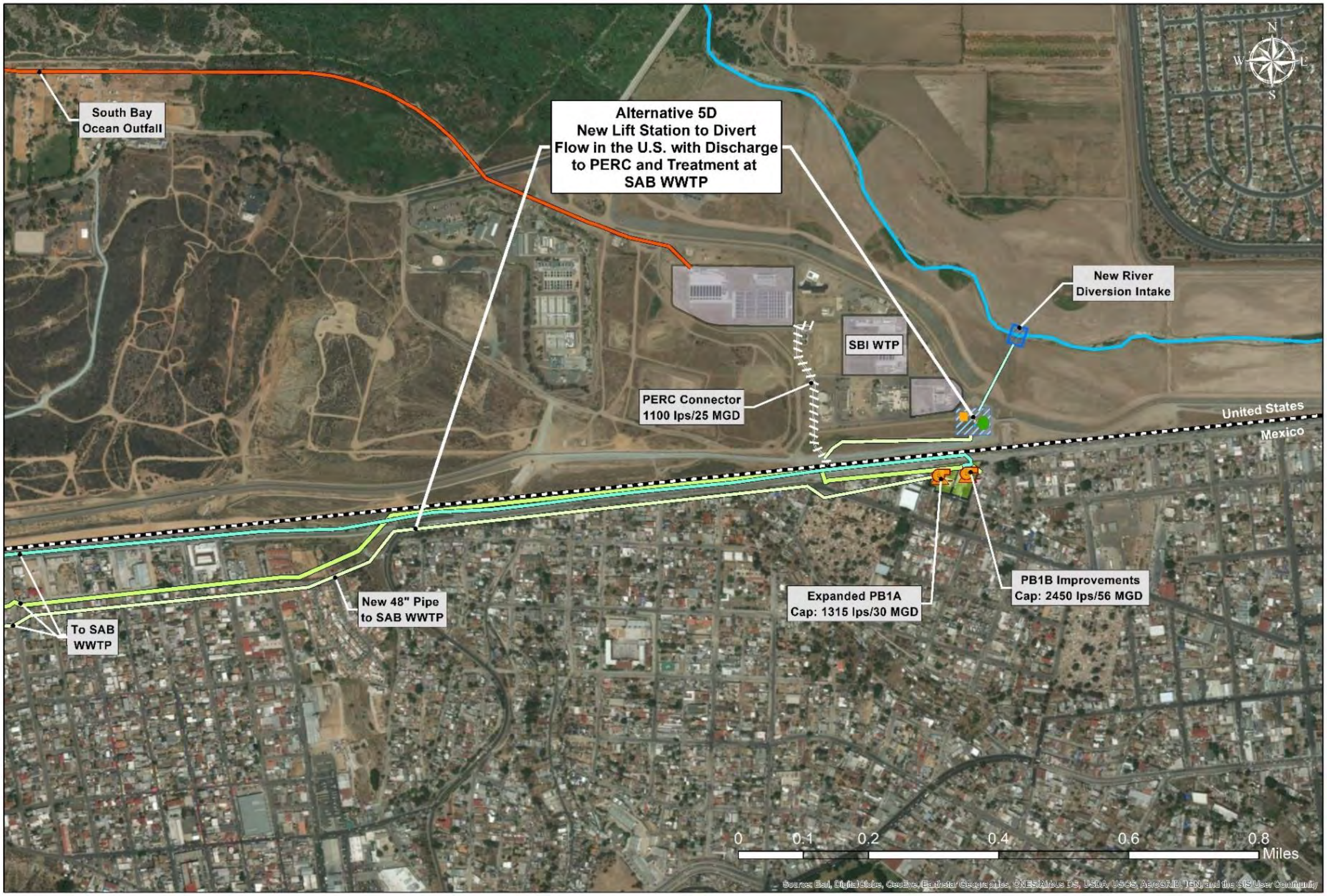


Figure 3-28. Lift Station with discharge at PERC and treatment at SAB WWTP (Alternative 5d)

3.2.2 Construction Cost and O&M Estimates

A study level of probable construction cost was developed for each alternative using a combination of sources that included RSMeans[17], historical bid tabs from the region, vendor/manufacturer estimates, communication with regional contractors and previous completed projects. The costs include improvements and/or modifications to existing infrastructure and a 30 % contingency to account for unknowns at this early stage.

Capital and operations costs were developed for the required system improvements and upgrades identified for each alternative described in Section 3.2. The cost estimates presented herein are based on available existing information and engineering judgment. The level of accuracy for the cost estimates corresponds to the Class 4 estimate as defined by the Association for the Advancement of Cost Engineering International. This level of engineering cost estimating is approximate and generally made without detailed engineering data and site layouts but is appropriate for preliminary budget-level estimating. The accuracy range of a Class 4 estimate is minus 15 to plus 20 % in the best case and minus 30 % to plus 50 % in the worst case.

The unit capital costs include materials of construction, installation, and contractor costs (overhead, profit, bonding, mobilization). All U.S. based costs include 5 % for mobilization, demobilizations and bonds; 12 % factor for engineering and 10 % for construction administration; 30 % for project contingencies and 15 % for contractors overhead and profit. All Mexico based costs include a 3 % factor for mobilization, 4 % factor for engineering and 5 % for construction administration; 30 % for project contingencies and a range between 5 to 8 % for contractors overhead and profit. All costs are developed for 2019 values, a future value should be considered for all technical alternatives when being considered at a later year. The net present value (NPV) of the operation and maintenance cost will be presented for the refined alternatives under section 4.1. Detail cost-estimates for all alternatives are included as part of Appendix I.

[17] CostWorks Version 16.02, RSMeans -- 2018 Estimating Cost with RSMeans from Gordian

Table 3-2. Summary of all Technical Alternatives, Costs and Flow Reduction Days

Category		Alternative	Description	Targeted diversion flow capacity[1]	Capital cost[2]	O&M cost (20-yr life cycle)	Average trans-boundary flow days/yr (days reduction, percent reduction)[1]
NO ACTION	1a	No Action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016	Existing facilities and historical diversions	1,000 lps (23 mgd)	$0	$2.7 M/yr	138
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	2a	Optimize existing facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps	River intake and lift station systems improvements (PBCILA, PB1A&1B) for reliable diversion of Tijuana River flows in accordance with existing operational protocol	1,000 lps (23 mgd)	$16 M	$4.35 M/yr	90 (-48, -35%)
	2b	Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability	River intake and lift stations (PBCILA, PB1A&1B) additional equipment, backup power supply, removal of silt and trash, and operational protocol modified to allow diversion of Tijuana River flows up to 1,300 lps	1,300 lps (29 mgd)	$24.5 M	$4.95 M/yr	69 (-69, -50%)
	2c	Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements	In combination with 2b facility improvements, addition of 4 inflatable dams impounding approximately 1.3M m^3 storage for detention of Tijuana River flows up to 1,300 lps	1,300 lps (29 mgd)	$32 M	$5.55 M/yr	11 (-127, -92%)
	3a	Diversion capacity expansion: Diversion system expansion in Mexico up to 2,600 lps (60 mgd)	Double the nominal capacity of diversion intake, PBCILA, and PB1A&1B lift stations, and modify operational protocol to allow diversion of Tijuana River flows up to 2,600 lps	2,600 lps (60 mgd)	$110 M	$6.59 M/yr	30 (-108, -78%)
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4a	New U.S. diversion infrastructure: New lift station to discharge directly to SBOO without treatment	New concrete diversion structure, a 35-MGD lift station to tie into SBOO without additional treatment.	1,500 lps (35 mgd)	$27.5 M	$5.5 M/yr[3]	58 (-80, -58%)
	4b	New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for primary treatment only *OPTION: Discharge at South Bay Reclamation Plant*	New concrete diversion structure, a 35-MGD lift station with primary treatment at SBIWTP, blending with full treatment discharges.	1,500 lps (35 mgd)	$48 M	$8.9 M/yr[3]	
	4c	New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for full treatment	New concrete diversion structure, a 35-MGD lift station with discharge at SBIWTP or SBWRP for full plant treatment.	1,500 lps (35 mgd)	$236 M	$9.5 M/yr[3]	
	4d	New U.S. diversion infrastructure: New lift station to discharge to Point Loma WWTP	New concrete diversion structure, a 35-MGD lift station with tie-in to abandoned line connecting to Point Loma WWTP	1,500 lps (35 mgd)	$43 M	$5.2 M/yr[3]	
	4e	New U.S. diversion infrastructure: Gravity flow to the SBOO	U.S. Tijuana River intake via gravity to discharge to SBOO	1,500 lps (35 mgd)	$18 M	$4.0 M/yr[3]	
	4f	New U.S. diversion infrastructure: Single inflatable dam or permanent weir on US-side of the Tijuana River *OPTION: To be located in Mexico*	Detention of small transboundary flows up to 100 lps	< 100 lps (2.3 mgd) (estimated - not modeled)	$8.6 M	$4.0 M/yr[3]	122 (-16, -12%)
COMBINED U.S. - MEXICO DIVERSION FACILITIES IMPROVEMENTS UP TO 29MGD (1,300 LPS)	5a	Gravity reclaimed water pipeline from WWTPs to SBOO	Reclaimed water pipeline from La Morita and Herrera-Solis WWTP with tie-in to SBOO	1,300 lps (29 mgd) + 600 lps (14 mgd) removal from River	$158 M	$5.4 M/yr	42 (-96, -70%)
	5b	Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP	Reclaimed water pipeline from La Morita and Herrera-Solis WWTP with tie-in to abandoned line reaching Point Loma WWTP	1,300 lps (29 mgd) + 600 lps (14 mgd) removal from River	$173 M	$6.9 M/yr	
	5c	Gravity reclaimed water pipeline system from WWTPs to Punta Bandera (ocean discharge)	Reclaimed water pipeline from La Morita and Herrera-Solis WWTP with tie-in to Punta Bandera.	1,300 lps (29 mgd) + 600 lps (14 mgd) removal from River	$213 M	$5.4 M/yr	
	5d	New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP	New concrete diversion structure, a 35-MGD lift station with discharge at using the PERC and discharging to the ocean through SAB WWTP.	1,500 lps (35 mgd)	$106 M	$16.3 M/yr	58 (-80, -58%)

[1]Data available from November 2009 - March 2016. [2]Capital costs are estimated to reflect regional labor, materials are U.S. Based, and all include a 30% contingency. [3]U.S. Side options are anticipated to operate only during failures of the diversion system in Mexico or when wet-weather flows are less than 1,500 lps (35 mgd). O&M Cost assume that the diversion system in Tijuana, B.C., Mexico will continue to divert dry-weather flows, as currently operated; therefore, O&M costs for the technical alternatives located in the U.S. include the existing O&M costs for the No Action alternative plus the cost for the new U.S. side alternative.

3.3 Alternatives Screening and Potential Investment Options

3.3.1 Cost and Non-Cost Evaluation Criteria

As shown in Table 3-2, capital costs for the potential investment alternatives range from $8M to $236M for those options considered viable. However, an evaluation of alternatives based only on costs would not result in a fair comparison for decision-making purposes since each investment supports different outcomes related to decreasing days of transboundary flows to the U.S. and each has activities with varying levels of anticipated implementation challenges. These non-cost characteristics of each alternative were integrated into the evaluation criteria for a more balanced comparison of options.

Each alternative was evaluated based on the following four factors, with weighted values as noted:

- Capital cost (25%)
- O&M cost (30%)
- Estimated days per year with transboundary flows (30%)
- Characteristics affecting feasibility (15%)

The first three factors were scored by comparing each option to the other, resulting in a calculated score prorated based on the maximum and minimum values for each factor. The factor for characteristics affecting feasibility considered any potential difficulties in implementing or operating the proposed infrastructure, such as requiring modifications to existing practices, regulatory or permitting needs, and physical capacity constraints in managing any new flows. The infrastructure investment options were ranked with the expectation that all viable options would provide reliable diversion of transboundary flows in the Tijuana River up to the design capacity. A matrix comparison of the technical alternatives was used to identify the top diversion system investment options.

Table 3-3. Tijuana River Diversion Alternatives: Evaluation summarizes the scoring of each investment option in consideration of the evaluation criteria, the attributes of each alternative under each criterion, and the score assigned to each alternative for each criterion. Scores were multiplied by the weighting factor and aggregated to determine the final score.

Table 3-3. Tijuana River Diversion Alternatives: Evaluation Matrix

Category		Alternative	Capital Cost[2]			O&M Cost			Average Transboundary Flow[1]			Average Transboundary Flow (days/yr)			Final Weighted Score
			Cost	Score	Weighted Score 30%	Cost	Score	Weighted Score 25%	Days/Year	Score	Weighted Score 30%	Characteristics Affecting Feasibility	Score	Weighted Score 15%	
No Action	1a	No Action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016	$0			$2.7 M/yr			138						Not Viable
INFRASTRUCTURE IMPROVEMENTS IN MEXICO	2a	Optimize Existing Facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps	$16 M	4.7	1.2	$4.35 M/yr	4.5	1.4	90	2.5	0.8	Minor modifications to existing infrastructure	5.0	0.8	4.04
	2b	Optimize Existing Facilities with Improvements: Allow diversions up to 1,300 lps and improve reliability	$24.5 M	4.6	1.2	$4.95 M/yr	4.3	1.3	69	3.2	1.0	Moderate modifications to existing infrastructure	5.0	0.8	4.15
	2c	Diversion System Improvements: Added detention storage upstream of PBCILA in combination with 2b improvements	$32 M	4.5	1.1	$5.55 M/yr	4.2	1.2	11	5.0	1.5	Significant implementation and operational concerns from CONAGUA	1.0	0.2	Not Viable
	3a	Diversion Capacity Expansion: Diversion system expansion in Mexico	$110 M	3.2	0.8	$6.59 M/yr	3.9	1.2	30	4.4	1.3	Modifications to existing infrastructure and construction of moderate new infrastructure	4.0	0.6	3.87
NEW INFRASTRUCTURE IN U.S.	4a	New U.S. Diversion Infrastructure: New lift station to discharge directly to SBOO without treatment	$27.5 M	4.5	1.1	$5.5 M/yr[3]	4.2	1.3				Owner/operator undefined. Regulatory approval and permitting could be challenged.	2.0	0.3	3.74
	4b	New U.S. Diversion Infrastructure: New lift station to discharge at SBIWTP for primary treatment only *OPTION: Discharge at South Bay Reclamation Plant*	$48 M	4.2	1.1	$8.9 M/yr[3]	3.2	1.0				Owner/operator undefined. Regulatory approval and permitting could be challenged but may be more favorable due to primary treatment. Quality of water may affect biological process.	4.0	0.6	3.66
	4c	New U.S. Diversion Infrastructure: New lift station to discharge at SBIWTP or SBWRP for full treatment	$236 M	1.0	0.3	$9.5 M/yr[3]	3.0	0.9	58	3.5	1.1	Owner/operator undefined. Regulatory approval and permitting could be challenged. Quality of water may affect biological process. Significant expense and implementation activities to obtain authority for the expansion and permitting of SBIWTP	3.0	0.5	2.66
	4d	New lift station to discharge to Point Loma WWTP	$43 M	4.3	1.1	$5.2 M/yr[3]	4.0	1.0				Quality of water may affect biological process. Capacity constraimts and regulatory compliance is a unknown for PLWWTP	1.0	0.2	3.55
	4e	New U.S. Diversion Infrastructure: Gravity flow to the SBOO	$18 M	4.7	1.2	$4.0 M/yr[3]	5.0	1.0				Feasibility to obtain regulatory approval for ocean disharge without additional treatment and ability to control quality is unknown.	1.0	0.2	Not Viable
	4f	New U.S. Diversion Infrastructure: Single inflatable dam or permanent weir on US-side of Tijuana River *OPTION: To be located in Mexico*	$8 M	4.9	1.2	$4.5 M/yr[3]	4.0	1.0	122	1.5	0.5	Additional capacity to control dry-weather. Similar practice already implemented. Location in US or Mexico may be an important decision.	4.0	0.6	3.61
COMBINED U.S. - MEXICO INFRASTRUCTURE IMPROVEMENTS	5a	Gravity reclaimed water pipeline from WWTPs to SBOO	$158 M	2.3	0.6	$5.4 M/yr	4.2	1.3				Feasibility to obtain regulatory approval for ocean disharge without additional treatment	1.0	0.2	3.20
	5b	Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP	$173 M	2.1	0.5	$6.9 M/yr	3.8	1.1	42	4.0	1.2	Feasibility to obtain regulatory approval for ocean disharge without additional treatment plus capacity constraints at Point Loma	1.0	0.2	3.00
	5c	Gravity reclaimed water pipeline system from WWTPs to Punta Bandera (ocean discharge)	$213 M	1.4	0.4	$5.4 M/yr	4.2	1.3				No major regulatory constraints anticiapted for discharge of treated effluent to the ocean in Mexico	3.0	0.5	3.27
	5d	New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP	$106 M	3.2	0.8	$16.3 M/yr	1.0	0.3	58	3.6	1.1	No major regulatory constraints anticiapted for discharge of treated effluent to the ocean in Mexico; conditions of trans-border infrastructure unknown	2.0	0.3	2.48

[1]Data available from November 2009 - March 2016. [2]Capital costs are estimated to reflect regional labor, materials are U.S. Based , and all include a 30% contingency. [3]U.S. Side options are anticipated to operate only during failures of the diversion system in Mexico or when wet-weather flows are less than 1,500 lps (35 mgd). O&M Cost assume that the diversion system in Tijuana, B.C., Mexico will continue to divert dry-weather flows, as currently operated; therefore, O&M costs for the technical alternatives located in the U.S. include the existing O&M costs for the No Action alternative plus the cost for the new U.S. side alternative.

3.3.2 Identification of Top Investment Options

The final step of the evaluation process was to identify the top five investment options for further definition of project components, process layout and costs. Those top scoring alternatives included three investment options for infrastructure located in Mexico (2a, 2b, and 3a) and two infrastructure alternatives to be constructed in the U.S. (4a and 4b). Option 4f, which is the next highest scored option and the lowest cost option was also added to the list for consideration. While this option provides a relatively small benefits in terms of reducing transboundary flows, it formalizes the implementation of the existing practice of building a berm in the rives to capture minor flows which has already shown to be effective. Table 3-4 presents the list of the top investment options identified through the evaluation process described above.

Table 3-4. Tijuana River Diversion Study – Top Investment Options

Category		Alternative
OPTIMIZATION OF EXISITNG DIVERSION FACILITIES IN MEXICO	2a	Operational protocol compliance improvements: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps
	2b	Diversion System Improvements: Allow diversions up to 1,300 lps
	3a	Diversion Capacity Expansion: Diversion system expansion in Mexico
NEW DIVERSION FACILITIES IN THE U.S.	4a	New lift station to discharge directly to SBOO without treatment
	4b	New lift station to discharge at SBIWTP for primary treatment only
	4f	Single inflatable dam on US-side of the Tijuana River

4 TOP INVESTMENT ALTERNATIVES

The screening of the fourteen alternatives reduced the list to six alternatives shown in Figure 4-1. For each of the alternatives, further refinement of the investment description was developed including an infrastructure layout or process schematic and updated capital costs as well as annual O&M costs. All U.S.-based investment options assume the diversion infrastructure in Mexico will continue to divert dry-weather flows, at least, as currently operated; therefore, O&M costs for the U.S. based alternatives include the current O&M costs for the no action alternative plus the O&M cost for the new infrastructure. Additionally, a net present value (NPV) was determined and qualitative considerations were defined.

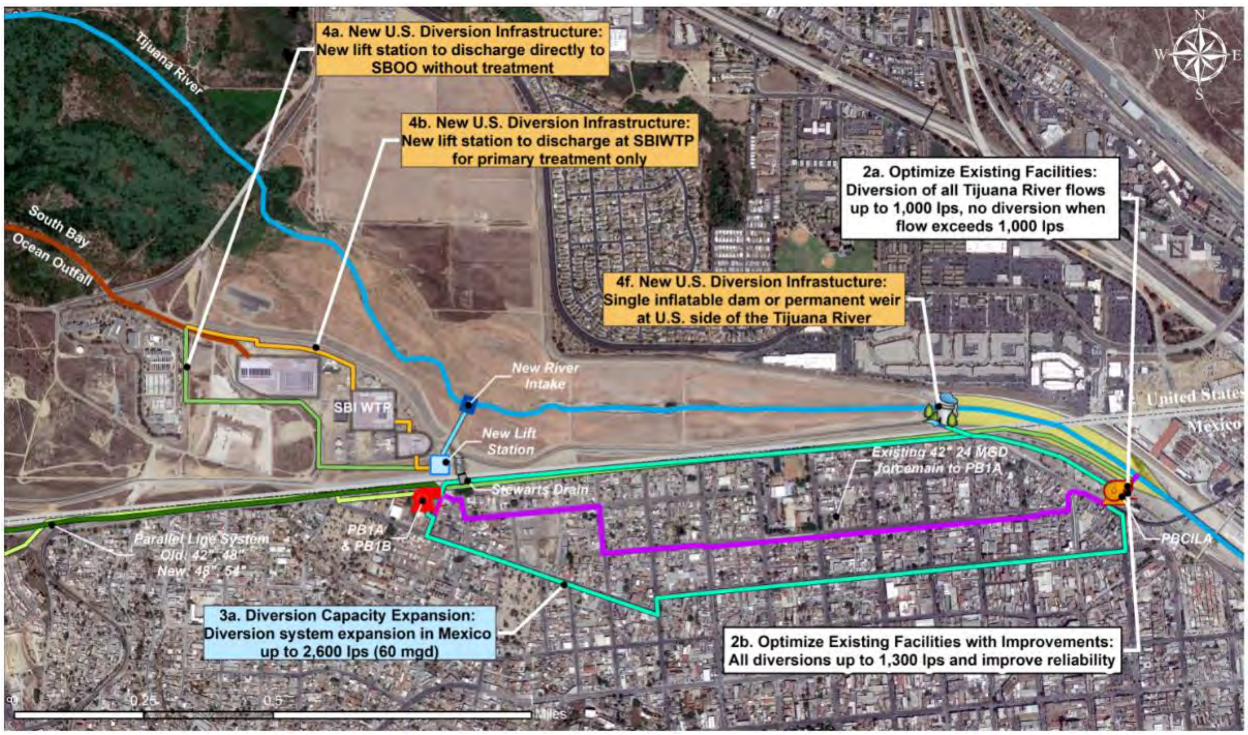


Figure 4-1. Top Investments Alternatives Graphical Representation

These technically feasible alternatives will reduce the percent of time exceedance between 75 and 92% of Tijuana River flows. The alternatives will also reduce the frequency of transboundary flows from 138 days per year to anywhere between 30 and 90 days per year in average.

The technically feasible alternatives have the potential to reliably address the dry-weather flows in the Tijuana River, in accordance with the binational agreement established by Minute 283. Due to the complexity of addressing the transboundary flow problematic, the study offers six technically feasible alternatives that can be implemented independently and/or more than one options could be selected and implemented to compliment the effectiveness of one another. Selection of any of these alternatives must be followed with a detailed feasibility study, preliminary design, environmental assessment, final design, specifications and opinion of probable construction cost.

4.1 Top Investment Alternatives Descriptions

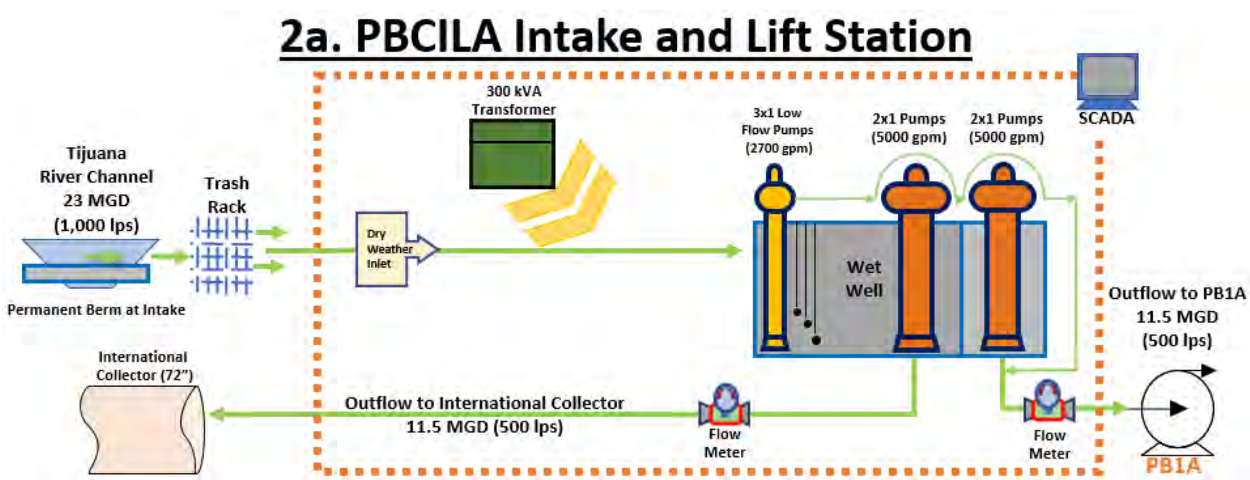
4.1.1 Components and Process Schematics

The following process schematics represent the concept idea behind each refined alternative, including proposed improvements. This provides a visual understanding behind the main components set as a new process arrangement to provide each alternative's goal to execution.

Alternative 2a

Optimize existing facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps

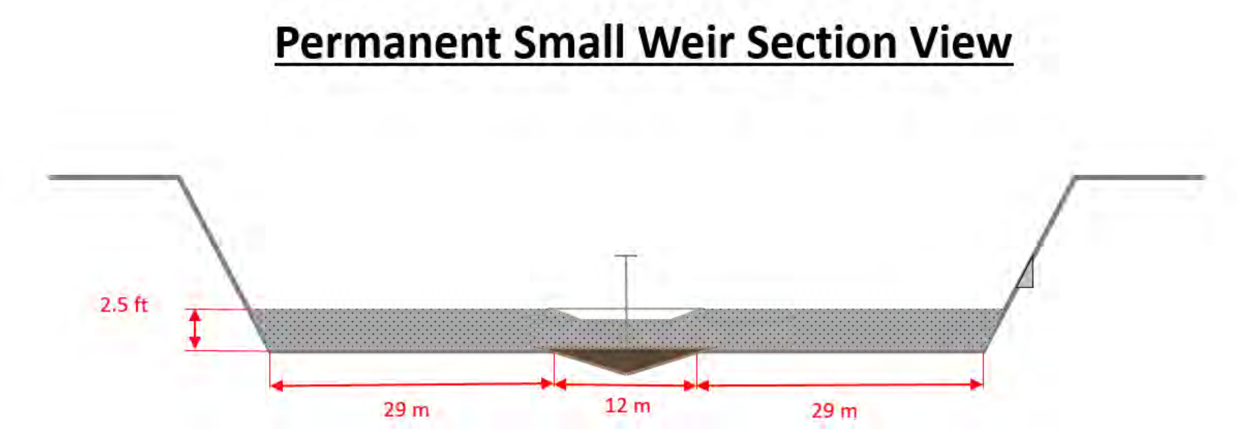
This alternative is composed of improvements to PBCILA intake, PBCILA, PB1A and PB1B lift stations:



At PBCILA, all the dry-weather flows, up to 1,000 lps (23 mgd), will be directed to the PBCILA intake, a permanent weir containing dry-weather flows will replace sandbags and earthen coffer dam currently in place, flows diverted from the river channel into PBCILA should target continuous pumping to PB1A and the International Collector if needed. Note the diagram schematic includes the addition of 2 flow meters to constantly collect outflow data to be available for CESPT. If flows are to continue to be split between the International Collector and the forcemain heading to PB1A, then the wet well will need to be upgraded to a design with the most effective partition.

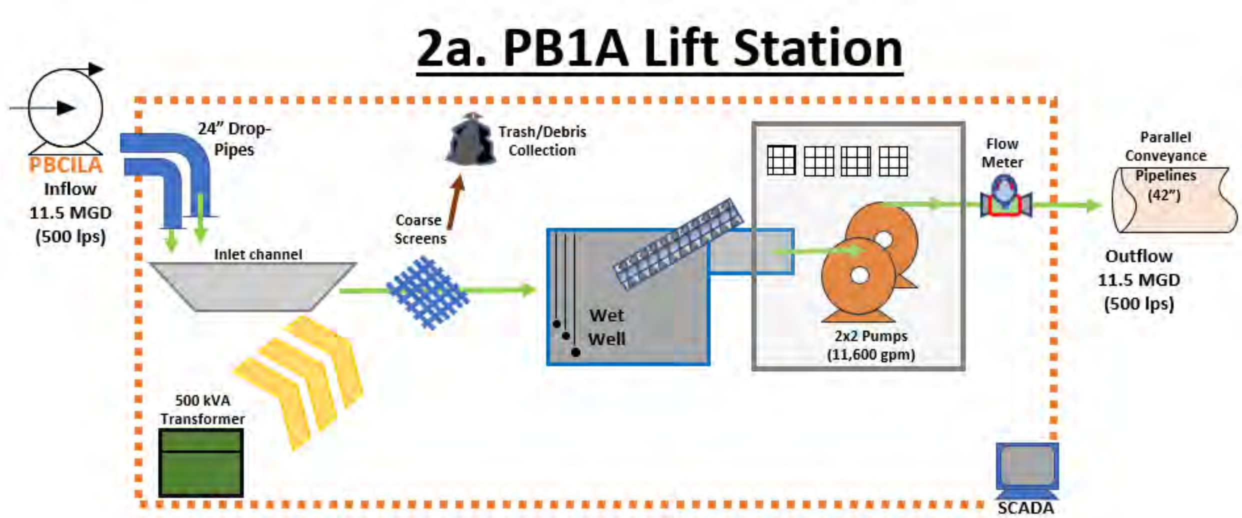
Alternative 2a PBCILA Intake components include:

- 1 permanent concrete berm at intake (approximately 2.5 ft high similar dimensions to the temporary coffer dam) with steel gate and spillway
- 1 new concrete high riser
- Concrete work and metal screen replacement of the existing intake
- River hydraulics should determine the height of the intake to reduce trash, debris and sediment.



Alternative 2a PBCILA lift station components include:

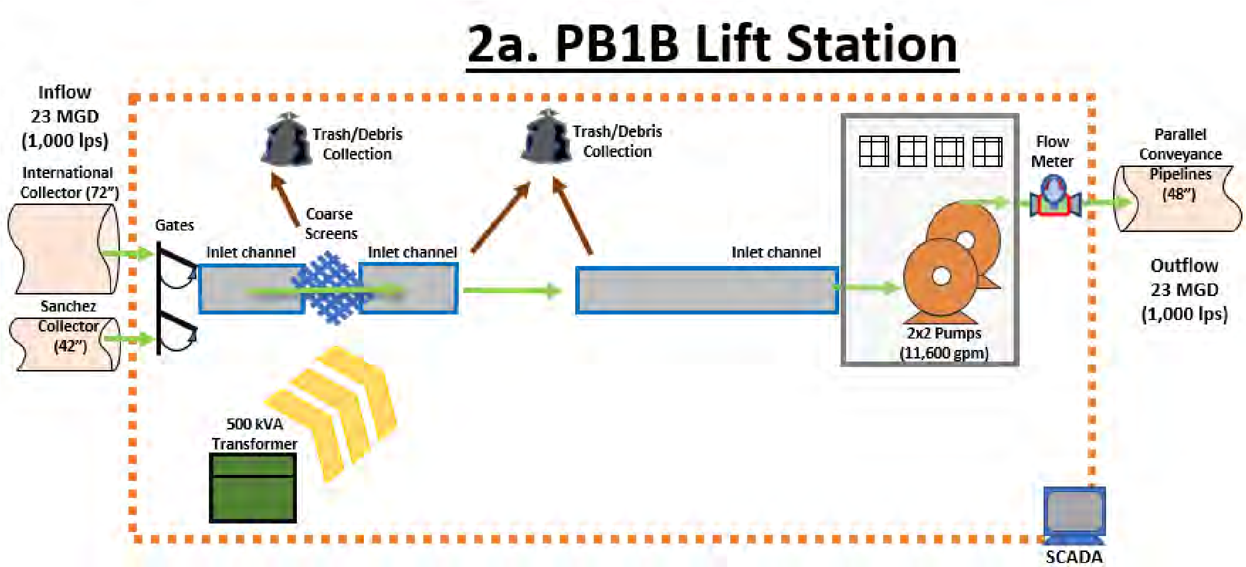
- 2 effluent flow meters
- Cleanup of wet well
- 4 new 5,000 gpm pumps and drive systems
- 2 pumps restorations (backup pumps)
- Wet well level controls and alarm system
- 300 kVA transformer replacement
- Additional wastewater rated pipelines and fittings for yard piping and required interconnections
- SCADA system installation
- Startup



Flows from PBCILA will be conveyed through the existing 42-inch metal pipe until it reaches the PB1A 24-inch drop pipes and inlet channel, from there it is metered, pumped and metered again as it flows into the parallel conveyance pipeline system. PB1A hosts the central control room for the SCADA system. This room requires retrofitting to ensure it can have interfaces for PBCILA, PB1A and PB1B.

Alternative 2a PB1A lift station components include:

- Demolish and replacement of Inlet Channel and wet well
- Demolish and replacement of 24-inch drop-pipelines and fittings
- 4 additional new 11,6000 gpm pumps and drive systems for 2 trains
- 1 pump train restoration (backup train)
- Wet well level controls and alarm system
- 1 effluent flow meter
- Demolish and replacement of the hoist and monorail system
- Demolish and replacement of pump house building
- Demolish and replacement of MCCs
- 500 kVA transformer replacement
- SCADA system and control room installation
- Startup



Flows from the International and Sanchez Collectors flow into the inlet channel, then into a multi-rake system, the inflows are pumped through two train systems, and metered as wastewater outflows into the parallel conveyance pipeline system. PB1B will send all SCADA signals to the central control room for the SCADA system in PB1A.

Alternative 2a PB1B lift station components include:

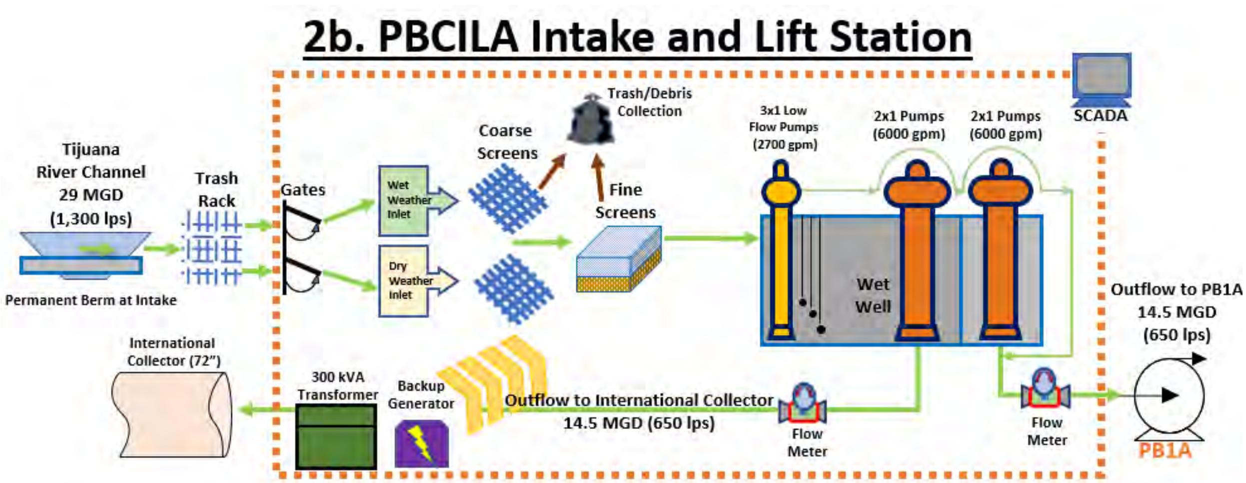
- Demolish and replacement of Inlet Channel and wet well
- Demolish and replacement of mechanical rakes
- Conveyor belts for automatic trash and debris collection

- 2 additional new 11,600 gpm pumps and drive systems for 1 train
- 1 pump train restoration (backup train)
- Wet well channel level controls and alarm system
- 1 effluent flow meter
- Demolish and replacement of hoist and monorail system
- Demolish and replacement of pump house building
- 500 kVA transformer replacement
- SCADA system installation
- Startup

Alternative 2b

Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability

This alternative is composed of improvements to the PBCILA Intake, PBCILA, PB1A and PB1B lift stations as follows:



At PBCILA, all the dry-weather flows, up to 1,300 lps (29 mgd) will be collected continually during small storm events. For this to occur, coarse and fines will be removed at higher levels with adequately selected technology compatible with the combined sewer flows and the variation of the flows that can go through the PBCILA intake. A redesign of the PBCILA intake is required through modeling software such as HEC-RAS, DSS and Culvert Master to set an adequate opening, sediment deposition and have Tijuana River Channel flows directed to the PBCILA intake with less sediment/trash/debris. A permanent weir containing dry-weather flows similar to Alternative 2a is included. This will continue to keep the diversion going into the intake.

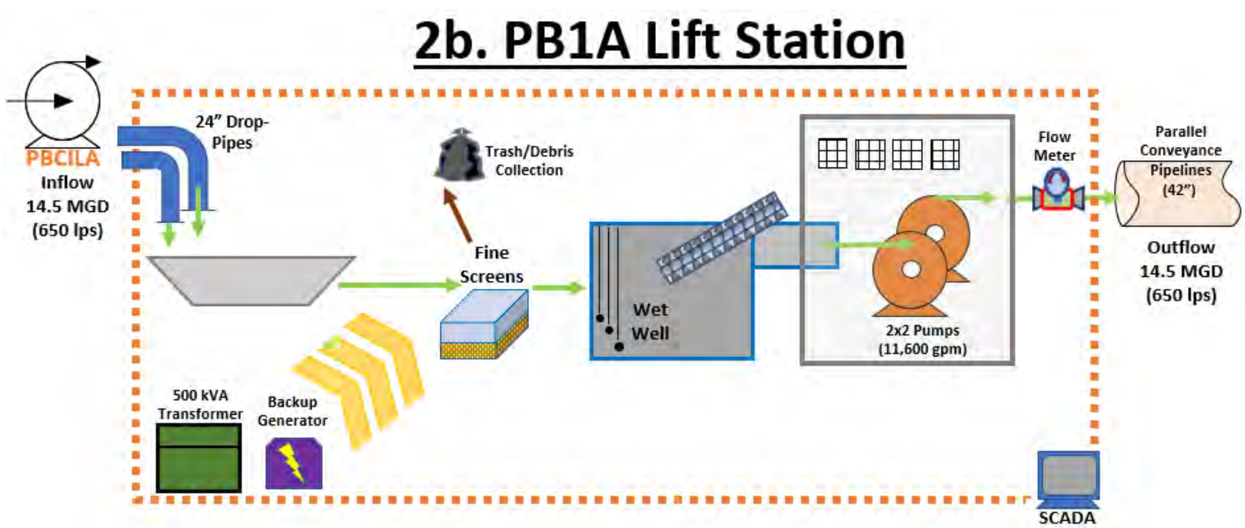
The mechanical rake and metal gates can control the flow of selected inflows to help protect PBCILA lift stations during high storm events, and the intake opening will be designed to permit design flows to be conveyed to PBCILA during storm events. The fine screens, which can include a grit chamber, will be designed to remove most sediment in an automated fashion, prior to flow metering incoming flows and having both low flow and peak flows continuously pumped to both PB1A and the International Collector. Additional surface area may be required for a coarse and fine screen process to be included as part this option; this should be evaluated in a feasibility study. As in Alternative 2a, outflow flow meters constantly collect outflow data for CESPT and other regional entities. The wet well will need to be upgraded and improved to a design that splits flows with an effective partition between the International Collector and between the forcemain heading to PB1A. The wet well will include wastewater rated hatch door openings, permitting proper sediment removal for pump protection. This setup includes a backup generator for immediate recovery from any power failure.

Alternative 2b PBCILA Intake components include:

- 1 permanent concrete berm at intake (approximately 2.5 ft high similar dimensions to the temporary coffer dam)
- 1 new mechanical rack system
- Channel modifications for intake to mechanical rack system for 29 mgd (1,300 lps)

Alternative 2b PBCILA lift station components include:

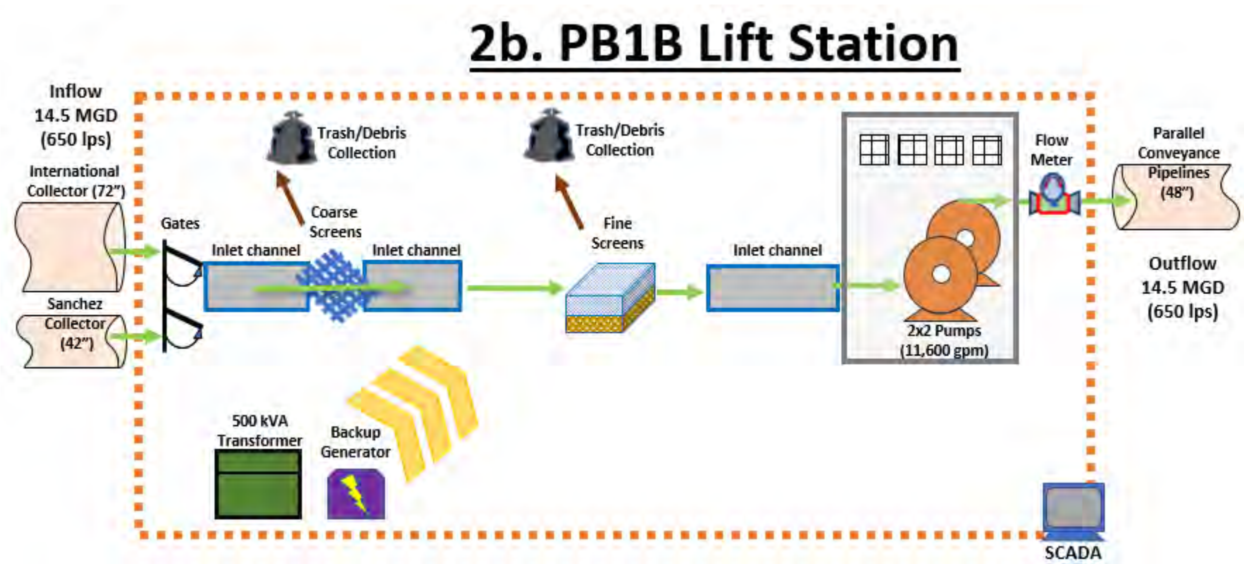
- 2 effluent flow meters
- 1 set of mechanical rakes for fines
- Conveyor belts for automatic trash and debris collection
- Cleanup of wet well
- 4 additional new 5,000 gpm pumps and drive systems
- 2 pump restorations (backup pumps)
- Wet well level controls and alarm system
- 300 kVA transformer replacement
- 350 kVA emergency generator
- SCADA system installation
- Startup



Flows from PBCILA will be conveyed through the existing 42-inch carbon steel pipe until it reaches the PB1A 24-inch drop pipes and inlet channel. From there it runs through wastewater rated fine screens (material selection should be done for local environment) and pumped and metered as it flows into the parallel conveyance pipeline system. An automated trash/debris/sediment collection system is used to reduce the manual labor currently performed with wheelbarrows hauled over the inlet channels over plywood sheets. The automated system will increase operators' safety. PB1A hosts the central control room for the SCADA system. This room requires retrofitting to ensure it has an interface for PBCILA, PB1A and PB1B. This setup includes a backup generator for immediate recovery from any power failure.

Alternative 2b PB1A lift station components include:

- Demolish and replace the Inlet Channel and wet well
- Demolish and replace the 24-inch drop-pipelines and fittings
- 1 set of mechanical rakes for fines
- 1 conveyor belt for automatic trash and debris collection
- 4 additional new 11,600 gpm pumps and drive systems for 2 trains
- 1 pump train restoration (backup train)
- Wet well level controls and alarm system
- 1 effluent flow meter
- Demolish and replace the hoist and monorail system
- Demolish and replace the pump house building
- Demolish and replace the MCCs
- 500 kVA transformer replacement
- 1,300 kVA backup generator
- 1 SCADA system and control room installation
- Startup



Flows from the International and Sanchez Collectors flow into the inlet channel. A gate system will be setup for flow control. Inflows then go into a multi-rake system, are metered, go through fine screens then are pumped through two train systems, and metered again as wastewater flows into the parallel conveyance pipeline system. In conjunction with PB1A, an automated trash/debris/sediment collection system is used to reduce the manual labor currently performed with wheelbarrows hauled over the inlet channels over plywood sheets. The automated system will increase operator safety. PB1B will send all SCADA signals to the central control room for the SCADA system in PB1A. This setup includes a backup generator for immediate recovery from any power failure.

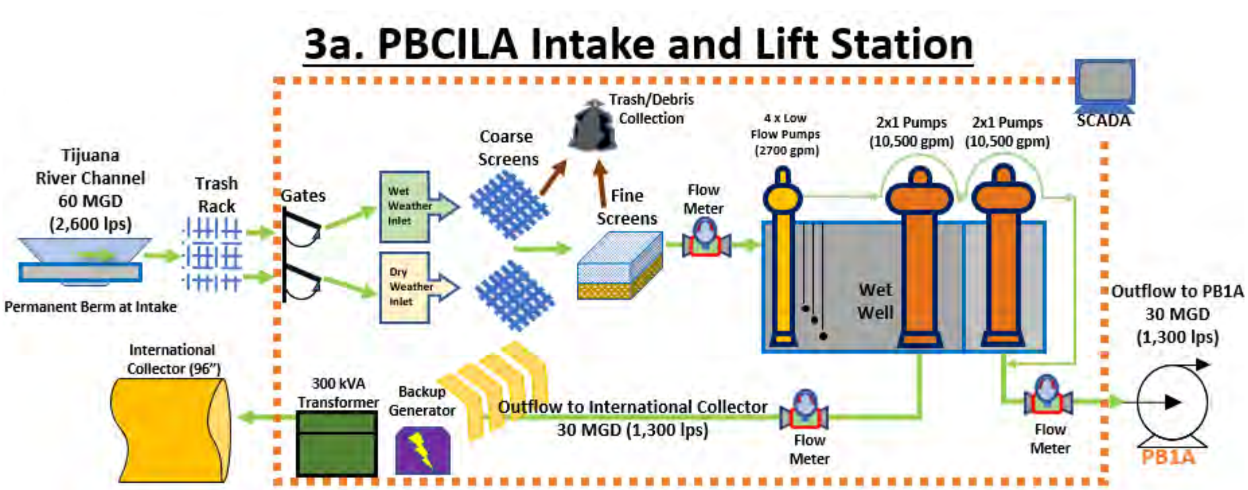
Alternative 2b PB1B lift station components include:

- Demolish and replace the Inlet Channel and wet well
- Demolish and replace the mechanical rakes
- Conveyor belts for automatic trash and debris collection
- 2 additional new 11,600 gpm pumps and drive systems for 2 trains
- 1 pump train restoration (backup train)
- Wet well channel level controls and alarm system
- 1 effluent flow meter
- Demolish and replace the hoist and monorail system
- Demolish and replace the of pump house building
- 500 kVA transformer replacement
- 1,300 kVA Backup generator
- SCADA system installation
- Startup

Alternative 3a

Diversion Capacity Expansion: Diversion system expansion in Mexico.

This alternative is composed of improvement and expansion to PBCILA Intake, PBCILA lift station, PBCILA to PB1A forcemain, International Collector, PB1A and PB1B lift stations as follows:



At PBCILA, all the dry-weather flows, up to 29 mgd (1,300 lps) will be collected continually during through small storm events, and in addition, the lift station will have an incremented capacity to divert an additional

30 mgd or 1,300 lps. Similar to Alternative 2b, the PBCILA intake will require a redesign through HEC-RAS, -DSS, Culvert Master modeling software to have a design that is functional for all dry-weather flows and the additional capacity to handle flows up to 60 mgd. At the lift station site, coarse and fines will be removed at the levels required to protect the pumps, using a selected technology that is compatible with the combined storm and sewer flows and the variation of the flow quantities that would pass through a new PBCILA intake. A new gate design will control the incoming flow to help protect the PBCILA lift station during high storm events. Both low flow and peak flows continuously pumped with higher rated pumps will be designed to pump to both PB1A and the International Collector. As in the Category 2 alternatives, two flow meters constantly collect inflow and outflow data for CESPT and other regional entities through an improved SCADA system. The wet well will need to be improved with a design that splits flows with an effective partition between the International Collector and the forcemain heading to PB1A. The wet well will include wastewater rated hatch doors, that also permits proper sediment removal for pump protection. This setup includes a backup generator for immediate recovery from any power failure.

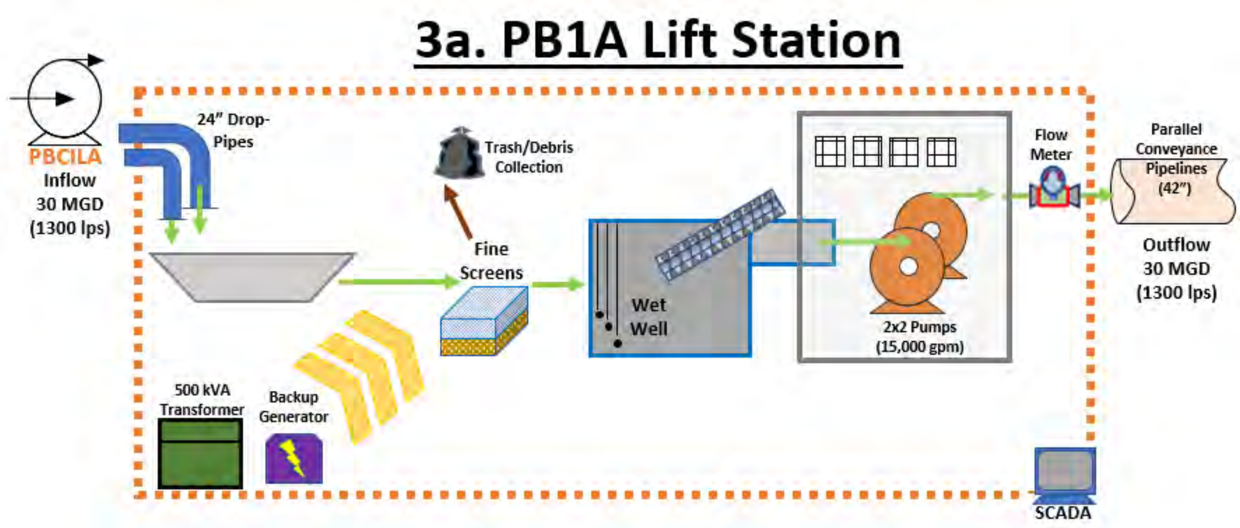
Flows from PBCILA will be conveyed through the existing 42-inch metal pipe until it reaches the PB1A 24-inch drop pipes and inlet channel. An additional line may be required to carry the additional flows from PBCILA lift station as shown on Figure 3-22. During the feasibility study and design stage, the design engineer should evaluate the existing 42-inch line, to determine if replacement with a higher pressure wastewater rated pipeline is a better suited option from a second separate pressure line.

Alternative 3a PBCILA Intake components include:

- 1 permanent concrete berm at intake (approximately 2.5 ft high similar dimensions to the temporary coffer dam)
- 2 new mechanical rack systems, grit chambers
- Channel modification and improvements for intake approach and channel to the mechanical rack system for 60 mgd (2,600 lps)

Alternative 3a PBCILA lift station components include:

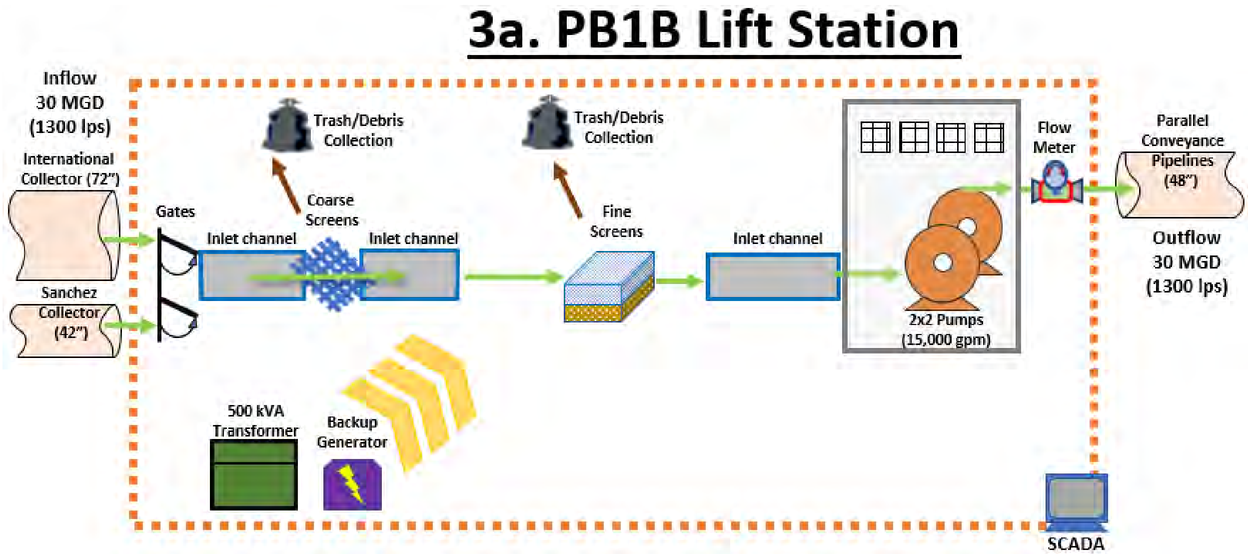
- 1 set of mechanical rakes for fines
- Conveyor belts for automatic trash and debris collection
- Demolish and replace the expanded wet well
- 4 additional new 10,500 gpm pumps and drive systems
- 2 pump restorations (backup pumps)
- Wet well level controls and alarm system
- 2 effluent flow meters
- Demolish and replace the 500-kVA transformer
- Emergency generator
- SCADA system installation
- Startup



As the flows reach PB1A, they would reach the inlet channels, go through fine screens, and higher rated pumps will convey the inflows into the parallel conveyance pipeline system. An automated trash/debris/sediment collection system is used to reduce the manual labor currently performed with wheelbarrows hauled over the inlet channels over plywood sheets. The automated system will increase operator safety. PB1A hosts the control room for the SCADA system. This room requires retrofitting to ensure it has the interface for PBCILA, PB1A and PB1B. This setup includes a backup generator for immediate recovery from any power failure.

Alternative 3a PB1A lift station components include:

- Demolish and replace the Inlet Channel and wet well, including expansion
- Demolish and replace the 24-inch drop-pipelines and fittings
- 1 set of mechanical rakes for fines
- 1 conveyor belt for automatic trash and debris collection
- 4 additional new 15,000 gpm pumps and drive systems for 2 trains
- 1 pump train restoration (backup train)
- Wet well level controls and alarm system
- 1 effluent flow meter
- Demolish and replace the hoist and monorail system
- Demolish and replace the pump house building
- Demolish and replace the MCCs
- Demolish and replace the 750-kVA transformer
- 1 backup generator
- 1 SCADA system and central control room installation
- Startup



Increased flows from the International and Sanchez Collectors will flow into the inlet channel. A gate system will be setup for flow control, then the flows go into a multi-rake system, after flows are metered the fine screens will remove additional sediments, then be pumped through two higher rated train systems, and metered again as wastewater flows into the parallel conveyance pipeline system. In conjunction with PB1A, an automated trash/debris/sediment collection system is used to reduce the manual labor currently performed with wheelbarrows hauled over the inlet channels over plywood sheets. The automated system will increase operator safety. PB1B will send all SCADA signals to the control room for the SCADA system in PB1A. This setup includes a backup generator for immediate recovery from any power failure.

This alternative will require additional capacity to the parallel pipeline system with an additional 48-inch wastewater pipeline. The upgrades will require a feasibility study and detail design to ensure any new upgrade is engineered for flow management from the diversion system to SAB WWTP for treatment.

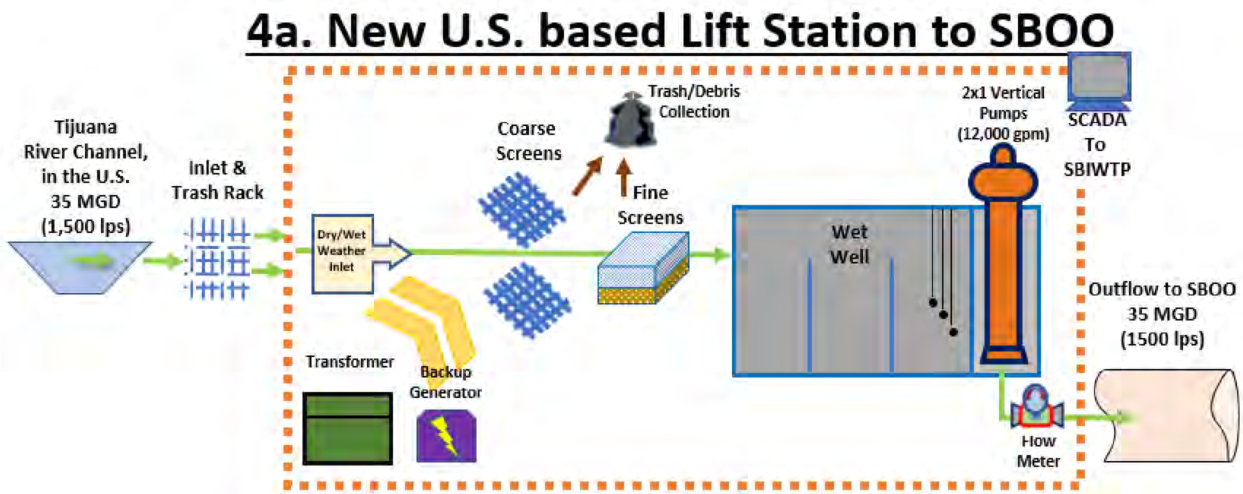
Alternative 3a PB1B lift station components include:

- Demolish and replace the Inlet Channel and wet well
- Demolish and replace the mechanical rakes
- Conveyor belts for automatic trash and debris collection
- 2 additional new 15,000 gpm pumps and drive systems for 2 trains
- 1 pump train restoration (backup train)
- Wet well channel level controls and alarm system
- 1 effluent flow meter
- Demolish and replace the hoist and monorail system
- Demolish and replace the pump house building
- Demolish and replacement of a 750 KVA transformer
- 1 backup generator
- SCADA system installation
- Startup

Alternative 4a

New lift station to discharge directly to SBOO without treatment.

This alternative is composed of a new intake and lift station on the U.S. side to have the capacity, components and tie-in to the SBOO as shown on the following schematic:



The new U.S. based diversion alternative incorporates a new intake and lift station to intercept dry-weather and small wet-weather flows up to 1,500 lps (35 mgd). The lift station can serve either as an additional diverting infrastructure supporting PBCILA when non-operational or as an additional source of diversion to reach some minor rain events with diversion capacity, it is estimated that the lift station would operate an average of 140 days per year. The tie-in to the SBOO could be done at the blending box exiting the SBIWTP.

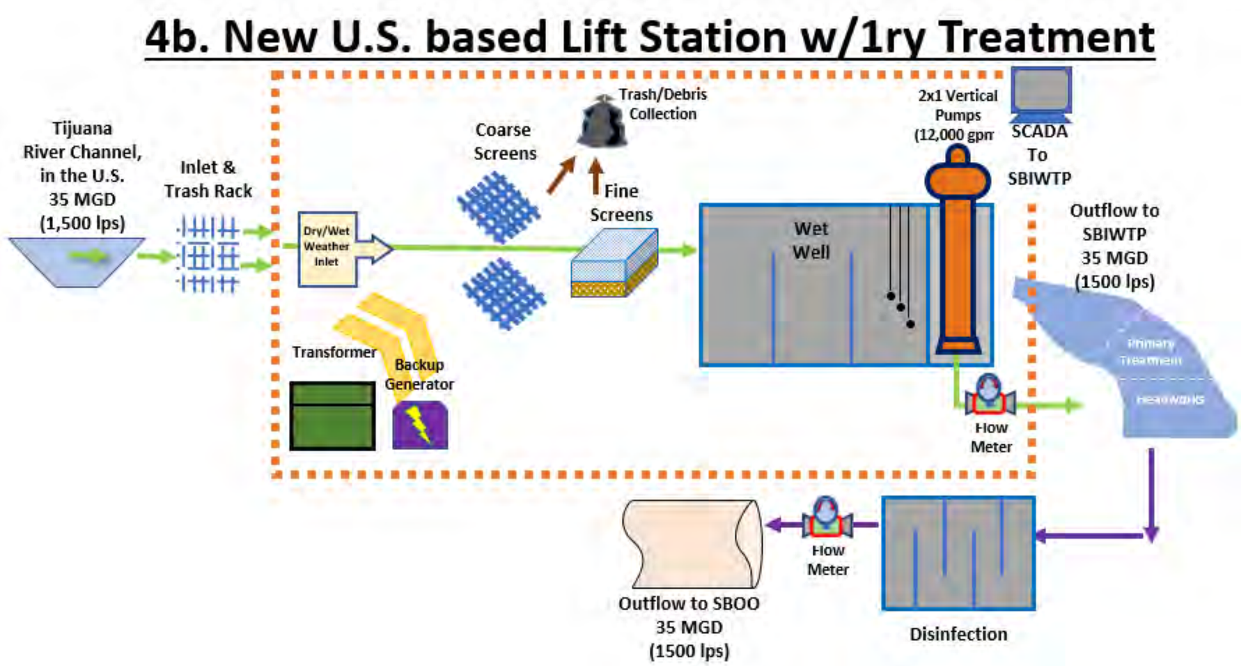
Alternative 4a components include:

- 1 inlet intake for 35 mgd (1,500 lps)
- Gravity pipeline from intake to lift station
- Fixed screens for coarse trash and debris
- Mechanical rakes for fines
- New lift stations including: wet well, on/off level and alarm system, 2 pumps in service each with 18,000 gpm capacity and accessories
- MCC Room
- Chain-link fence around perimeter and access road
- New lift station shelter
- Power supply
- 1 backup generator
- 1 effluent flow meter
- 1 SCADA system
- Lift station startup
- Discharge forcemain to SBIWTP blending box
- Tie-in to blending box for SBOO discharge

Alternative 4b

New lift station to discharge at SBIWTP for primary treatment only.

This alternative is composed of a new intake and lift station on the U.S. side to have the capacity, components and tie-in to the SBIWTP for an enhanced primary treatment as shown on the following schematic:



Similar to Alternative 4a, a new U.S. based diversion alternative with a new intake and lift station to intercept all the dry-weather flows and small wet-weather flows up to 1,500 lps (35 mgd) is the main basis for this alternative. The lift station can serve either as an additional diverting infrastructure supporting PBCILA when non-operational or as an additional source of diversion to reach some minor rain events with diversion capacity, its estimated that the lift station would operate an average of 85 days per year. Tie-in will occur at the headworks of SBIWTP for primary treatment only.

SBIWTP appears to have enough capacity to manage 35 mgd of additional flow into the existing primary treatment facilities. Our evaluation of inflows indicates that SBIWTP is treating an average of 25 mgd (see Appendix J for the average inflows from 2013 to 2018), and our review of existing record drawings indicate available capacity at the primary treatment process; headworks, grit chamber and primary clarifier basins is sufficient to treat flows from a new U.S. based lift station. It is recommended that a chemically enhanced primary treatment (CEPT) is operated for the diverted flows with an addition of ferric chloride and anionic polymer.

During a feasibility and preliminary engineering phase, the design engineer will need to evaluate this alternative; through hydraulic, process modeling and sampling plan; to develop a mass balance to define the water quality within SBIWTP, the effluent water quality, and the quantity of additional solids to be handled by the facility. The most beneficial configuration for the facility should be presented as a preliminary design, at a 30% design level, to manage additional flows with a CEPT along with disinfection while raw wastewater flows from the international collector go through the entirety of the plant. Flows exiting an enhanced primary treatment will by-pass secondary treatment, through an available 66-inch pipeline to merge at the blending basin with the secondary treatment process effluent prior to discharging into the SBOO.

Alternative 4b components include:

- 1 inlet intake for 35 mgd (1,500 lps)
- Gravity pipeline from intake to lift station
- 1 influent flow meter
- Fixed screens for coarse trash and debris
- Mechanical rakes for fines
- New lift stations including: wet well, on/off level and alarm system, 2 pumps in service each with 18,000 gpm capacity and accessories
- MCC Room
- Chain-link fence around perimeter and access road
- New lift station shelter
- Power supply
- 1 backup generator
- 1 effluent flow meter
- 1 SCADA system
- Lift station startup
- Discharge forcemain to SBIWTP headworks
- Tie-in to SBIWTP headworks
- Instrumentation and equipment upgrade at SBIWTP headworks
- SBIWTP primary treatment basins improvements and upgrades
- Disinfection station
- Dechlorination station

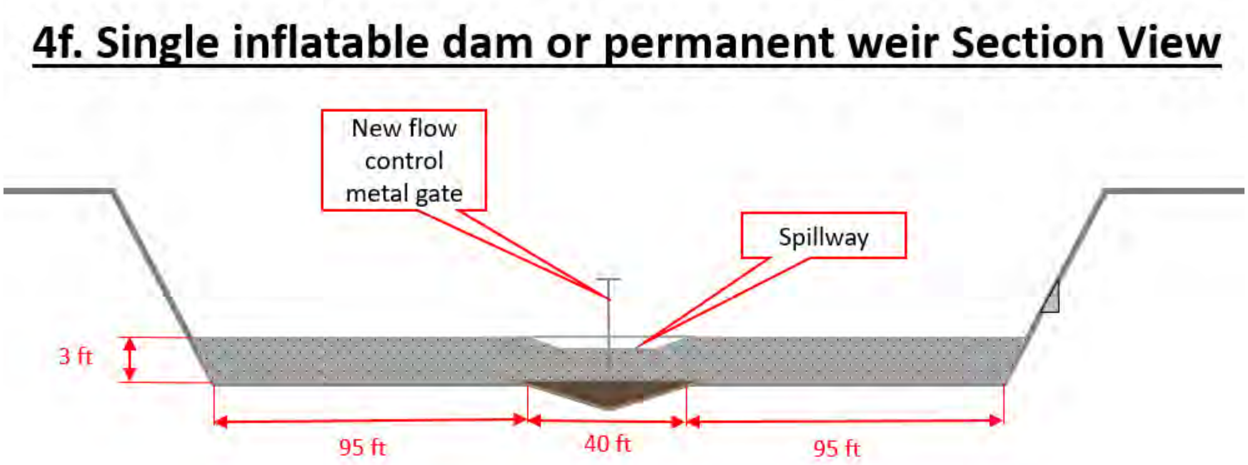
Alternative 4b Option: Discharge at the South Bay Water Reclamation Plant (SBWRP). As an option to alternative 4b, it is technically feasible to send approximately 2.5 mgd to the SBWRP located at 2411 Dairy Mart Rd, San Diego, CA 92154, adjacent to the SBIWTP. In an analysis presented by the City of San Diego (see Appendix K), available capacity ranges from 2.48 to 7.05 mgd, dependent on the flows being processed at the time. Although this study did not complete an analysis for this option, a feasibility study can incorporate an analysis of re-direction of a limited flow quantity to SBWRP. Flow re-direction can provide additional capacity for diversion of flows. Two items to consider include:

- SBIWTP to treat raw wastewater flows from the Tijuana wastewater collection system
- Intercepted flows from a U.S. based river intake and lift station, such as alternative 4b, can have a diversion control to split flows between SBIWTP and SBWRP.

Alternative 4f

New U.S. diversion infrastructure: Single inflatable dam or permanent weir on US-side of the Tijuana River.

This alternative is composed of a new inflatable or permanent weir as a control measure for dry-weather flows in the U.S. side as shown on the following schematic:



A single inflatable dam as shown in Figure 4-2 can be placed on the U.S. side or in the Mexican side of the Tijuana River to effectively control all dry-weather flows. The storage capacity would be approximately 60,000 m^3 or 16 million gallons (49 acre-feet), which represents about 5% of the volume that 4 dams can hold (as presented in Alternative 2c). Weir capacity is determined by the length to the PBCILA intake and to the availability of concrete river channel in the U.S. For O&M purposes, the dam can be cleaned by sump pumps or vacuum trucks which can dispose of the collected water at SBIWTP; end of monsoon season channel cleanup will provide a more efficient dry-weather flow control.

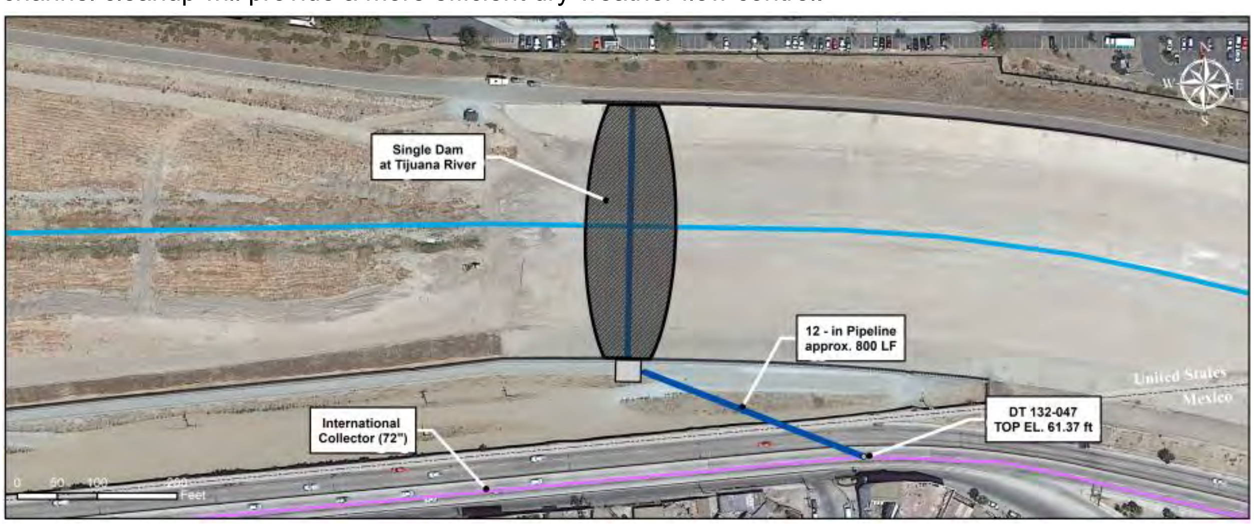
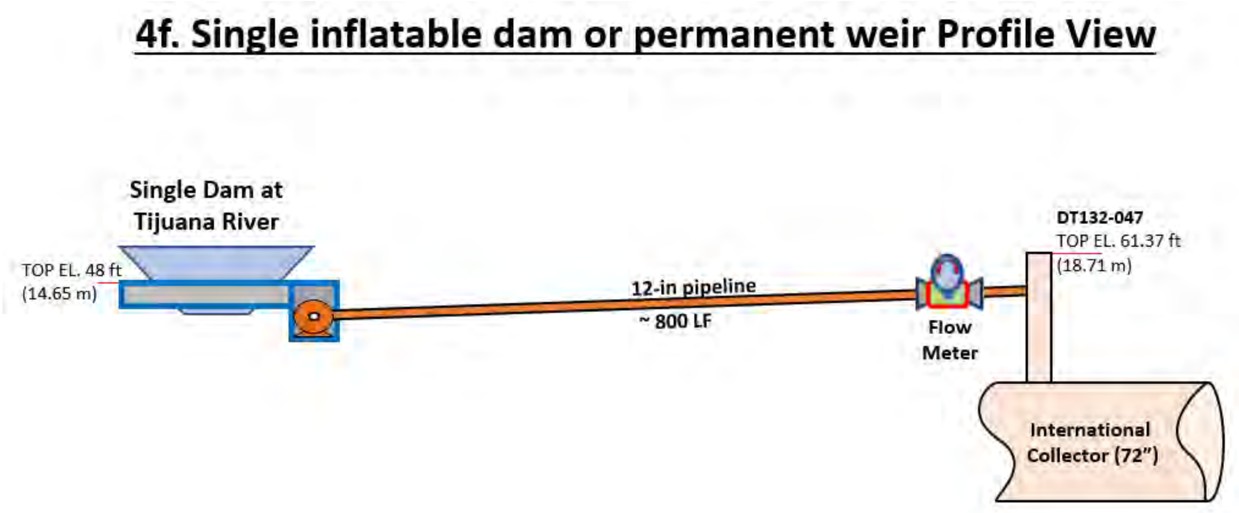


Figure 4-2. View of U.S. side single weir.

During 2018, USIBWC performed additional O&M to the Tijuana River by adding a coffer dam. This measure was set to augment the protection of the Pacific Coast and the TRNERR from contaminated flows with the Tijuana River Flood Control Project during July-August 2018. The Tijuana River Flood Control Project included sediment removal from the river channel and addition of a coffer dam to function as a temporary flow control at the international border line which has been successful at keeping transboundary flows under 1.5 mgd from reaching the Pacific Coast. As such, an inflatable dam or permanent weir can be an effective measure to control flows during dry-weather conditions.

As an option for O&M, the dam can have a small intake discharging into either SBIWTP, International Collector or PBCILA intake. The schematic below shows one option by having the flows pumped into a manhole located nearby, with a new sump pump and a new pipeline for low flow conditions. Although not in this evaluation, the tie in connection to a discharge can be also located to be discharged at PBCILA.



Alternative 4f components include:

- 1 dam (either inflatable or concrete)
- 1 metal gate
- 1 new inlet intake for low flow pumping
- 800 LF of wastewater pipeline
- 1 influent flow meter
- Fixed screens for coarse trash and debris
- 2 pumps in service each with 750 gpm capacity and accessories
- Power supply
- 1 backup generator

4.1.2 Investment Estimates

Estimated O&M costs have been determined to give the reader the study level range of yearly operational budget required to run the alternatives; the refined alternatives O&M cost range from $4M to $6.59M per year. The values for the O&M costs where obtained through conversations with entities such as CESPT, USIBWC, and their current O&M budget for operating the existing facilities.

4.1.2.1 Net Present Value Calculation

The present value of each of the alternatives was calculated using a discount rate of 6%, a cost escalation factor of 3.5% an assumed 20 years, and the total annual O&M costs. The total O&M costs were estimated using existing labor costs at each facility and an estimated cost for improved equipment functionality as well as new infrastructure and controls are integrated. The NPV was calculated based on the following equation;

$$PV = \frac{FV}{(1+i)^n}$$

Where,

PV= Present Value

FV= Future Value

i= discount rate

n= years

The equation is applied yearly over the 20-year life-cycle, annual value (A value) is determined for O&M costs, the NPV of the uniform series is determined by considering each A value as a yearly PV, and then summing all PV values throughout the 20 year life-cycle.

4.1.2.2 Study Level Estimate of Probable O&M Cost

This section presents the average per year O&M cost and the NPV for the top alternatives. The O&M cost breakdown includes a 20-year PV and a total annualized cost. The analysis includes the calculation of year one of the O&M cost, then using an escalation factor of 3.5% the subsequent annual O&M costs were determined. Once the NPV is determined over a 20-year life-cycle, the present worth O&M is calculated by subtracting the total construction cost, the average per year O&M is then determined by multiplying the PV of O&M by the capital-recovery factor. The NPV and O&M detail evaluation for all alternatives is in Appendix I.

Alternative 2a

Each item cost includes personnel labor, upgraded equipment and new equipment, O&M for: SCADA, electrical system, mechanical, structural, pipes and valves, vehicle usage, and electricity costs.

Item Description	Quantity	Unit	Amount
PBCILA lift station and intake annual O&M	1	Lump sum (LS)	$782,500
PB1A annual O&M	1	LS	$1,122,984
PB1B annual O&M	1	LS	$1,114,982
		Estimated O&M Cost (year 1)	**$3,020,467**
		Rounded Total Construction Cost	$16,000,000
		Present Worth of O&M (20 years)	$49,916,000
		Net Present Value	**$69,530,800**
		Average per year O&M Cost (20 years)	**$4,350,000**

Alternative 2b

Each item cost includes personnel labor, upgraded equipment and new equipment, O&M for: SCADA, electrical system, mechanical, structural, pipes and valves, vehicle usage, equipment and electricity costs. Higher O&M costs are attributed to post-storm operational equipment.

Item Description	Quantity	Unit	Amount
PBCILA LS and intake annual O&M	1	LS	$872,900
PB1A annual O&M	1	LS	$1,274,896
PB1B annual O&M	1	LS	$1,256,823
		Estimated O&M Cost (year 1)	**$3,404,619**
		Rounded Total Construction Cost	$23,500,000
		Present Worth of O&M (20 years)	$56,770,000
		Net Present Value	**$80,270,000**
		Average per year O&M Cost (20 years)	**$4,950,000**

Alternative 3a

Each item cost includes personnel labor, upgraded equipment and new equipment, O&M for: SCADA, electrical system, mechanical, structural, pipes and valves, vehicle usage, equipment and electricity costs.

Cost includes upgrades to equipment to function as intended as well as additional equipment to increase capacity in PBCILA, PB1A and PB1B lift stations.

Item Description	Quantity	Unit	Amount
PBCILA and intake annual O&M	1	LS	$1,348,700
PB1A annual O&M	1	LS	$1,869,412
PB1B annual O&M	1	LS	$1,821,850
		Estimated O&M Cost (year 1)	**$5,039,962**
		Rounded Total Construction Cost	$109,432,000
		Present Worth of O&M (20 years)	$84,173,000
		Net Present Value	**$193,605,000**
		Average per year O&M Cost (20 years)	**$6,590,000**

Alternative 4a

Each item cost includes personnel labor, upgraded equipment and new equipment, O&M for: SCADA, electrical system, mechanical, structural, pipes and valves, vehicle usage, equipment and electricity costs.

This cost represents maintenance of the U.S. based lift station, a new intake at the Tijuana Channel, conveyance to SBOO, and O&M costs of the existing Diversion System in Mexico.

Item Description	Quantity	Unit	Amount
U.S. 35 mgd Lift Station, intake and SBOO Tie-in O&M	1	LS	$2,060,500
Mexico On-going O&M (PBCILA, PB1A and PB1B with 2a improvements)	1	LS	$3,020,467
		Estimated O&M Cost (year 1)	**$5,080,967**
		Rounded Total Construction Cost	$27,500,000
		Present Worth of O&M (20 years)	$63,000,000
		Net Present Value	$90,500,000
		Average per year O&M Cost (20 years)	**$5,500,000**

Alternative 4b

Each item cost includes personnel labor, upgraded equipment and O&M for: SCADA, electrical system, mechanical, structural, pipes and valves, vehicle usage, equipment and electricity costs.

Cost is adjusted to Alternative 4a with the connection to SBIWTP and its appurtenances. This O&M cost includes any chemical use for primary treatment of lift station influent and O&M costs of the existing Diversion System in Mexico.

Item Description	Quantity	Unit	Amount
U.S. 35 mgd Lift Station and intake O&M	1	LS	$2,060,500
SBIWTP Headworks and Primary O&M	1	LS	$5,309,000
Mexico On-going O&M (PBCILA, PB1A and PB1B with 2a improvements)	1	LS	$3,020,467
		Estimated O&M Cost (year 1)	**$10,389,870**
		Rounded Total Construction Cost	$48,000,000
		Present Worth of O&M (20 years)	$98,100,000
		Net Present Value	$146,100,000
		Average per year O&M Cost (20 years)	**$8,500,000**

Alternative 4f

Each item cost includes personnel labor, new equipment and O&M for: mechanical and electrical system, structural, pipes and valves, vehicle usage, equipment, electricity costs and cleanup.

This O&M cost includes pump use, sediment removal, and O&M costs of the existing Diversion System in Mexico.

Item Description	Quantity	Unit	Amount
Dam weir system O&M	1	LS	$800,000
Mexico On-going O&M (PBCILA, PB1A and PB1B with 2a improvements)	1	LS	$3,020,467
		Estimated O&M Cost (year 1)	**$3,820,467**
		Rounded Total Construction Cost	$8,000,000
		Present Worth of O&M (20 years)	$53,148,000
		Net Present Value	$61,148,000
		Average per year O&M Cost (20 years)	**$4,000,000**

4.1.3 Top Investment Alternatives Summary

Table 4-1 shows a summary for each of the top alternatives, including a description of the improvements, with the anticipated benefits, capital and O&M costs along with comments to be considered as the alternative may be advanced for further development.

Table 4-1. Top Investments Options Summary

Category		Alternative	Description	Targeted diversion flow capacity[1]	Capital cost[2]	O&M cost	Average trans-boundary flow days/yr	Comments
No Action	1a	No Action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016	Existing facilities and historical diversions	23 mgd 1,000 lps	$0	$2.7 M/yr	138	
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	2a	Optimize Existing Facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps	River intake and lift station systems improvements (PBCILA, PB1A&1B) for reliable diversion of Tijuana River flows in accordance with existing operational protocol	23 mgd 1,000 lps	$16 M	$4.35 M/yr	90	- Improves capacity for full system operations - Built-up sludge and sediment will be removed from wet wells and influent channels, restoring needed capacity. - Improves operational flexibility. - Increases reliable operations for diversion of all dry-weather transboundary wastewater flows.
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	2b	Optimize Existing Facilities with Improvements: Allow diversions up to 1,300 lps and improve reliability	River intake and lift stations (PBCILA, PB1A&1B) additional equipment, backup power supply, removal of silt and trash, and operational protocol modified to allow diversion of Tijuana River flows up to 1,300 lps	29 mgd 1,300 lps	$24.5 M	$4.95 M/yr	69	- Increase the reliability of the diversion system. - Adds new capability to continue operations during small storm events and quick start-up of equipment post-storm - In-take improvements for sediment and debris removal protect upstream equipment and reduce manual labor . - New generators mitigate interruptions in electricity service
OPTIMIZATION OF EXISTING DIVERSION FACILITIES IN MEXICO	3a	Diversion Capacity Expansion: Diversion system expansion in Mexico	Double the nominal capacity of diversion intake, PBCILA, and PB1A&1B lift stations, and modify operational protocol to allow diversion of Tijuana River flows up to 2,600 lps	60 mgd 2,600 lps	$110 M	$6.59 M/yr	30	- In-take improvements for sediment and debris removal protect upstream equipment and reduce manual labor. - New generators mitigate interruptions in electricity service. - Provides additional flexibility in operation. - Additional capacity is only required during storm events (approximately 50 days average per year), resulting in O&M challenges.
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4a	New U.S. Diversion Infraestructure: New lift station to discharge directly to SBOO without treatment	New concrete diversion structure, a 35-MGD lift station to tie into SBOO without additional treatment.	35 mgd 1,500 lps	$27.5 M	$5.5 M/yr[3]	58	- Establishes a redundant diversion capacity. - To be used if operations fail in Mexico and/or for small storm events, upto 1,500 lps. - Typical lift station design with familiar operation requirements. Designed for improved water quality. - Includes physical and chemical removal of some sediment. - Undefined terms: Owner/operator? Income source to support operations? Regulatory compliance (CWA) / exception for water quality exceedances?
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4b	New U.S. Diversion Infrastructure: New lift station to discharge at SBIWTP for primary treatment only *OPTION: Discharge at South Bay Reclamation Plant*	New concrete diversion structure, a 35-MGD lift station with primary treatment at SBIWTP, blending with full treatment discharges.	35 mgd 1,500 lps	$48 M	$8.9 M/yr[3]	58	- Same benefits and concerns as 4a. - Flows receive chemically enhanced primary treatment at SBIWTP, most likely avoiding water quality concerns for discharge; requires upgrades at SBIWTP. - Technical Feasibility: Will mix of water low in food sources affect the biological process? - Regulatory approval may be more favorable due to primary treatment.
NEW DIVERSION FACILITIES IN THE U.S. UP TO 35 MGD (1,500 LPS)	4f	New U.S. Diversion Infrastructure: Single inflatable dam or permanent weir on US-side of Tijuana River *OPTION: To be located in Mexico*	**Detention of small transboundary flows up to 100 lps (2.3 mgd). Flows will be pumped back to PBCILA once the diversion system goes back on-line.**	< 2.3 mgd < 100 lps	$8.6 M	$4 M/yr[3]	122	- To control dry-weather transboundary flows due to failure at diversion infrastructure - Formalizes a similar practice implemented by IBWC with effective results (temporary soil berm). - Detention of dry-weather flows to prevent small transboundary discharges due to breakdowns of system in Mexico. - Storage capacity of up to 16 MG or 60,000 m3. - Yearly maintenance required, includes sediment removal - Undefined terms: Owner/operator?

[1]Data available from November 2009 - March 2016. [2]Capital costs are estimated to reflect regional labor, materials are U.S. Based, and all include a 30% contingency. [3]U.S. Side options are anticipated to operate only during failures of the diversion system in Mexico or when wet-weather flows are less than 1,500 lps (35 mgd). O&M Cost assume that the diversion system in Tijuana, B.C., Mexico will continue to divert dry-weather flows, as currently operated; therefore, O&M costs for the technical alternatives located in the U.S. include the existing O&M costs for the No Action alternative plus the cost for the new U.S. side alternative.

4.2 Additional Components to Study

Through Arcadis' condition assessment as described in Section 2 of this document, it was concluded that two important components are noted to be part of any proposed solution:

- Improvements and capacity increase to the International Interceptor
- Stewart's Drain Diversion Box improvements

These two components will allow flows to reach its treatment destination at a higher percentage, reducing any storm and wastewater pools within low elevation areas (Stewart's Drain/Puerta Blanca) and reducing the overflows from the wastewater pipeline at the low elevation areas. The problem these two additional components will resolve relate to: (1) International Collector is a pipeline flowing at 100% capacity during wet weather conditions, and (2) Stewart's Drain is a low elevation point naturally intercepting the sanitary sewer overflows (SSOs) from the International Collector and other sources. An adequate size pipeline will eliminate SSOs, while additional drainage at Stewart's Drain will permit for better collection of transboundary flows at that location.

4.2.1 Improvements and Capacity Increase to International Interceptor

The International Collector is a reinforced concrete pipeline in service since the late 1980's. It has reached its life span and is near full capacity. During peak flow events, the 72-inch pipeline capacity is surpassed. During this study, two SSO events were observed at the pipeline draining into Stewart's Drain. This is due to the increase of wastewater being conveyed through the same pipeline. Current flows at the International Collector exceed its maximum flow capacity ranging from 2,604 to 4,945 lps (59 to 113 mgd) by approximately 377 lps (9 mgd) at some of its pipeline segments. In addition to the capacity constraints, CESPT's closed circuit television inspections have recorded fractures in the pipe wall and metal diaphragm. The fractures allow inflows and infiltration to seep into the International Collector contributing to SSOs during rain events.

Figure 4-3. Plan view of the International Interceptor location and length.

It is estimated that a 72-inch pipeline can be replaced with a new 96-inch pipeline that permits wastewater flows to reach treatment. A more in-depth analysis should be completed to determine the preferred alignment, design sizing and pipe material and construction methodology. Materials may include centrifugally cast glass fiber reinforced or high-density polyethylene. The most common construction methodology is open cut, but other trenchless methodologies exist such as pipe bursting, which has been practiced for large size diameters in the U.S. Arcadis is estimating an open cut construction methodology, which will have a new 96-inch pipeline adjacent to the existing 72-inch, then once the new line is constructed and in service, the old line is decommissioned and removed.

Pipe diameter for the International Collector was determined through an evaluation of the population projections of 1.66 million for the 21 service areas in each sub-basin that will reach the International Collector through 2050 and an average 176 liters per capita per day of sewer discharges, see Appendix C for diameter determination.

Description	Quantity	Unit	Amount
Trench cut, fill, compaction and haul away access	100,000	Cubic yard (CY)	$23,379
International Interceptor replacement of 96-inch pipeline, fittings and appurtenances	8,200	LF	$7,667,000
Concrete street demolition and re-paving	140,000	Square feet	$715,720
Manhole installation	30	EA	$66,000
Tie-in to SBIWTP and to PB1B, including all accessories, complete in place	1	EA	$71,500
Hydrostatic leak testing	2	EA	$176,000
Traffic Control Plan and execution	1	LS	$815,283
		Subtotal Construction Cost	**$9,535,000**
Mobilization, demobilization, insurance, bonds and related expenses		5%	$476,750
Engineer's Fee (with geotechnical investigation and topographic survey)		12%	$1,144,200
Construction Phase Services		10%	$953,500
Construction Contingency		30%	$2,860,500
General Contractor Overhead and Profit		15%	$1,644,787
		International Interceptor Repairs Total Construction Cost	**$16,615,000**

4.2.2 Stewart's Drain Diversion Box Improvements

This component deals with both a U.S.- and a Mexican-based solution to reduce the pooling of transboundary flows within Stewart's Drain/Puerta Blanca during dry-weather conditions. A mix of storm and wastewater flows have continued to reach Stewart's Drain during both dry and wet weather conditions, with low flows averaging 3 to 5 lps (48 to 80 gpm) during dry-weather conditions as documented through spill reports by USIBWC from February 2015 to October 2018 (Appendix A for spill report summary tables).

Previous identified problems at Stewart's Drain have included:

(1) SSOs from the box manhole at the international interceptor close to lift station PB1B and just south of Stewart's Drain. The box manhole had a weir type opening at one of its walls that discharged into Stewart's Drain from surge event occurrences at the International Collector. This has been repaired by CESPT by covering the weir opening.

(2) Raw wastewater flows from PB1B reaching Stewart's Drain whenever the lift station manually closes its inflow gates, while undergoing repairs, to protect it from any overflows from the International Collector. Stewart's Drain is a low point within the city of Tijuana, collecting any runoffs/spills that occur within the region.

Figure 4-4. Plan view of U.S. based solution at Stewarts Drain with new grate structure discharging to SBIWTP.

Under the U.S. based solution, Arcadis proposes to add an additional trench drain that sits immediately across the border to provide a more effective sheet flow removal at Stewart's Drain. The trench drain will have a larger opening area that will permit for additional flows to be captured and conveyed to SBIWTP as shown in Figure 4-4. This new drain will capture flows immediately north of the border fence, directing flows to the SBIWTP.

The estimated construction cost for a U.S. based solution at Stewart's Drain is approximately $1.6 Million.

Description	Quantity	Unit	Amount
Concrete work	250	CY	$59,000
Trench cut, fill, compaction and haul away access	10,000	CY	$442,000
Hatch doors, 4 feet x4 feet	2	EA	$91,000
18-inch pipeline connecting drain to junction box No. 1 (JB#1)	100	LF	$130,000
JB#1 Tie-in	1	EA	$110,500
Check valves	2	EA	$91,000
Subtotal Construction Cost			**$923,000**
Mobilization, demobilization, insurance, bonds, and related expenses		5%	$46,150
Engineer's Fee (with geotechnical investigation and topographic survey)		12%	$110,760
Construction Phase Services		10%	$92,300
Construction Contingency		30%	$277,000
General Contractor OH&P		15%	$160,000
U.S. Based Solution - Stewart's Drain Diversion Box Total Construction Cost			**$1,608,000**

A Mexican based solution is shown in Figure 4-5. It would require an additional set of three box trenches underneath the three-barrel concrete culvert crossing the International Boulevard, draining to a concrete junction box with a set of 150 gpm pumps discharging into PB1B. Construction would be complex due to the limited vertical clearance. However, the mix of runoff during dry-weather conditions averaging 3 to 5 lps (48 to 80 gpm) would be collected at the new trench system which will then be pumped and conveyed to PB1B's influent channel. For clean-up purposes the trenches should be extended through the culvert up to the extent of the boulevard right-of-way up to the south sidewalk. This will permit operators to access the trenches to clean and remove debris and sediment after each end of the wet season.

The estimated construction cost for a Mexican based solution at Stewart's Drain is approximately $635,000.

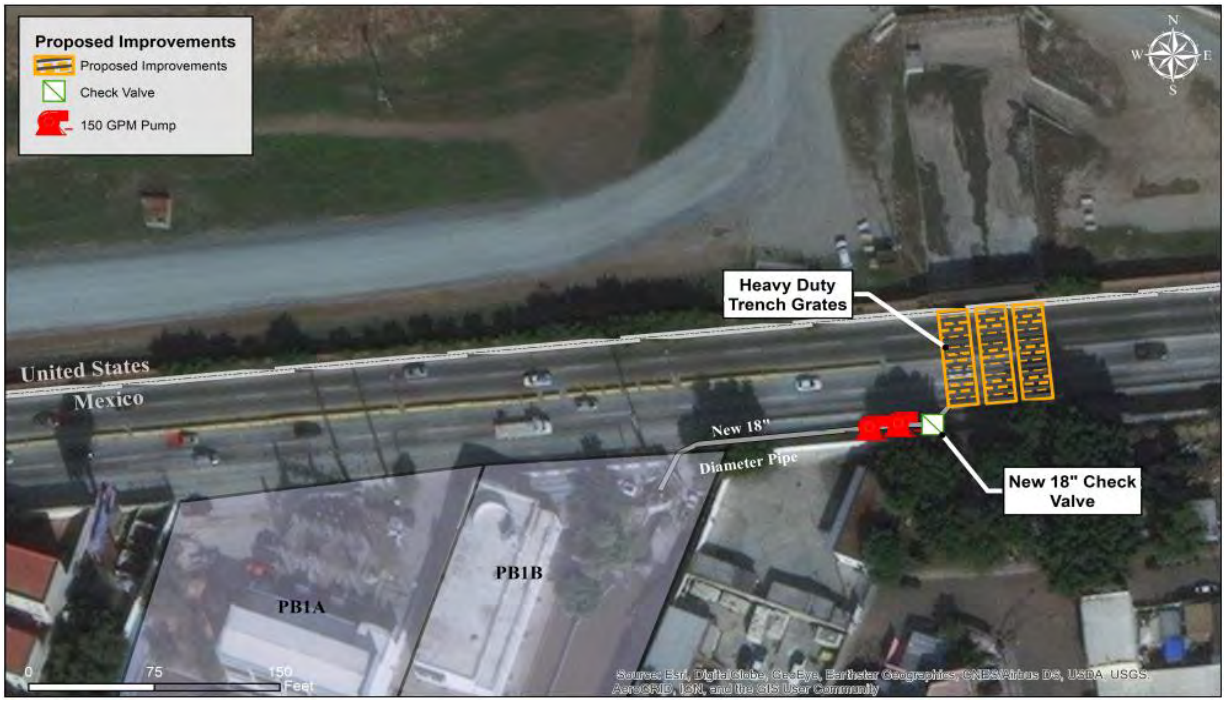


Figure 4-5. Plan view of Stewarts Drain Mexican Based with new grate structure discharging to PB1B.

Description	Quantity	Unit	Amount
Trench cut, fill, compaction, and haul away excess	2,500	CY	$51,750
Concrete work	20	CY	$4,163
18" check valves	1	EA	$38,500
Hatch doors (4'x4')	3	EA	$11,550
Metal precast grates	3	EA	$115,500
Submersible Sump Pumps 150-200 gpm, 10 HP	2	EA	$17,600
18" pipeline connecting drain to PB1B	100	LF	$31,350
PB1B Tie-in	1	EA	$93,500
		Subtotal Construction Cost	**$364,000**
Mobilization, demobilization, insurance, bonds, and related expenses		5%	$18,200
Engineer's Fee (with geotechnical investigation and topographic survey)		12%	$43,680
Construction Phase Services		10%	$36,400
Construction Contingency		30%	$109,200
General Contractor OH&P		15%	$62,790
Mexican based solution - Stewart's Drain Diversion Box Total Construction Cost			**$635,000**

4.3 Alternative Analysis – Conclusions

Flow diversion through the PBCILA intake should be reliable and operate continually, capturing flows of 1,300 lps (29 mgd) during dry- and small wet-weather events. Reduction of transboundary flows will most likely be achieved and the diversion of flows maximized considering the following elements:

- Pursuing an operational diversion system targeted at 1,300 lps or 29 mgd is the most cost-effective solution to the transboundary flows. The diversion system should target to divert all dry-weather flows within the Tijuana River Channel while maintaining operations at capacity during rain events. This would be possible by providing design upgrades to the PBCILA Intake, permitting operations during wet-weather flow events and updating the PBCILA protocol. It appears that Alternative 2b is the most cost-effective alternative to provide continuous operation at capacity of the Tijuana Diversion System.
- The infrastructure requiring immediate replacement and repairs identified in the diagnostic task (Section 2.2) should be prioritized for funding. Most of the diversion system components need replacement including most yard piping, valves (gate, check, plug, air release), pump equipment and electrical components at PBCILA, PB1A and PB1B lift stations. Alternative 2a would accomplish this goal.
- Due to the sensitivity of the diversion system, it is important to constantly meter outflows at all lift stations with a new SCADA system and new central control room. Sharing meter flow data with the Core Group and included as part of a revised PBCILA protocol.
    - A SCADA system is needed, and it's a critical tool for the operations team to overview the system in one single location. The SCADA system is a component of all alternatives and should be implemented to provide more efficient operations, control, and protection of the diversion system facilities as required.
- A supplemental power supply agreement should be obtained by CESPT for reliable operations at PBCILA, PB1A and PB1B lift stations.
- A U.S. based component is recommended to initially be a small inflatable dam or a permanent weir structure targeted to contain dry-weather flows.
- It is recommended that a feasibility study is done for the International Collector for its improvements and capacity expansion in the near future. The International Collector is a critical component of the wastewater collection system that will continue to serve as a raw wastewater conveyance for the SBIWTP.
- A design group with sediment transport expertise would need to prepare a feasibility study and preliminary engineering to identify the best location for a U.S. intake structure and to develop a design that protects the intake and does not adversely impact a U.S. based lift station. Similarly, a redesign of the PBCILA intake should include sediment transport expertise to ensure flows into the existing Diversion System minimize sediment and debris.
- While all the top alternatives offer improvements from current conditions, a combination of alternatives can be implemented to increase the benefits, including reliability and consistency, of the diversion system for effectively managing transboundary flows in the Tijuana River.

5 STUDY CONCLUSIONS

Tijuana River flows experienced during medium and large storm events (commonly occurring from October through April) that exceed diversion and treatment system capacity will typically result in transboundary flows. Alternatives evaluated in this study consider diversion of Tijuana River flows up to 60 mgd (2,600 lps). The larger flows will continue to reach the Pacific Ocean. Based on the limited data available, the study indicates that beach closures correlate reasonably well with rainfall, impact of any of the alternatives reducing beach closure will have to be further investigated.

According to the analysis, consistent and reliable operations at the current diversion infrastructure at a design capacity of 23 mgd (1,000 lps) appears to offer the lowest-cost approach to reduction of transboundary flow days per year – from an average of 138 days per year from November of 2009 through March of 2016 – to an average of 90 days per year over the same period. The most cost-effective approach to further performance improvement is to modify the intake and lift stations to enable protocol-compliant operation at a capacity of 29 mgd (1,300 lps), which reduces transboundary flow days to 69 per year on average. Further enhancements to the operational capability of the existing infrastructure by design modifications and new equipment can reduce the average number of transboundary flows days to an estimated 58 days per year – about 42% of current levels.

The diversion system infrastructure is operated by CESPT in consideration of an operations and communication protocol established in coordination with USIBWC/CILA. We recommended, at a minimum, updating of the current operational protocol to reflect capacity improvements associated with technical alternatives described in Section 4. The protocol should aim to reduce post wet-weather transboundary flows up to a design capacity (1,300 lps or 29 mgd) by restarting diversion system operations as quickly as possible once river flows have receded to design capacity levels.

The study highlights the following facts about the existing conditions of wastewater infrastructure in Tijuana and the River Diversion System:

- The condition of critical wastewater collection and conveyance infrastructure in Tijuana is poor. This has resulted in frequent pump failures and line breaks causing raw sewage to flow into the Tijuana River and adjacent canyons.
- Continued investment in Tijuana's wastewater infrastructure and O&M is critical to address the aged and deteriorated infrastructure vulnerable to pipe and pump failures, and inadequate wastewater treatment.
- Operation of the diversion infrastructure in Mexico has been unreliable, with frequent service interruptions due to blockages in the intake structure, lift station power outages, mechanical failures, limited operation and maintenance practices, and an inability to accommodate high trash- and sediment-laden flows associated with rain events.
- Dry-weather flows in the river are approaching the capacity of the diversion system. The raw sewage from infrastructure failures mixes in the river with natural flow from groundwater and treated effluent from upstream wastewater treatment plants. The system that diverts the combined flows into Tijuana's wastewater collection and treatment system is approaching its capacity. Without reuse of Tijuana's treated effluent, continued growth of wastewater generation will continue to exacerbate the problem.

- Temporary soil berms built by IBWC to contain flows in Mexico have been effective in reducing dry-weather transboundary flows caused by mechanical breakdowns, power outages, and trash blockages at the diversion system. Similarly, permanent debris traps built by CESPT to contain trash and large items along the river prior to the diversion system have helped to avoid blockages at the in-take infrastructure.
- Beach closures are more likely influenced by the volume of the transboundary flow and not simply due to the number of days of transboundary flow. This study identifies options to reduce the number of days with transboundary flows as well as to address smaller flows in the river that result at the tail end of storms or when there is a breakdown in equipment. The study did not identify any feasible options to prevent transboundary flows above 60 mgd from crossing the border.
- Replacement of infrastructure in Tijuana, outside of the diversion system affecting the quantity and quality of Tijuana River flows in consideration of:
    - Diversion system vulnerability from untreated discharges caused by pipeline failures, untreated discharges, and inadequate treatment within the Tijuana wastewater collection, conveyance, and treatment infrastructure
    - Untreated discharges (fugitive flows to the Tijuana River or other low-lying areas)
    - Adequacy of O&M budgets, plans, and BMPs
- Potential for diversion of treated effluent from the La Morita and Herrera-Solis WWTPs through water reuse projects to effectively increase the capacity of the diversion system and create beneficial uses of treated effluent presently discharged to the Tijuana River.

Flow volumes in the Tijuana River during storm events typically exceed diversion infrastructure capacity, resulting in transboundary flows. Section 4 of this study presents six alternatives considered to be the cost-effective investment options intended to improve the performance of diversion system infrastructure at the U.S.-Mexico border for diversion of dry-weather flows and improved management of post-storm event flows. Conjunctive implementation of more than one proposed option can provide more reliable dry-weather operation and improve operational capabilities during some wet-weather conditions as well.

The following conclusions may be drawn from the study regarding opportunities for reduction of transboundary flows:

- Mexican-side alternatives for capture and diversion of river flows are typically more cost-effective.
- Due to obstacles related to permitting and O&M in the U.S., Mexican-side alternatives are likely more feasible to implement at a quicker pace.
- Reliable operation of the diversion system in Mexico along with investments to enhance the existing infrastructure provide the lowest-cost approach and reduce annual transboundary flow days by 35% with Alternative 2a and by 50% with Alternative 2b.
- Projected O&M budgets for U.S.-side alternatives assume that Mexico will still be operating their system at capacity and that the U.S.-side alternatives would only be operated on an as-needed emergency basis.
- Upstream wastewater recycling would reduce the need to increase capacity of the diversion system. Diverting treated effluent, from both La Morita and Herrera-Solis WWTPs for reuse would reduce the dry-weather flow in the river.

- Diverted river flows and outflows at all lift stations should be metered continuously with a new SCADA system and new central control room, with a commitment to share this data with the Core Group entities.
- Backup power supply is needed for reliable operation of the PBCILA, PB1A and PB1B lift stations.

It is also crucial that the following inter-related investments be made in Tijuana's wastewater system:

- Repairs to prevent pipeline failures, uncontrolled discharges, and inadequate treatment within the collection, conveyance and treatment infrastructure
- Investigations to identify causes and measures to mitigate fugitive flows to the river or other low-lying areas
- Adequate and sustained O&M budgets and programs

Finally, a comprehensive solution to reducing transboundary flows must include actions related to stormwater and waste management; however, neither is the responsibility of CESPT, nor will they be improved by the infrastructure investment options identified in this study.

Overall, the study presents the top six investment options to improve the effectiveness of the diversion system at the U.S.-Mexico border for management of dry-weather flows in the Tijuana River. Some of these options also offer the potential for diversion and treatment of small wet-weather flows resulting from storm events, as well as a more rapid response to post-storm event conditions. Implementation of diversion system operational and/or capacity improvements in conjunction with other collection, conveyance and treatment system improvements are needed to maximize the effectiveness of the diversion system.

APPENDIX A

Summary Table of Transboundary Flows Spill Reports for the Tijuana River

International Boundary and Water Commission Transboundary Flow Reports

As posted in The California Water Board Webpage for San Diego – R9 (see link in footer)

2019 TRANSBOUNDARY FLOW REPORTS[1]

Start Date	End Date	Volume (Gallons)	Type (A or B)	Link to Report
January 2019[2]	N/A	N/A	N/A	N/A
February 2019[2]	N/A	N/A	N/A	N/A
March 2019[2]	N/A	N/A	N/A	N/A
04/10/2019	04/11/2019	2,000,000	B	Transboundary Flow Report
04/11/2019	04/11/2019	30,000	B	Transboundary Flow Report
04/12/2019	04/12/2019	19,800	B	Transboundary Flow Report
04/17/2019	04/17/2019	27,800,000	B	Transboundary Flow Report
04/17/2019	04/17/2019	1,500,000	B	Transboundary Flow Report
04/18/2019	04/25/2019	9,148,000	B	Transboundary Flow Report
05/03/2019	05/05/2019	4,186,000	B	Transboundary Flow Report
05/10/2019	05/13/2019	56,700,000	B	Transboundary Flow Report
05/16/2019	05/17/2019	9,750,000	B	Transboundary Flow Report
06/01/2019	06/01/2019	80,000	B	Transboundary Flow Report

[1]See pages 15-16 of Order No. R9-2014-0009 for information on the differences between Type A and B spills. Type is assigned based on what best describes the spill.

[2]USIBWC was affected by the federal government shutdown, which may have delayed the submittal of official spill reports. The San Diego Water Board will post the missing spill reports when available.

Link:https://www.waterboards.ca.gov/sandiego/water_issues/programs/tijuana_river_valley_strategy/spill_report.html

International Boundary and Water Commission Transboundary Flow Reports

As posted in The California Water Board Webpage for San Diego – R9 (see link in footer)

2018 TRANSBOUNDARY FLOW REPORTS[1]

Start Date	End Date	Volume (Gallons)	Type (A or B)	Link to Report
01/29/2018	01/29/2018	208,000	B	Transboundary Flow Report
02/04/2018	02/04/2018	100,000	B	Transboundary Flow Report
02/09/2018	02/09/2018	561,000	B	Transboundary Flow Report
02/10/2018	02/11/2018	664,000	B	Transboundary Flow Report
02/20/2018	02/20/2018	304,000	B	Transboundary Flow Report
02/25/2018	02/26/2018	1,185,000	B	Transboundary Flow Report
03/05/2018	03/06/2018	1,500,000	B	Transboundary Flow Report
03/06/2018	03/07/2018	63,000	B	Transboundary Flow Report
10/19/2018	10/19/2018	1,640,000	B	Transboundary Flow Report
11/21/2018	11/21/2018	2,240,000	B	Transboundary Flow Report
11/25/2018	11/26/2018	7,900,000	B	Transboundary Flow Report
December 2018[2]	N/A	N/A	N/A	N/A

[1]See pages 15-16 of Order No. R9-2014-0009 for information on the differences between Type A and B spills. Type is assigned based on what best describes the spill.

[2]USIBWC was affected by the federal government shutdown, which may have delayed the submittal of official spill reports. The San Diego Water Board will post the missing spill reports when available.

Link:https://www.waterboards.ca.gov/sandiego/water_issues/programs/tijuana_river_valley_strategy/spill_report.html

International Boundary and Water Commission Transboundary Flow Reports

As posted in The California Water Board Webpage for San Diego – R9 (see link in footer)

2017 TRANSBOUNDARY FLOW REPORTS

Start Date	End Date	Volume (Gallons)	Type (A or B)	Link to Report
02/06/2017	02/23/2017	143,000,000	B	Transboundary Flow Report
03/01/2017	03/01/2017	145,000	A	Transboundary Flow Report
04/24/2017	04/24/2017	143,000	B	Transboundary Flow Report
04/24/2017	04/24/2017	12,850	A	Transboundary Flow Report
04/30/2017	05/01/2017	645,000	A	Transboundary Flow Report
05/21/2017	05/21/2017	1,560	A	Transboundary Flow Report
05/21/2017	05/21/2017	400,000	B	Transboundary Flow Report
05/24/2017	05/24/2017	3,800	A	Transboundary Flow Report
05/25/2017	05/25/2017	335,000	B	Transboundary Flow Report
06/09/2017	06/09/2017	42,800	B	Transboundary Flow Report
06/10/2017	06/10/2017	161,670	B	Transboundary Flow Report
06/12/2017	06/12/2017	66,600	B	Transboundary Flow Report
06/20/2017	06/21/2017	100,000	B	Transboundary Flow Report
06/27/2017	06/27/2017	5,500,000	A	Transboundary Flow Report
07/31/2017	07/31/2017	1,720,000	B	Transboundary Flow Report
08/07/2017	08/07/2017	311,000	B	Transboundary Flow Report
08/17/2017	08/17/2017	411,000	B	Transboundary Flow Report
09/09/2017	09/10/2017	3,900,000	B	Transboundary Flow Report
09/12/2017	09/13/2017	192,000	B	Transboundary Flow Report
09/19/2017	09/19/2017	38,000	B	Transboundary Flow Report
10/06/2017	10/07/2017	4,152,000	A	Transboundary Flow Report
10/11/2017	10/11/2017	80,800	B	Transboundary Flow Report
10/19/2017	10/19/2017	1,207,000	A	Transboundary Flow Report
10/22/2017	10/22/2017	228,000	B	Transboundary Flow Report
12/11/2017	12/11/2017	223,000	B	Transboundary Flow Report

Link:https://www.waterboards.ca.gov/sandiego/water_issues/programs/tijuana_river_valley_strategy/spill_report.html

International Boundary and Water Commission Transboundary Flow Reports

As posted in The California Water Board Webpage for San Diego – R9 (see link in footer)

2016 TRANSBOUNDARY FLOW REPORTS

Start Date	End Date	Volume (Gallons)	Type (A or B)	Link to Report
01/16/2016	01/17/2016	6,620,000	B	Transboundary Flow Report
01/17/2016	01/19/2016	8,450,000	B	Transboundary Flow Report
01/19/2016	01/20/2016	2,080,000	B	Transboundary Flow Report
01/20/2016	01/21/2016	2,090,000	B	Transboundary Flow Report
01/21/2016	01/22/2016	1,600,000	B	Transboundary Flow Report
01/23/2016	01/24/2016	2,170,000	B	Transboundary Flow Report
01/23/2016	01/23/2016	720,000	B	Transboundary Flow Report
01/24/2016	01/25/2016	1,440,000	B	Transboundary Flow Report
01/25/2016	01/26/2016	940,000	B	Transboundary Flow Report
01/26/2016	01/27/2016	480,000	B	Transboundary Flow Report
01/28/2016	01/28/2016	2,238	A	Transboundary Flow Report
01/29/2016	01/29/2016	690,000	B	Transboundary Flow Report
02/12/2016	02/13/2016	370,000	B	Transboundary Flow Report
04/05/2016	04/05/2016	4,860,000	B	Transboundary Flow Report
06/30/2016	06/30/2016	440,000	B	Transboundary Flow Report
07/02/2016	07/02/2016	1,320,000	B	Transboundary Flow Report
07/04/2016	07/04/2016	33,000	B	Transboundary Flow Report
09/05/2016	09/05/2016	390	A	Transboundary Flow Report
09/08/2016	09/08/2016	690,000	B	Transboundary Flow Report
10/26/2016	12/15/2016	920,000	B	Transboundary Flow Report
11/29/2016	11/29/2016	200,000	A	Transboundary Flow Report

Link:https://www.waterboards.ca.gov/sandiego/water_issues/programs/tijuana_river_valley_strategy/spill_report.html

International Boundary and Water Commission Transboundary Flow Reports

As posted in The California Water Board Webpage for San Diego – R9 (see link in footer)

2015 TRANSBOUNDARY FLOW REPORT

Start Date	End Date	Volume (Gallons)	Type (A or B)	Link to Report
02/12/2015	02/12/2015	53,000	B	Transboundary Flow Report
02/14/2015	02/16/2015	172,000	B	Transboundary Flow Report
06/17/2015	06/17/2015	47,600	B	Transboundary Flow Report
07/25/2015	07/27/2015	556,000	B	Transboundary Flow Report
07/31/2015	08/01/2015	846,400	B	Transboundary Flow Report
08/02/2015	08/02/2015	2,165,930	B	Transboundary Flow Report
08/03/2015	08/03/2015	1,592,945	B	Transboundary Flow Report
08/06/2015	08/06/2015	437,465	B	Transboundary Flow Report
08/08/2015	08/09/2015	109,366	B	Transboundary Flow Report
09/19/2015	09/22/2015	7,729,398	B	Transboundary Flow Report
10/13/2015	10/13/2015	1,350,000	B	Transboundary Flow Report
10/14/2015	10/14/2015	1,240,000	B	Transboundary Flow Report
10/17/2015	10/18/2015	1,300,000	B	Transboundary Flow Report
11/19/2015	11/19/2015	1,310,000	B	Transboundary Flow Report
12/11/2015	12/11/2015	2,060,000	B	Transboundary Flow Report

APPENDIX B

PBCILA Operational Protocol

INTERNATIONAL BOUNDARY AND WATER COMMISSION (IBWC)

"CILA Pump Station Operations and Notification Protocol"

Background

The CILA Pump Station (PS-CILA) is located approximately 1,200 feet (400 m) upstream of the international boundary between the U.S. and Mexico, and it diverts the waters from the Tijuana River into the City of Tijuana, B.C. sewer system. It was built in the year 1991 in order to comply with *Recommendation #16* of IBWC Minute 283, entitled ***"Conceptual Plan for the International Solution to the Border Sanitation Problem in Tijuana, Baja California- San Diego, California,"*** signed between the two countries on August 8, 1990.

The implementing agreement for the construction of this pump station was the ***"Joint Report of the Principal Engineers Recommending Temporary Needed Works to Divert Uncontrolled Wastewaters that Cross the International Boundary in the Tijuana River Channel,"*** dated March 20, 1991. Then, the infrastructure of this Defensive System was formally turned over to the State Public Utility Commission for Tijuana (**CESPT)** in 1991 for it to take charge of its operation and maintenance, forming an integral part of the City of Tijuana, B.C. sanitation system.

At the time, no operations protocol was defined in the *Joint Report of Principal Engineers,* and only the diversion of flows in the river channel during the dry season was considered, leaving it up to the participating entities (the two Sections of the IBWC and the CESPT Utility Operator) to coordinate its operation with the goal of developing a technically functional procedure based on the behavior of the basin and the infrastructure built. Until recently, there was an unwritten operations protocol, which currently is being documented in this *Joint Document*. This protocol for PS-CILA includes the timely notification of the International Boundary and Water Commission, United States and Mexico (*US-MX IBWC*), the international body that paid for the construction of said infrastructure, by *CESPT* of any situation that interrupts, impedes or negatively alters the operation of the pump station.

Over the years, the pump station has undergone modifications. In the period 2009-2010, its installed capacity was increased to an additional 1,500 lps, utilizing funds from the U.S. Environmental Protection Agency (USEPA) and with joint financing from BECC and NADB. This modification to PS-CILA is referred to in the 2008 *USEPA* Environmental Assessment Study. This was in anticipation of the expected increase in projected flows during the dry season once the newly constructed "La Morita" and "Jose Arturo Herrera Solis" wastewater treatment plants became operational upstream of PS-CILA, in addition to the flows from the City of Tecate, B.C. wastewater treatment plant. At the end of 2010 these new secondary treatment plants came online. The discharge of secondary effluent to the Tijuana River in 2010-2011 averaged around 450 lps daily (approx. 10 MGD). This discharge was captured and diverted by PS -CILA downstream. Additionally, between the years 2012 and 2013, the Alamar River (tributary to the Tijuana River) was channelized and lined with concrete. It is believed that the peak flows in that portion of the canalization have increased because of less infiltration. The average flow through the Tijuana River in the dry season is now estimated to be around 600 to 700 lps (13.7 to 16.0 MGD).

Under IBWC Minute 320, one of the objectives identified by the Water Quality Binational Work Group (WQ BWG), which was proposed to the Binational Core Group (BCG), was the development of an "**Operation and Notification Protocol**" for PS-CILA, with the aim of assuring greater operational transparency and providing timely notification to the public for their security and wellbeing.

Currently, the only existing measurement for the flows that cross the border into the United States is provided by the telemetry station on the river channel in U.S. territory, near the international border, operated by the U.S. Section of the IBWC (USIBWC). The data provided by that meter is used by U.S. agencies to transfer information into the Southern California Coastal Ocean Observing System (SCCOOS), which is an online tool developed by the Scripps Institution of Oceanography that models and tracks the discharge from the Tijuana River. The information is also used by the San Diego County Environmental Health Department in California to publish the conditions of the beaches for public use. During the rainy season (the region's winter) the beaches are usually closed from the border area with Mexico up to Imperial Beach because of the mixture of flows that potentially contain pollutants as a result of the transport of urban debris and/or the incorporation of wastewaters.

Objective

The operation of PS-CILA is intended to capture, convey and manage the sanitation of the surface flows through the Tijuana River channel (during the dry season) coming from the different upstream water sources in the basin, which are typically confined to the pilot channel of the lined canal. For this purpose, there is a "capture and diversion" structure that intercept flows and conveys them through a pipeline to a wet well located outside the concrete channel; from there the water is conveyed to Pump Station No. 1 (PS-1) through two pipelines, described below.

Description of the PS-CILA Works (Components)

- **Settling Basins:** There are three (3) settling basins in the river pilot channel that includes the bypass structure. They are constant-level, gravimetric longitudinal canals; the first one has a length of 120 meters, the second settling basin is 150 meters, and the last one before the intake is 120 meters long. Each of the three settling basins has a width of 8 meters. The primary objective of these structures is to reduce and control the velocity, thereby facilitating the precipitation by gravity of sediment and sand. This mitigates the clogging of the station's wet well with sediment.

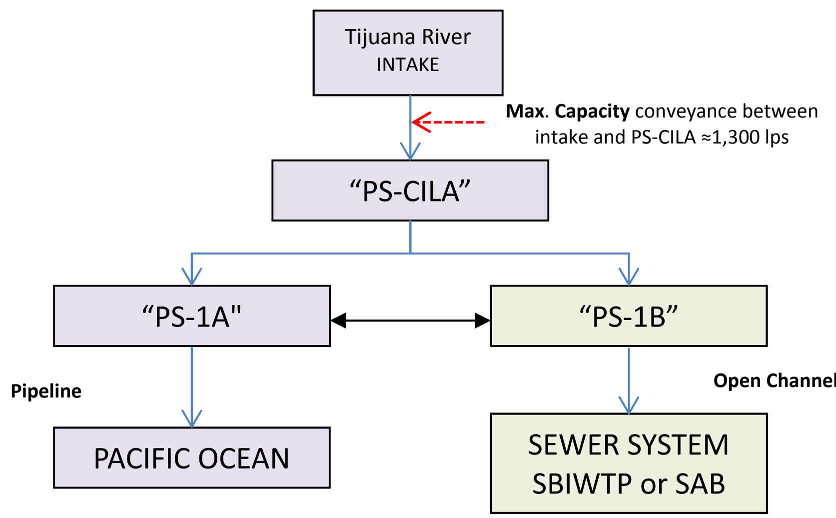
- **Diversion Structure and Intake:** Made up of a reinforced concrete wall that retains and diverts flow from the low-flow pilot channel towards the Intake, which has a system of bar grates to retain large, floating debris that must be removed manually. Once the flow of water is filtered, it is conveyed by gravity to the wet well, located outside the river channel.

- **Pumping Systems:** The electromechanical equipment for PS-CILA has two sets, or pumping systems, with a total of 6 pumps.

  One set consists of 3 centrifugal pumps, each of which has an installed capacity of 500 liters per second. Under normal conditions, two of the pumps operate jointly or alternating as needed. The third is used only as backup or in case of emergency. This system is known as the "*Surface Flow Disposal System*" (SAAS, in Spanish). The SAAS system is responsible for diverting the treated wastewater coming from the "La Morita" and "Jose Arturo Herrera Solis" plants, as well as the flows from the neighboring city of Tecate. All of the flow is conveyed to PS-1A, via a force main separate from the untreated wastewater collector. (This pump set can also convey flow to PS-1B pump station.) The force main from PS-CILA to PS-1A has a diameter of 30 inches and an approximate capacity of 1000 lps. PS-1A conveys the effluent in a pipeline to discharge at the coast of the Pacific Ocean in Mexican territory.

The second pump set consist of three (3) vertical turbine pumps, each with a capacity of 500 lps. Under normal conditions, two (2) operate jointly or alternating as needed, and the third is used as a backup or in emergencies. This pump set discharges flow into a 72" diameter wastewater collector which terminates at PS-1B or the South Bay International Wastewater Treatment Plant. Capacity of the 72-inch diameter collector is approximately 75 mgd. This pump set can only deliver flow to the 72" diameter collector and from there to PS-1B. PS-1B sends the water through a force main and open channel to the San Antonio de los Buenos WWTP (*Punta Bandera*).

The systems can work simultaneously or independently to send the treated wastewater to the outlet in the Pacific Ocean.



- **PS-CILA & PS-1A:** The PS-CILA defensive system and PS-1A/1B are interrelated in their operations process because the conveyance capacity of the supply line from PS-CILA to PS-1 is 1,000 lps and the conveyance capacity of the pipeline that connects the intake with the PS-CILA is around 1,300 lps. Any proposed future change to the system should consider the two pumping systems together as a whole unit (PS-CILA and PS-1).

- **Backup Generator:** In the event of a potential power failure for any reason in the power line to PS-CILA, there is currently a backup power generator capable of providing power within minutes after the service interruption and it can maintain only one (1) pump in constant operation; the generator is switched on manually. It is technically viable to incorporate other backup units.

<u>Operation in Low-water (dry) Season</u>

<u>Normal Conditions</u>

Under normal conditions and during the dry season, normally considered to be May 1 to November 1, the procedure is as follows:

- ✓ Clean-out of the grate system and supervision of the pilot channel. Both are done at intervals from two (2) to three (3) hours, using a crew of two operators. The clean-out of the grates on the pilot channel is done manually, since security concerns do not allow for another type of equipment to be installed in the pilot channel. CESPT has the necessary equipment and personnel required for cleaning.

- ✓ The hours of operation of the motor pumps at PS-CILA are recorded daily. The data collected is used to estimate and keep a record of the times and volumes of water from the river that is pumped.

<u>“Abnormal” Conditions</u>

PS-CILA remains active, including when the runoff inside the pilot channel exceeds the operating capacity of the plant. Cases like this tend to happen when there are obstructions, collapses, breaks or failures in the city’s water distribution or sewer system, either in the municipality of Tijuana or in Tecate, BC. MXIBWC will notify USIBWC in cases where the channel capacity exceeds pump station capacity but the pump station continues to operate.

The operations procedure applied in these conditions is outlined below:

- ✓ Ongoing supervision is performed every two (2) hours, for the purpose of keeping the Intake grate (access to the defensive system) free from debris.

- ✓ Physical flow measurements are directly made in the river channel, upstream of the PS-CILA.

- ✓ In an “emergency” up to a maximum of three (3) motor pumps can be activated, using a combination of pumps from either of the two pump sets. The information from operating the equipment is used to calculate the daily usage and is communicated to the *CESPT Wastewater Control Office* in order to anticipate any potential issue with the system that could adversely impact the plant.

Operation during the rainy season

<u>Temporary Suspension of Operations</u>

a) In the case of sporadic rainfall that causes minimal increase in river flow that is within the emergency capacity of the pump station, pumping is increased based on the availability of the emergency equipment but without putting PS-CILA at serious risk of sediment entering the wet well. The conditions of the grates is monitored and the regular clean-out is increased to intervals between one (1) to two (2) hours, until it is determined that the new operations conditions should be modified. During this operational phase, partial spills of water into U.S. territory can occur due to the “peak flows” that exceed the installed pumping capacity at PS-CILA.

b) If the frequency or intensity of the rain increases, there is an inherent risk of the infrastructure in general experiencing major damage, mainly due to the high level of sands and suspended solids transported by the river flows, which can obstruct and/or wear down the pump impellers. When this situation happens, CESPT makes the decision to close the Intake to the defensive system and operation of the Pump Station is suspended; next, CESPT informs the MXIBWC with a phone call explaining the reason for the decision. Normally, this condition occurs when the flow in the Tijuana River exceeds 1,000 lps. The MXIBWC will inform its U.S. counterpart by phone, and then will follow up with another notification via email.

Preliminary Work to Restart Service

Once the rain event has passed, the level of runoff in the Tijuana River will be monitored until it can be determined that the flow is equal to or less than 1,300 lps (daily average), which is calculated manually (area/velocity) in the pilot channel, and providing rain has not been forecast for the next three days. CESPT will make the decision to proceed with the next step called “Preliminary Work.” During this phase, CESPT personnel will frequently review the records for the Tijuana River flow meter (located in U.S. territory and operated by the USIBWC). This can be consulted through the website http:// http://www.ibwc.gov/wad/013300_a.txt, which provides data for the estimated volume of runoff in the Tijuana River, with a 2-hour delay. If the meter is out of operation, then CESPT performs direct physical measurements of the flows in the river channel.

When the flows reach 1,300 lps or less, personnel will verify the runoff with direct physical measurements in the pilot channel using the area and velocity measurement. This makes it possible to determine the approximate instantaneous flow in the river. Once the readings are confirmed, the instruction is given to proceed with the clean-up work of the sedimentation basins in the Tijuana River channel and to remove solid debris from the wet well. Inspections of the motor pumps at both PS-CILA and PS-1A are undertaken (including the valve system, float levels and general electrical systems at the facilities). Preparatory work normally takes 1 to 2 days to complete.

Resuming Service (Start up)

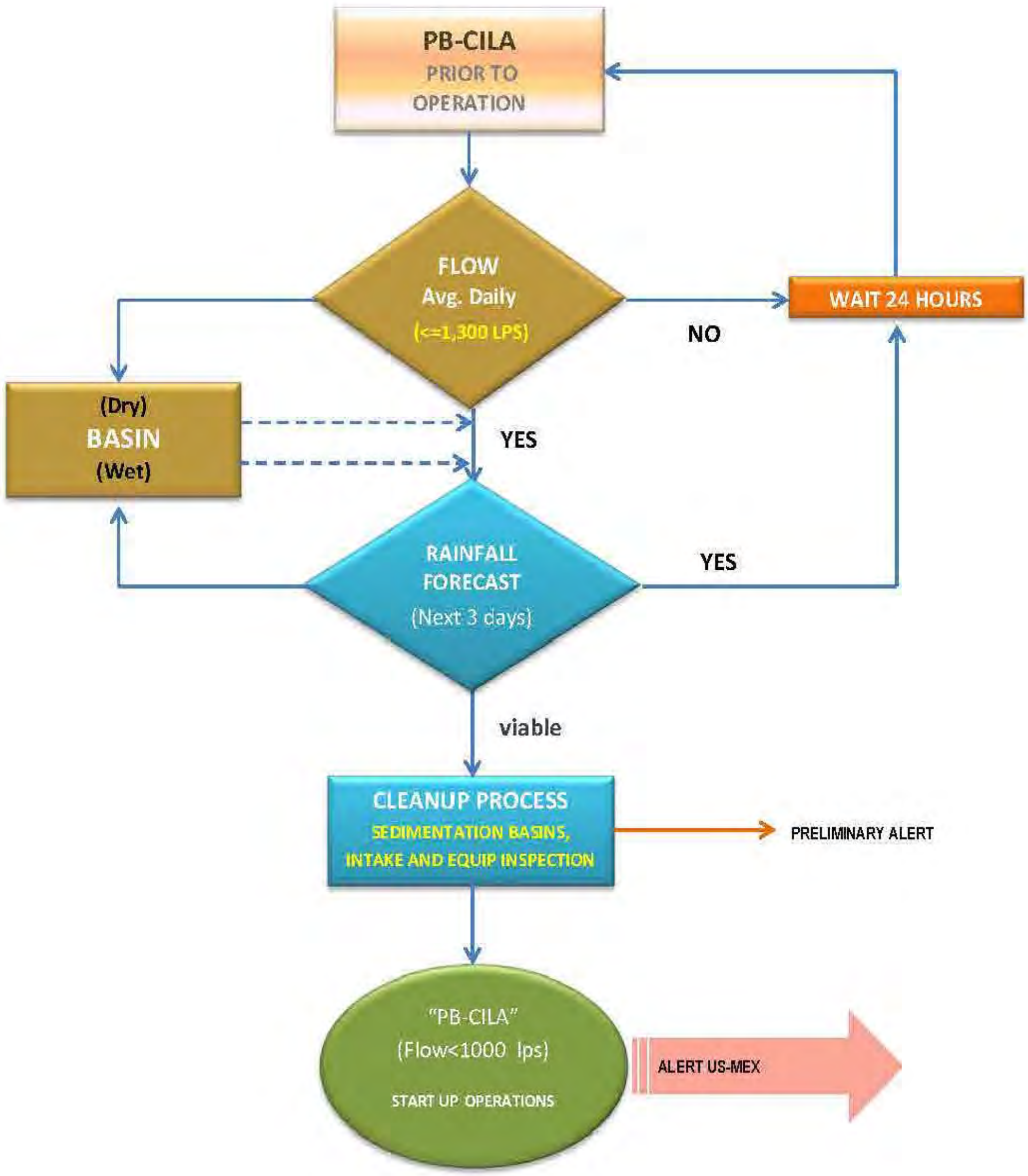
Once the flows in the river have decreased and remain below 1,000 lps, the preparatory work is finished at PS-CILA, and all the facilities are ready to begin receiving the water flows from the Tijuana River pilot channel. CESPT will notify the MXIBWC field office in Tijuana, B.C., by phone, email, or other means of the start-up of the PS-CILA defensive system. The MXIBWC then will notify its U.S. counterpart by telephone and/or email.

The procedure to reactivate the Pump Stations (PS-CILA and PB-1A) initiates with three (3) pumps in order to evacuate as soon as possible the water level; this begins the disposal of the waters of the Tijuana River towards the San Antonio de los Buenos WWTP (*Punta Bandera*) and their final discharge into the San Antonio arroyo and the Pacific Ocean.

Additional Actions

Additional safety measures taken by CESPT operators include the inspection of the air extraction (purge) valves along the wastewater force main to ensure that the force main is free of obstructions and the pumping process has been normalized.

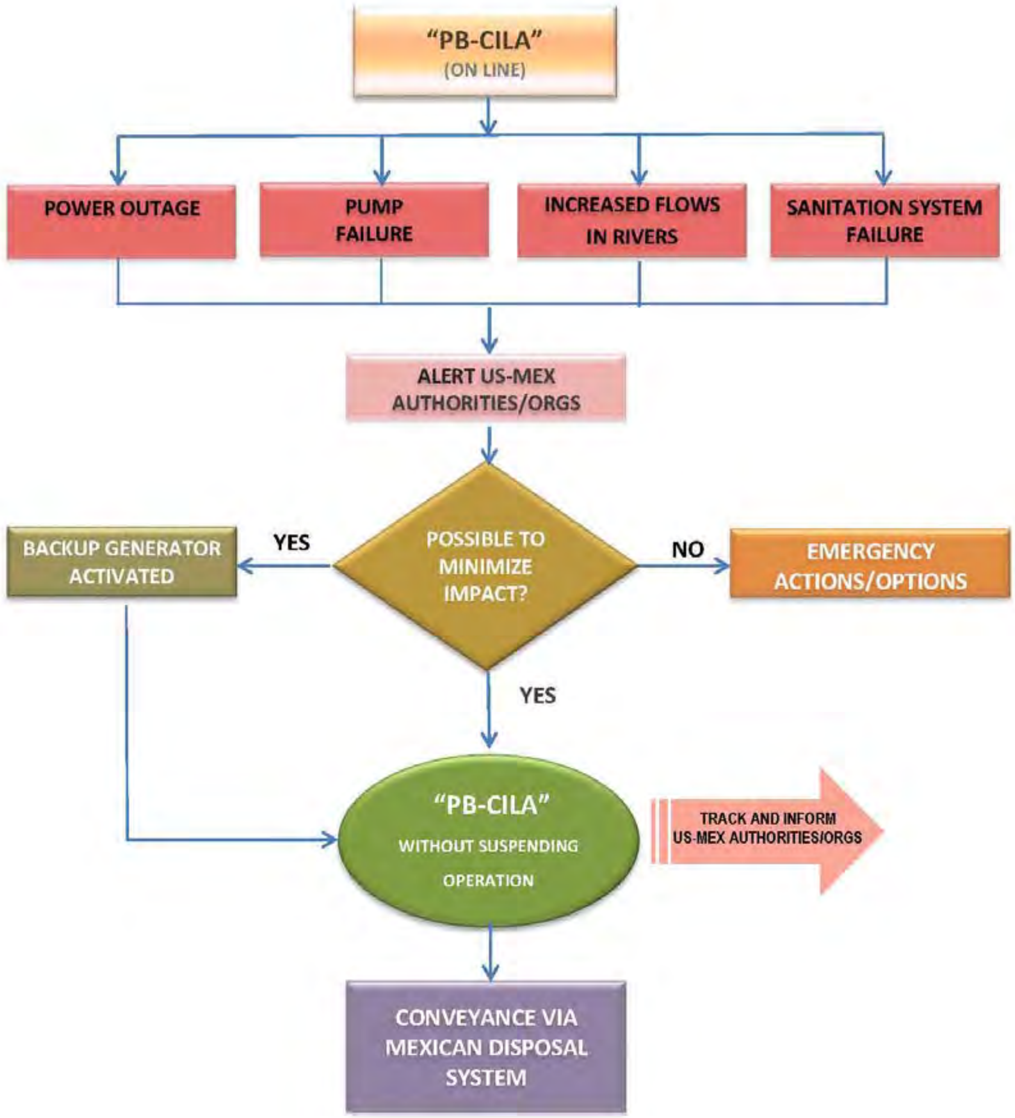
During the first days following the re-start of operations of the PS-CILA defensive system, the frequency of the inspection visits to the intake and grate structure is increased because of potential sediment and/or trash transport after a rain event.



"CILA" PUMP STATION (PB-CILA)

OPERATIONS PROTOCOL - CURRENT

(FLOW CHART)



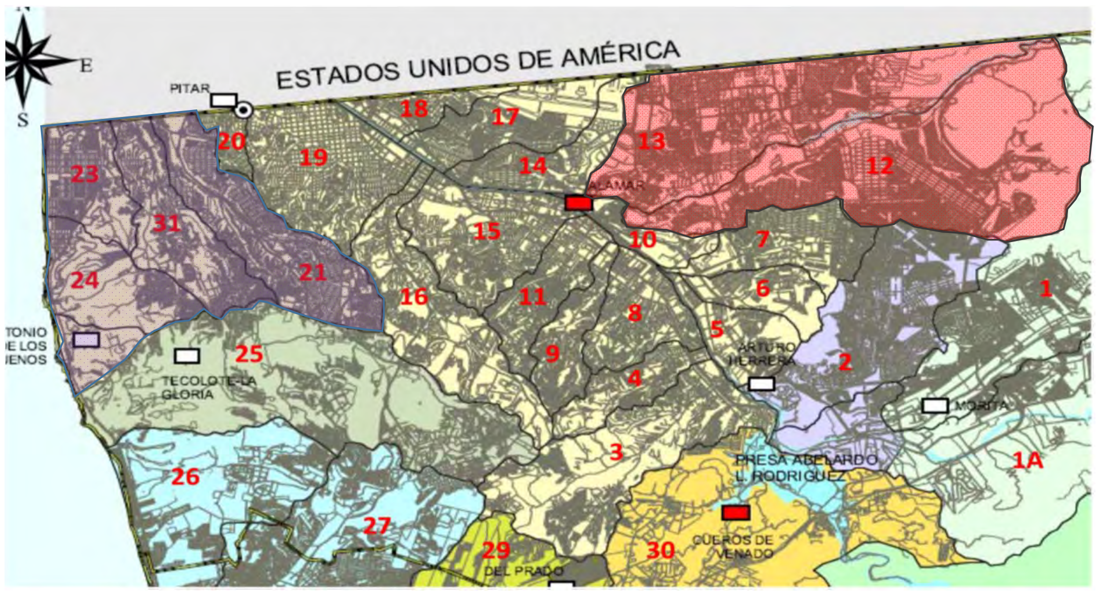
"CILA" PUMP STATION

OPERATIONS PROTOCOL - EMERGENCIES

(FLOW CHART)

APPENDIX C

Tijuana Flow Projections and International Collector sizing



TIJUANA RIVER SUB-BASINS
(SUBCUENCAS DEL RIO TIJUANA)*:

SAB WWT/PTAR SAB

ALAMAR RIVER/RIO ALAMAR

SBIWTP/PITAR

HERRERA SOLIS WWTP/PTAR

LA MORITA WWTP/PTAR

CUEROS DE VENADO

*These sub-basins have been identified to have flows discharging into the diversions system and the International Collector

* Se ha identificado que los caudales derivados de estas subcuencas tienen in impcato directo al sistema de desvío y el Colector Internacional

SUB-BASIN POPULATION PROJECTIONS IN TIJUANA AND ROSARITO:
POBLACIÓN POR CUENCAS EN TIJUANA- ROSARITO

No.	SUB BASIN/CUENCA:	2018	2035	2050
1	Matanuco Norte (La Morita)	107,312	124,413	140,537
1A	Matanuco Sur	85,909	122,142	152,745
2	El Florido	183,526	198,310	210,626
3	El Sainz	58,928	70,570	82,011
4	México Lindo	18,535	21,293	23,861
5	Cerro Colorado	28,288	30,512	32,355
6	Guaycura Presidentes	24,435	26,661	28,558
7	El Gato Bronco	54,950	59,234	62,780
8	La Mesa	41,690	45,221	48,190
9	Sánchez Taboada	40,342	43,343	45,803
10	Sistema Álamos	20,119	21,669	22,949
11	Camino Verde	47,270	50,588	53,277
12	Tributarios Alamar izq.	171,455	198,131	223,173
13	Tributario Alamar der.	116,747	125,856	133,398
14	La Pechuga	34,836	37,224	39,150
15	Agua Caliente	64,398	69,546	73,827
16	Aguaje de la Tuna	100,831	108,716	115,246
17	Pastejé o Aviación	45,592	48,898	51,595
18	Emiliano Zapata	19,605	21,265	22,660
19	Sistema Centro	80,590	87,928	94,182
20	Cañón del Sol	9,936	10,756	11,441
21	El Matadero	86,609	92,568	97,380
22	Valle de las Palmas	49,490	142,937	223,164
23	Playas Norte	36,993	39,717	41,947
24	Playas Sur	23,122	26,239	29,090
25	San Antonio de los Buenos	89,033	104,780	119,924
26	San Antonio del Mar	19,557	30,710	40,182
27	Plan Libertador	23,816	31,180	39,176
28	Guaguatay	-	-	-
29	Rosarito	13,121	27,722	40,217
30	Cueros de Venado	32,273	55,400	75,104
31	Los Laureles	56,821	60,846	64,116
32	Rosarito Sur	11,788	33,372	51,900
33	Playa Encantada	-	-	-
34	El Morro	21	23	24
35	El Paraíso	1	2	2
36	El Descanso	75	81	86
37	Mesa del Descanso	-	-	-
38	La Misión	213	229	242
		-	-	-
26	San Antonio del Mar	5,250	8,368	12,490
27	Plan Libertador	20,673	31,965	46,460
28	Guaguatay	14,570	20,788	28,162
29	Rosarito	18,152	27,291	38,706
32	Rosarito Sur	10,870	16,077	22,475
33	Playa Encantada	10,640	15,331	20,949
34	El Morro	12,864	18,973	26,459
35	El Paraíso	10,360	15,578	22,096
36	El Descanso	2,962	4,454	6,318
37	Mesa del Descanso	3,553	5,342	7,578
38	La Misión	1,295	1,948	2,763
	TOTAL	1,909,419	2,334,197	2,725,377

Estimated people per capita or population discharging into the Tijuana River Diversion System Población que descarga hacia al Sytema de Desvio del Rio Tijuana (Incluye PTAR Morita y Herrera Solís) no incluye descargas a la presa Rodriguez	**1,377,633**	**1,566,918**	**1,732,030**

Population projection estimate to International Collector/ Poblacion estimada de descarga al Colector Internacional

	2018	2035	2050
Estimated population discharging into the Tijuana River Diversion System/ Población que descarga hacia al Sytema de Desvio del Rio Tijuana (Incluye PTAR Morita y Herrera Solís) no incluye descargas a la presa Rodriguez	1,377,633	1,566,918	1,732,030
Population Discharging into Alamar River/ Población que descarga al Rio Alamar	110,455	171,818	179,182
Population Discharging into International Collector/ Población total que podría drenar a Colector Internacional	1,488,087	1,738,736	1,911,212
Flows Discharging into PBCILA and PB1A lift Station (lps)/ Caudal que se conduce de la PBCILA a la PB1B (lps)	500	500	500
Population discharging into PBCILA and PB1A lift Station (lps)/ Poblacion que descarga de la PBCILA a la PB1A (lps)	245,455	245,455	245,455
Estimated Population discharging into International Collector/ Población estimada de proyecto al Colector Internacional	1,242,633	1,493,281	**1,665,757**

International Collector

					Design Data									
ID of Stretch of Pipe	Local Area	Local Population of the Basin Area	No. of Discharge Points	Population that is Incorporated in the Basin Area	Cumulative Population	Inputs	Q Mean	Q min (L/s)	Q min (m3/s)	M	Q max	Q max provided	Q max provided	**Diameter**
		Population		Population	pop	l/pop/d	lps	lps	m3/s		lps	lps	m3/s	inches
1-2	PARALELO A CANAL	1,665,756.98	1.00	1665756.98	1665756.98	176.00	3393.21	1696.60	1.6966043	1.80	6107.78	9161.66	9.161663	**84**
2-3	LÍNEA INTERNACIONAL	0.00	1.00	0.00	1665756.98	176.00	3393.21	1696.60	1.6966043	1.80	6107.78	9161.66	9.161663	**96**

ID of Stretch of Pipe	Diameter	Diameter	Material	Roughness	Length	Length of Stretch of Pipe	Ground Elevation Upstream	Difference in Pipe Diameter	Elevation of Lift Station Upstream	Ground Elevation Downstream	Elevation of Lift Station DownStream	Difference Between Up and Downstream Lift Station Elevation	S	S	A	R (Hydraulic Radius)	R^(2/3)	S^(1/2)	QLL	VLL
	meters	cm					meters		meters					Thousandths	m^2	m			m^3/s	m/s
1-2	2.13	213.36	HDPE	0.010	400.000	400.000	20.000		16.366	19.000	15.366	1.000	0.00250	3.000	3.575	0.533	0.658	0.055	12.880	3.602
2-3	2.44	243.84	HDPE	0.010	3000.000	2487.000	19.000	0.305	15.062	15.000	11.331	3.731	0.00150	2.000	4.670	0.610	0.719	0.045	15.015	3.215

	Revision of Maximum Velocity																		
ID of Stretch of Pipe	QP	QP/QLL	% of Full Flow Discharge	% Max. Flow Discharge	Verification	VP/VLL	VP	V max. Normals	Verification of V max.	Q min	Q min/QLL	V min/VLL	V min	V min Normals	Verification of V min.	YP/D	Strap Max.	Ymin/D	Strap Min.
	m^3/s							m/s									m		m
1-2	9.16166	0.711	0.711	0.850	OK	1.084	3.906	5.000	ok	1.69660	0.131725	0.697	2.509	0.300	ok	0.623	1.329	0.245	0.523
2-3	9.16166	0.610	0.610	0.850	OK	1.049	3.373	5.000	ok	1.69660	0.112997	0.663	2.131	0.300	ok	0.564	1.376	0.226	0.551

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{\frac{2}{3}} \sqrt{S} \quad [\text{U.S.}]$$

$$Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}} \sqrt{S} \quad [\text{SI}]$$

APPENDIX D

Field Assessment Site Visits Photolog

OCEAN DISCHARGE (21/06/18)

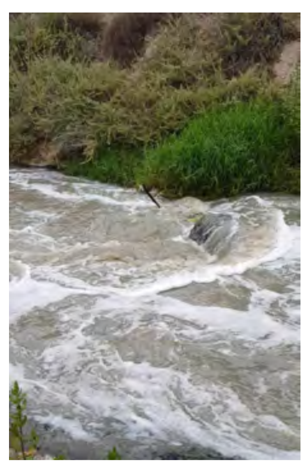
Photograph 1: open channel discharge

Photograph 2: open channel discharge to ocean

Photograph 3: open channel discharge to ocean

Photograph 4: open channel discharge to ocean

Photograph 5: Arcadis team performing filed measurements at ocean discharge



Photograph 6: discharge to the ocean

PB1A LIFT STATION (21/06/18)

Photograph 1: (2) - 24-inch gate valves from PBCILA, exterior oxidation noticeable

Photograph 2: carbon steel feed line to compressors outside PB1A&B

Photograph 3: Sedimentation Channel deteriorated conditions at PB1A &B

Photograph 4: Corroded conditions of metal handrail at inlet junction box, PB1A&B

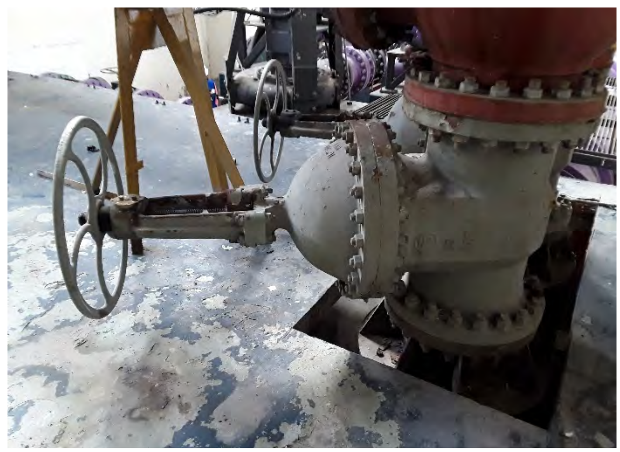
Photograph 5: Inlet Channel, from International Collector deteriorated conditions at PB1A &B

Photograph 6: sedimentation ramp and channel, from International Collector deteriorated conditions at PB1A &B. Trash along the edge of concrete.

Photograph 7: non-working conditions of screens

Photograph 8:

Photograph 9: 20 in check valve stuck



Photograph 10: 20 in gate valve, external oxidation is visible

Photograph 11: 20 in mov not operational

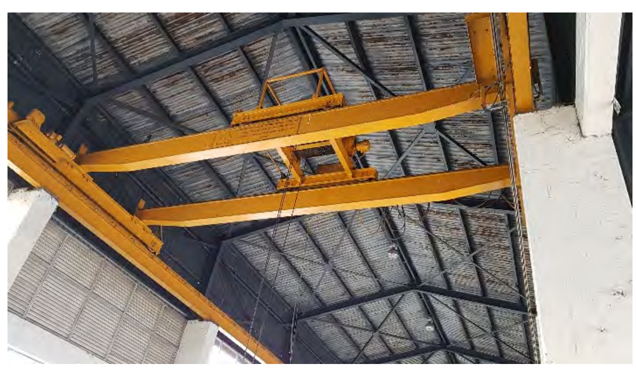
Photograph 12: 24 in gate valve for effluent ww 1 of 2

Photograph 13: 20 in gate valve newco

Photograph 14: 24 in gate valves for surge control system

Photograph 15: 24 in check valve for surge control system

Photograph 16: 24 in gate valves for surge control system



Photograph 17: Original hoist system

Photograph 18: Original hoist system


Photograph 19: vertical pump 3B


Photograph 20: PB1A effluent manifold


Photograph 21: PB1A effluent manifold


Photograph 22: PB1A effluent manifold and check valve


Photograph 23: tie-in to effluent manifold


Photograph 24: deteriorated building conditions

Photograph 25: Old pump train No. 1 concrete base

Photograph 26: PB1a Building, interior wall

Photograph 27: Train 3, hoist beams and building ceiling

Photograph 28: Pump train not in service at PB1A

Photograph 29: reducer from inlet channel into pump rain 3

Photograph 30: reducer from inlet channel into pump rain 4

Photograph 31: old centrifugal pump, not in service

Photograph 32: concrete base deteriorated conditions

Photograph 33: pump 4 train in service

Photograph 34: surge tank at PB1A

Photograph 35: PB1A MCC plate

Photograph 36: MCC at PB1A

Photograph 37: MCC at PB1A

Photograph 38: MCC at PB1A

Photograph 39: Batteries at PB1A

Photograph 40: MMC panel plate at PB1A

Photograph 41: transformer control panel at PB1A

Photograph 42: null-2018-0620-1217-21

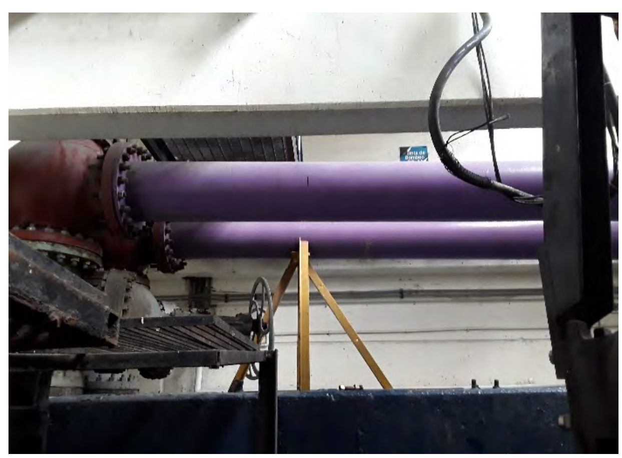
Photograph 43: sump pump control panel

Photograph 44: air compressor at PB1A

Photograph 45: effluent meter from PB1A

Photograph 46: sump pump setup

Photograph 47: null-2018-0620-1220-54



Photograph 48: null-2018-0620-1221-06

Photograph 49: Trash rack for screens

Photograph 50: Trash rack for screens

Photograph 51: Inlet box filled with trash

Photograph 52: 20180620_095106

Photograph 53: Trash collected along the side of the lift station

Photograph 54: PB1A Building

Photograph 1: Influent Channel

Photograph 2: Sedimentation Channel

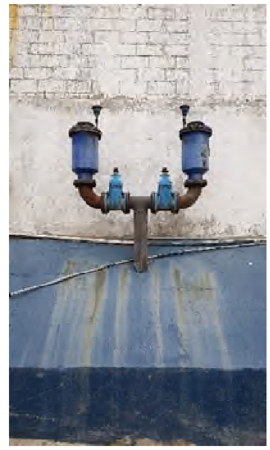
Photograph 3: Non-operational mechanical racks

Photograph 4: Control panel for mechanical racks

Photograph 5: influent channel junction box

Photograph 6: Mechanical rank channel, metal gate and screens

Photograph 7: influent junction bock from Sanchez Collector

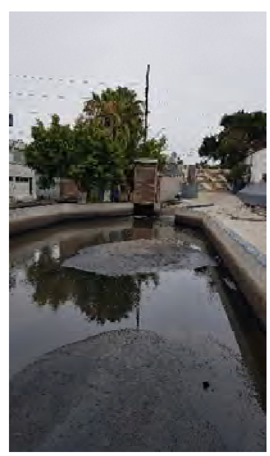


Photograph 8: Air Valve, leaks stains shown

Photograph 9: Trash piles along lift station property

Photograph 10: Trash piles along lift station property

Photograph 11: Wood boards over channels for wheel barrel removal of trash



Photograph 12: Sedimentation within inlet channel

Photograph 13: Gate operating valves

Photograph 14: corrosion conditions of channels

Photograph 15: metal screens with visible corrosion

Photograph 16: metal screens with visible corrosion

Photograph 17: trash at blocked gate shown

Photograph 18: junction boxes with corroded cover

Photograph 19: temporary cover for junction box

Photograph 20: inlet channel to PB1B

Photograph 21: influent channel into PB1B

Photograph 22: drop pipe into inlet channel

Photograph 23: 20180620_091324

Photograph 24: 20180620_091331

PB1B (20/06/18)

Photograph 25: 20180620_091419

Photograph 26: 20180620_091603

Photograph 27: full trash container

Photograph 28: 20180620_092112

Photograph 29: 20180620_092128

Photograph 30: 20180620_092212

Photograph 31: Sump pump system

Photograph 32: pump room

Photograph 33: pump room

Photograph 34: pumps returning from repair shop

Photograph 35: pump room

Photograph 36: Outflow manifold

Photograph 37: pump 1 train setup

Photograph 38: pump 2 train setup

Photograph 39: MCC

Photograph 40: check valve setup

Photograph 41: pump room

Photograph 42: sub station for both PB1A and PB1B

Photograph 1: Looking North at Tijuana River during Dry Weather flows

Photograph 2: Looking South at Tijuana River during Dry Weather flows

Photograph 3: Lateral drain discharging to Tijuana River

Photograph 4: Lateral drain discharging to Tijuana River

Photograph 5: Lateral drain discharging to Tijuana River

Photograph 6: earthen berm next to PBCILA Intake

PBCILA INTAKE (19/06/18)

Photograph 7: PBCILA Intake

Photograph 8: PBCILA Intake trash removal

Photograph 9: side view of PBCILA intake

Photograph 10: new dry-weather rack installation at V-notch channel

Photograph 11: new dry-weather rack installation at V-notch channel

Photograph 12: new dry-weather rack installation at V-notch channel

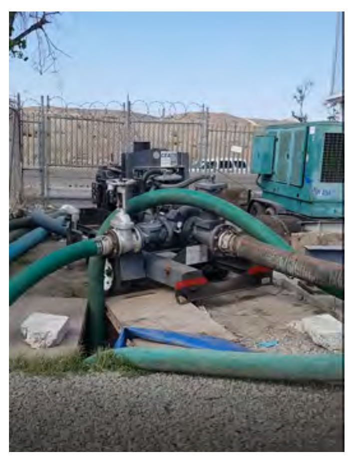
Photograph 1: PBCILA lift station configuration

Photograph 2: PBCILA from Tijuana River Levee

Photograph 3: PBCILA Pumps 5 and 6 flowing to PB1A

Photograph 4: Pumps 1 and 3 in place, pump 2 decommissioned. Only pump 1 is operational

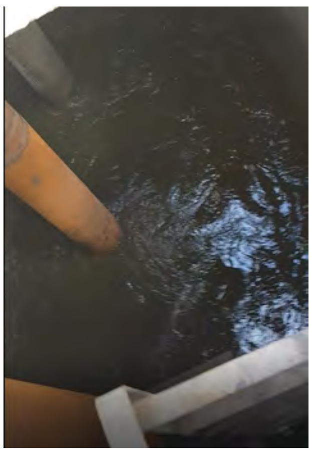
Photograph 5: Pumps 4 to 6, stagnant water from pump 6 air release pipe discharges



Photograph 6: Temporary pumping to International Collector

Photograph 7: Steel 36 in outflow from PB CILA to PB-1A

Photograph 8: Pump 2 out of commission, open pipe to have valve replaced



Photograph 9:Water level inside of wet well

Photograph 10: New manifold pipe for low flow pumping

Photograph 11: Replacement of valve no. 4, pump no. 2 is decommissioned

Photograph 12: Welding of new manifold pipe for low flow pumps

Photograph 1: SAB WWTP entrance

Photograph 2: view of biological lagoons

Photograph 3: Sludge piles

Photograph 4: Sludge piles

Photograph 5: sub station

Photograph 6: Sludge piles

Photograph 7: centrifugal pump at lift station

Photograph 8: SAB pump station from open channel to treatment

Photograph 9: check valve setup at lift station

Photograph 10: check valve setup at lift station

Photograph 11: pump base, while pump out for repair

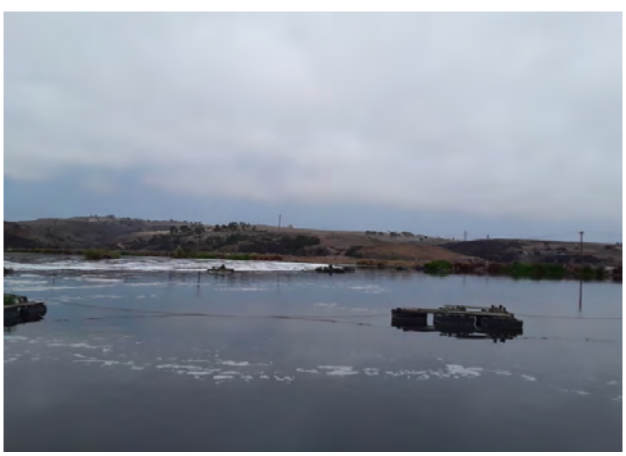
Photograph 12: pump gear

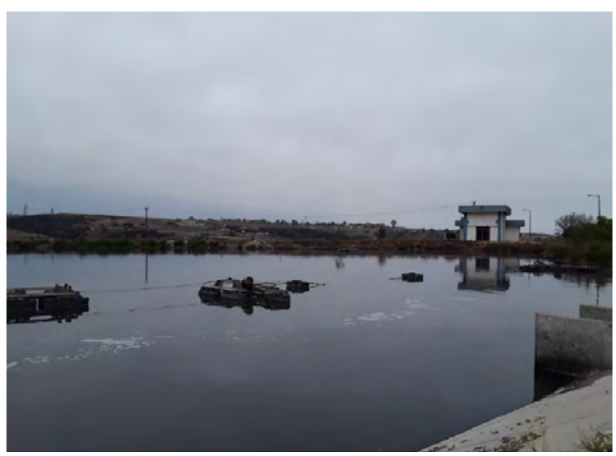

Photograph 13: discharge piping section


Photograph 14: gate valve at lift station


Photograph 15: centrifugal pump setup


Photograph 16: tie-ins to lagoon system


Photograph 17: biological lagoon with non-operational aerators


Photograph 18: biological lagoon with non-operational aerators

Photograph 19: biological lagoon with non-operational aerators

Photograph 20: Sludge piles

Photograph 21: chlorine injection station

Photograph 22: valve site

Photograph 23: discharge piping section

Photograph 24: gate valve at discharge

APPENDIX E

Request for Information Letters
Questionnaire submitted to CESPT

Project: Tijuana Diversion Study

INFORMATION REQUEST

1. Tijuana and Playas de Rosarito Water and Wastewater Master Plans
2. Most current Master Plan updates, as prepared by CESPT.
3. Plans for reuse of treated wastewater in Tijuana.
4. Water and Wastewater master plan developed by or for Tijuana.
5. Wastewater conveyance program from La Morita and Arturo Herrera Solis WWTPs to Valle de Guadalupe.
6. Population growth projections from each of the sub-basins discharging to the Tijuana River, transboundary canyons and to the Pacific Ocean, as well as the wastewater flow projections in the Tijuana and Playas de Rosarito municipalities.
7. Location, design capacity, and current flows for existing WWTP in the City of Tijuana.
8. Wastewater collection system drawings from the City of Tijuana, in AutoCAD, including location of lift stations and WWTPs, with information of pipe diameters and pipe material, installation dates, pipe carrying capacities and current condition status.
9. Condition assessment of existing wastewater collectors, sub-collectors, interceptors, force mains and wastewater mains. Needs assessment for pipeline rehabilitation or replacement.
10. Civil, electrical and electromechanical condition assessment for the Tijuana Wastewater Collection system Lift Stations with an emphasis on: PBCILA, PB1A, PB1B, Matadero, Laureles, in Playas de Tijuana and at the SAB WWTP lagoons.
11. Civil, electrical and electromechanical condition assessment and effluent flows from the Tijuana WWTPs discharging to the Tijuana River, cross-border canyons and to the Pacific Ocean.
12. Statistical data from the last 5 years, documenting operational failure at the lift stations, wastewater treatment plants, collectors, sub-collectors, interceptors, mains and forcemains, which have contributed to any treated or raw wastewater spills. What has been the main cause of the failures?
13. Wastewater lift stations operational times for pump and motor equipment at each location during the last 5 years.
14. Reports on the quantity and duration of wastewater discharges, treated or untreated, discharged into the Tijuana River, cross-border canyons and into the sea in the municipality of Tijuana, and those that have crossed the border, causes of these events (In the last five years).
15. Quality and quantity of effluents flows discharged from La Morita, Arturo Herrera Solis and San Antonio de los Buenos WWTPs and from SBIWTP during the last three years.
16. Engineering drawings, showing pumps and valve locations at each of the lift stations within the sub-basins of the Tijuana River, cross-border canyons, Playas de Tijuana, from which operational failure may result in transboundary discharges or Ocean discharges.
17. Sewer general maps, showing the wastewater section, for both treated raw wastewater.
18. Flow measurements within the wastewater collection system.
19. Flow measurements within the Tijuana River lining.
20. Reports on the lift stations and treatment plants and their operation with respect to capacity according to design (Maximum and Average flows)? Any operational failures at the lift stations or treatment plants in Tijuana, SBIWTP or Point Loma? Statistical data on operational failure occurring during peak conditions or during average flows.

21. Site identification (whether pipeline, lift station or treatment plant) currently complying with existing regulations. What part of the process, or equipment is causing problems of compliance with existing regulations? Is there any existing documentation of non-compliance with the existing regulations?
22. Identification of the service area for each lift station and treatment plant.
23. Documentation of any service interruption in the lift stations and in the treatment plants during the last 3 to 5 years.
24. Information available on the flow or continuous flow of the Tijuana River.
25. Transboundary measured rainfall and data used to develop statistics, graphs and figures in the NADB's Scope of Work from December 2017.
26. Flow measurements (measured, calculated or estimated) at the Tijuana River, upstream of the Tijuana Interceptor to the Pacific Ocean.
27. Precipitation gage measurements and locations for the Tijuana river basin.
28. Known dates and data of the Tijuana Interceptor service interruptions and the reason for the operation failure (if any).
29. Known dates of the beach closures in Imperial Beach. Reason for beach closure.
30. Information on flows going through Puerta Blanca crossing to Stewart's Drain.
31. Phase 1 hydrology study (USACE, LA District).
32. 2016 Study on Transboundary Flow Analysis (USEPA).
33. Flood mapping (UC Irvine: bit.ly/floodrise TRV).
34. Latest versions of: State of BC Design Standards for Wastewater Projects, State of BC Design Standards for Drinking Water Projects, and State of BC Design Standards for Storm sewer Projects.
35. Operational Manaulas for PB CILA to pump with one, two, three or maximum number of existing pumps, as well as to stop pumping water from the channeling of the Tijuana River in rainy seasons. Records of flows pumped every day in the last five years and flows that flowed into the US and reasons. Estimation of water flows that crossed into the USA.
36. Flows pumped in the last five years each day in PB1A, PB1B, PB SLAUGHTER, PB LAURELES, PB PLAYAS 1 AND PB BEACHES 2.
37. Flows discharged every day, in the last five years by each of the issuers that discharge in San Antonio del Mar.
38. Location and capacities of the sand catchers that capture runoff that reach the Tijuana River and the cross-border canyons.
39. Map of the storm sewer network, with dimensions of the structures and conduction capacities, that discharge to the Tijuana River and the cross-border canyons.
40. Maintenance programs for the work of the PB CILA, as well as the pumping plants that discharge to the Tijuana River and the cross-border canyons.
41. Coverage of the garbage collection service in the different sectors of the city of Tijuana. Location of clandestine garbage dumps. Estimation of the amount of solid waste that is not collected in the various sectors of the City of Tijuana.
42. Latest CESPT Water Plan.
43. Study of alternatives of the CSI company of 2008 for the CESPT-EPA-NADB.

Tijuana, B.C. a 14 de Mayo de 2018.

ARQ. GERMÁN JESÚS LIZOLA MÁRQUEZ

DIRECTOR GENERAL

CESPT

PRESENTE

El Banco de Desarrollo de América del Norte (BDAN) ha promovido la elaboración del estudio "Diagnóstico y Desarrollo de Alternativas sobre las Obras de Desvío del Río Tijuana", con el fin de minimizar las descargas de agua que cruzan la frontera de Tijuana, vierten al Valle del Río Tijuana y finalmente descargan al mar en Imperial Beach, CA. La empresa ARCADIS, fue a la que se adjudicó el contrato por parte del BDAN, como se notificó en la Reunión de Arranque el pasado miércoles 9 de Mayo en las oficinas de la Comisión Internacional de Límites y Aguas Sección Americana (USIBWC) en la Planta Internacional de Tratamiento, en la calle Dairy Mart Road, San Ysidro, CA., a la que ustedes asistieron.

En la parte inicial del estudio se está solicitando la información que se anexa y en particular la siguiente:

1.- Planos de la PBCILA, en autocad de preferencia, mostrando la obra de toma en el Canal, Tubería que cruza la vía rápida, cárcamo de bombeo, arreglo mecánico y eléctrico, línea de impulsión hacia PB1.

2.- Planos de la PB1A y PB1B y arreglo general donde se muestren desarenadores, tanques, accesos, entradas de agua de los colectores o líneas de impulsión, incluyendo las conexiones con la PITAR de agua cruda y tratada, cárcamos de bombeo, subestaciones, arreglos electromecánicos de cada planta de bombeo.

3.- Plano general, de la PTAR SAB, y planos de bombeos, cloración, mecánicos y eléctricos, subestaciones. (Autocad de preferencia)

3.- Plano Interceptor internacional, llegada a PB1 y conexiones con PBCILA (Autocad de preferencia)

4.- Línea de impulsión de PBCILA a PB1, Emisor antiguo de PB1 – SAB- Descarga al mar, Emisor paralelo de PB1 – SAB- Descarga al mar. Líneas cuatas y conexiones.

5.- Planos del arreglo general de las PTAR Morita y Herrera Solís y descargas al Río Tijuana (Autocad de preferencia)

El Ing. Joel Mora es el líder del Proyecto con representación en Tijuana a través de los Ingenieros Leonardo Arturo Caloca Galindo y Blas Efrén Peña Aguirre.

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Sin otro particular nos ponemos a sus órdenes para cualquier aclaración.

A T E N T A M E N T E:

ING. JOEL MORA

ARCADIS

ccp Ing. Carlos Peña. IBWC, San Diego, CA.

ccp Ing. Roberto Espinosa Mora. CILA Tijuana

ccp Químico Toribio Cueva López. BDAN, Proyectos, Zona Noroeste, México.

Tijuana, B.C. a 14 de Mayo de 2018.

ING. ROBERTO ESPINOSA MORA

REPRESENTANTE EN TIJUANA DE LA CILA

PRESENTE

El Banco de Desarrollo de América del Norte (BDAN) ha promovido la elaboración del estudio "Diagnóstico y Desarrollo de Alternativas sobre las Obras de Desvío del Río Tijuana", con el fin de minimizar las descargas de agua que cruzan la frontera de Tijuana, vierten al Valle del Río Tijuana y finalmente descargan al mar en Imperial Beach, CA. La empresa ARCADIS, fue a la que se adjudicó el contrato por parte del BDAN, como se notificó en la Reunión de Arranque el pasado miércoles 9 de Mayo en las oficinas de la oficinas de la Comisión Internacional de Límites y Aguas Sección Americana (USIBWC) en la Planta Internacional de Tratamiento, en la calle Dairy Mart Road, San Ysidro, CA., a la que ustedes asistieron.

En la parte inicial del estudio se está solicitando la información que se anexa y en particular la siguiente:

1.- Plano general, de preferencia en autocad, que muestre la canalización del Río Tijuana en su primera, segunda y tercera etapas, mostrando elevaciones de plantilla, de corona de bordos, dimensiones de las secciones transversales, pendientes del canal y localización de las descargas que se hacen al canal y sus características.

2.- Plano general, de preferencia en autocad, que muestre la canalización del Río Alamar, mostrando elevaciones de plantilla, de corona de bordos, dimensiones de las secciones transversales, pendientes del canal y localización de las descargas que se hacen al canal y sus características.

3.- Plano de la obra de toma de la PBCILA sobre el cauce piloto de la canalización del Río Tijuana, primera etapa, conducción a cárcamo de bombeo, PBCILA y línea de impulsión hasta la PB1 u otros sitios de descarga.

4.- Mediciones de caudales que se conducen por el canal del Río Tijuana, que se captan en PBCILA y que se bombean, indicando el destino final del agua bombeada. Política de operación del bombeo.

5.- Cronología de la operación de la PBCILA y de los derrames (Flujos, duración y volúmenes de agua estimados) que cruzan la frotera en el Río Tijuana, Puerta Blanca y en general cañones transfronterizos y sitios donde se descarga hacia EEUU, en Tijuana.

El Ing. Joel Mora es el líder del Proyecto con representación en Tijuana a través de los Ingenieros Leonardo Arturo Caloca Galindo y Blas Efrén Peña Aguirre.

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Sin otro particular nos ponemos a sus órdenes para cualquier aclaración.

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ARCADIS

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ccp Ing. Roberto Espinosa Mora. CILA Tijuana

ccp Químico Toribio Cueva López. BDAN, Proyectos, Zona Noroeste, México.

Tijuana, B.C. a 14 de Mayo de 2018.

LIC. JOSÉ ALEJANDRO CERVANTES BELTRÁN

DIRECTOR GENERAL DEL ORGANISMO DE CUENCA

DE LA PENÍNSULA DE BC, CONAGUA

PRESENTE

El Banco de Desarrollo de América del Norte (BDAN) ha promovido la elaboración del estudio "Diagnóstico y Desarrollo de Alternativas sobre las Obras de Desvío del Río Tijuana", con el fin de minimizar las descargas de agua que cruzan la frontera de Tijuana, vierten al Valle del Río Tijuana y finalmente descargan al mar en Imperial Beach, CA. La empresa ARCADIS, fue a la que se adjudicó el contrato por parte del BDAN, como se notificó en la Reunión de Arranque el pasado miércoles 9 de Mayo en las oficinas de la Comisión Internacional de Límites y Aguas Sección Americana (USIBWC) en la Planta Internacional de Tratamiento, en la calle Dairy Mart Road, San Ysidro, CA., a la que asistió el Ing. Manuel Colima Sánchez por parte de CONAGUA, B.C.

En la parte inicial del estudio se está solicitando la información que se anexa y en particular la siguiente:

1.- Plano general, de preferencia en autocad, que muestre la canalización del Río Tijuana en su primera, segunda y tercera etapas, mostrando elevaciones de plantilla, de corona de bordos, dimensiones de las secciones transversales, pendientes del canal y localización de las descargas que se hacen al canal y sus características.

2.- Plano general, de preferencia en autocad, que muestre la canalización del Río Alamar, mostrando elevaciones de plantilla, de corona de bordos, dimensiones de las secciones transversales, pendientes del canal y localización de las descargas que se hacen al canal y sus características.

3.- Plano de la obra de toma de la PBCILA sobre el cauce piloto de la canalización del Río Tijuana, primera etapa, conducción a cárcamo de bombeo, PBCILA y línea de impulsión hasta la PB1.

4.- Precipitaciones registradas por las estaciones climatológicas en la estación Presa Rodríguez, en el registro histórico hasta el 2017 y otras localizadas en el Municipio de Tijuana, diarias y máximas en 24 horas.

5.- Mediciones de caudales que se conducen por el canal del Río Tijuana y el canal del Río Alamar.

6.- Estudios hidrológicos de los caudales que se descargan al Río Tijuana y Río Alamar, para diversos periodos de retorno.

7.- Programa de mantenimiento de las canalizaciones de 2015 a la fecha.

El Ing. Joel Mora es el líder del Proyecto con representación en Tijuana a través de los Ingenieros Leonardo Arturo Caloca Galindo y Blas Efrén Peña Aguirre.

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Sin otro particular nos ponemos a sus órdenes para cualquier aclaración.

A T E N T A M E N T E:

ING. JOEL MORA

ARCADIS

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ccp Ing. Roberto Espinosa Mora. CILAMX Tijuana, B.C.

ccp Químico Toribio Cueva López. BDAN, Proyectos, Zona Noroeste, México.

Tijuana, B.C. a 14 de Mayo de 2018.

ARQ. ALEJANDRO RICARDO LOMELÍN CLAPERA

SECRETARIO DE DESARROLLO URBANO Y ECOLOGÍA

XXII AYUNTAMIENTO DE TIJUANA

PRESENTE

El Banco de Desarrollo de América del Norte (BDAN) ha promovido la elaboración del estudio "Diagnóstico y Desarrollo de Alternativas sobre las Obras de Desvío del Río Tijuana", con el fin de minimizar las descargas de agua que cruzan la frontera de Tijuana, vierten al Valle del Río Tijuana y finalmente descargan al mar en Imperial Beach, CA. La empresa ARCADIS, fue a la que se adjudicó el contrato por parte del BDAN, como se notificó en la Reunión de Arranque el pasado miércoles 9 de Mayo en las oficinas de la oficinas de la Comisión Internacional de Límites y Aguas Sección Americana (USIBWC) en la Planta Internacional de Tratamiento, en la calle Dairy Mart Road, San Ysidro, CA.

En la parte inicial del estudio se está solicitando la información que se anexa y en particular la siguiente:

1.- Plano general, de preferencia en autocad, que muestre la canalización del Río Tijuana en su primera, segunda y tercera etapas, mostrando elevaciones de plantilla, de corona de bordos, dimensiones de las secciones transversales, pendientes del canal y localización de las descargas que se hacen al canal y sus características.

2.- Plano general, de preferencia en autocad, que muestre la canalización del Río Alamar, mostrando elevaciones de plantilla, de corona de bordos, dimensiones de las secciones transversales, pendientes del canal y localización de las descargas que se hacen al canal y sus características.

4.- Datos para la K24 para diversos periodos de retorno, actualizados, para estudios hidrológicos.

5.- Estudios hidrológicos de los caudales que se descargan al Río Tijuana y Río Alamar, para diversos periodos de retorno.

6.- Mantenimiento de las canalizaciones.

7.- Localización de los pluviales que descargan al Río Tijuana y Alamar, así como desarenadores y capacidades.

8.- Programas de mantenimiento de pluviales y desarenadores que descargan a los Ríos Tijuana y Alamar de 2015 a la fecha.

9.- Coberturas por zonas de la recolección de residuos sólidos y localización de rellenos sanitarios y basureros clandestinos. Planes de ampliación de la cobertura de estos servicios.

El Ing. Joel Mora es el líder del Proyecto con representación en Tijuana a través de los Ingenieros Leonardo Arturo Caloca Galindo y Blas Efrén Peña Aguirre.

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Tijuana Baja California, 5 de Julio de 2018

Reunión de Trabajo Arcadis

Joel Mora US

Leonardo Caloca Galindo Mx

Efrén Peña Aguirre Mx

CUESTIONARIO

OBRA DE TOMA PBCILA

¿Cuál es el área de influencia en PB CILA y que Volumen de agua llega a PB CILA

R= Cuenca del Rio Tijuana, que contempla una parte de Estados Unidos. Y el Volumen estimado 900 LPS Aprox. (Depende de la Estación del Año), Es importante señalar que se podrían tener gastos picos estimados del orden de 1300 LPS).

(derrames de aguas negras, agua del Rio Alamar, excedencias de fugas de agua potable, etc.)?

R= No se dispone de la Info. Anterior.

¿Por qué no existen Desarenadores y Rejillas en Obra de Toma?

R= Si existen desarenadores en el Cauce Piloto del Rio Tijuana.

¿Cuál es el Diámetro de la Tubería de Obra de Toma hacia Estación de Bombeo PB CILA?

R=36 Pulgadas

¿Cuál es la Capacidad de Conducción de Obra de Toma hacia Estación de Bombeo PB CILA?

R=1182 LPS Teórico, Gasto estimado real del Orden de 1,300 LPS.

¿Cuál es el tipo de Material de la Tubería de Obra de Toma hacia Estación de Bombeo PB CILA?

R=Acero soldable.

¿En qué año se construyó?

R=Mayo de 1992

¿Con que Normas Mexicanas cumple el agua de llegada, Si cumplen con (NOM-001-SEMARNAT-1996 y NOM-003-SEMARNAT-1997)?

R=No se cuenta con esa información.

¿Cuál es la Pendiente Hidráulica de la Tubería de Obra de Toma a PB CILA?

R=URIEL

¿En qué año se construyó?

R=En 1991-1992

ESTACIÓN DE BOMBEO PB CILA

¿Enqué año se construyó?

R=En 1991-1992

¿Cuál es el Gasto Medio Diario de Diseño de la Planta?

R=Actualmente cuenta con dos equipos de 550 LPS, Un equipo de 400 LPS y 3 de 300 LPS y se encuentra en construcción la instalación 4 equipos de 170 LPS cada uno, por lo que el Gasto de Diseño se desconoce ya que se ha estado ampliando su capacidad. No obstante el Gasto se encuentra limitado por su capacidad de conducción entre la Interconexion del Cauce Piloto del Rio Tijuana y El Carcamo de la Planta PB CILA.

¿Cuál es el Gasto Medio Diario de Operación de la Planta?

R=Del orden de 900 LPS.

¿Cuáles son los Gastos Máximos Extraordinarios, y cuáles son las horas pico?

R=1300 LPS.

¿Cuáles son los Gastos Mínimos?

R= NO se cuenta con esa Info.

¿Existen controles de Calidad de Agua a la llegada y Análisis Fisicoquímicos y Bacteriológicos?

R=No

¿Existen controles de Calidad de Agua a la Salida y Análisis Fisicoquímicos y Bacteriológicos?

R=No

¿Se tiene documentado la Obra de Construcción del Sistema (Obra de Toma-Estación de Bombeo PB CILA)?

R=No

¿Cuáles son las dimensiones del Cárcamo de Bombeo?

R=Ver Plano entregado por CILA el 13 Jun 18.

¿Qué tipo de concreto se utilizó en la Construcción?

R=No se tiene esa Info.

¿Cuenta con algún tipo de recubrimiento en Muros de Cárcamo de Bombeo?

R=No

¿Cómo determinaron la Capacidad y Niveles de llegada del Cárcamo?

R=No se cuenta con esa Info.

¿Existen Desarenadores y Rejillas en PB CILA? ¿Si no existen como limpian el cárcamo?

R=Si y son de limpieza manual.

¿Cuántas Bombas están Instaladas en PB CILA?

R= 6 y en Proceso de Instalar 4 Bombas.

¿Qué Capacidad en Hp tienen las Bombas?

R=125 HP. 75HP Y 40 HP.

¿Con que Eficiencia están Operando las Bombas?

R=No se cuenta con la Info.

¿Qué Capacidad tienen los Motores?

R=125 HP. 75HP Y 40 HP.

¿Con que Eficiencia están Operando los Motores?

R=No se cuenta con la Info

¿Cuántas Bombas Funcionan actualmente?

R=Tres Horizontales 2 Verticales y la tercera vertical esta en mantenimiento.

¿Cómo Operan las Bombas, Ej. 1+1?

R=Operan alternadas las Bombas Verticales y Horizontales.

¿Es nueva instalación o reemplazo la nueva Bomba?

R=No está clara la pregunta.

¿Cuándo se instalará la nueva bomba?

R=No esta clara la pregunta.

¿El predio es de la CESPT?

R=Positivo.

SUBESTACIÓN ELÉCTRICA PB CILA

¿En qué año se construyó?

R=Se cuentan con dos Subestaciones eléctricas, La primera en su construcción y la segunda en 2009.

¿Cuál es la Capacidad de la Subestación Eléctrica Instalada?

R=225 KVA y la Grande de 300 KVA

¿Cuál es el consumo Operativo actual de la Subestación Eléctrica?

R= Electromecanica

¿Cuándo se pone en Operación la Subestación Eléctrica?

R=No esta clara la pregunta.

¿Cuándo deja de Operar el Sistema de Bombeo?

R=En temporada de lluvia, (Cuando los gastos son mayores a 1,000 LPS)

¿Quién es el encargado del paro y arranque del Sistema de Bombeo?

R=CESPT

¿Cómo se reanuda la Operación del Sistema de Bombeo?

R=Al bajar el Gasto a menor de 1,000 LPS

¿Cuánto tiempo se queda fuera de Operación?

R=Depende el periodo de lluvias

¿Cuentan con Manuales de Operación?

R= Negativo

¿Cuentan con Bitácora o Registros de los tiempos fuera de Operación?

R=NEgativo

¿Quién se encarga del Mantenimiento de la Subestación Eléctrica?

R=Subestacion eléctrica y equipos de bombeo el Departamento de Electromecanica de la CESPT

Los equipos son de arranque automatico y la instalación no cuenta con personal fijo en las instalaciones.

BOMBA DE RESPALDO PBCILA

¿Cuentan con Sistema Preventivo?

R=No se entiende la Pregunta

¿Si tienen Sistema de Respaldo?

R=Ver respuestas anteriores

¿Cuándo se Adquirió la Bomba de Respaldo?

R=No aplica

¿Cuál es la Capacidad de la Bomba?

R=NO aplica

¿Cuántos días al año se pone en Operación la Bomba de Respaldo?

R=No aplica

¿Esta fija la Planta de Respaldo en PBCILA?

R= No Aplica

¿Se le da mantenimiento Preventivo?

R= No Aplica

¿Cada cuánto tiempo?

R= No Aplica

¿Quién da el mantenimiento Preventivo?

R= No Aplica

CENTRO DE CONTROL DE MOTORES (CCM) PB CILA

¿Cuándo fue construido el CCM?

R=Ver respuestas anteriores

¿Si tiene telemetría?

R=Si se cuenta con Telemetría operando deficientemente, se espera que al termino de los trabajos de la instalación de los equipos de 40 HP, se encuentre operando.

¿Todas las Bombas son controladas por el CCM?

R=Existen dos CCM, en proceso de reemplazo del CCM Original de 1991 así como de la instalación de un tercer CCM para los equipos de 40 HP.

¿Si cuentan con Variadores de Frecuencia o Variadores de Velocidad?

R=Negativo

¿Si tienen Válvula controlada de manera electrónica?

R=Negativo

¿Si tienen Medidor de Gasto?

R=Positivo instalado por medio de la IBWC sin Operar. Se instalo en 2017.

¿Si tiene sistema de alarmas dentro del cárcamo para el paro y arranque de las bombas?

R=Negativo

¿Si tienen protocolo de seguridad en caso de siniestro?

R=Existe un Manual para actuar en caso de contingencia.

¿Se tiene considerado el Reemplazo o Modernización del CCM?

R=Positivo

¿Cuentan con Telemetría?

R=Ver respuestas anteriores

¿Se ha reemplazado el Cableado Eléctrico en general?

R=Negativo se contemplaran al momento de la Instalacion del nuevo CCM

¿Cuentan con Electro niveles?

R=Positivo

PB CILA – PB1. (TRAMO DE CONDUCCION)

¿Cuál es el Diámetro de la Tubería de PB CILA a PB1?

R=Inicia en 36 Pulgadas en Acero y cambia a 42 Pulgadas en PVC.

¿Cuál es el Material de la Tubería de PBCILA a PB1?

R=Acero hasta limite del predio y PVC hasta la llegada a PB1.

¿Cuál es la Longitud de la Tubería de PBCILA a PB1?

R=Ver Plano (Pendiente)

¿Cuál es el Gasto de PBCILA a PB1?

R=Ver respuestas anteriores

¿Cuándo se construyó?

R=2009

¿Existe interconexión entre PBCILA e Interceptor Internacional?

R=Positivo es Colector Internacional

¿Se puede mandar el Agua de PBCILA a la PITAR?

R=Positivo De manera indirecta ya que se mezclan con las Agua Negras. Del Colector Internacional.

Si existe ¿Qué capacidad tiene la línea de Interconexión?

R= Diámetro de conducción 36 Pulagdas.

¿Cuál es el Gasto Operativo?

R=Depende de la Politica de Operación del momento

PLANTA DE BOMBEO (PB1)

¿Cuál es la Capacidad de la Caja de Descarga?

R=No está clara la pregunta

¿Se tiene bitácora o registro del cierre de compuertas?

R= Negativo

¿Cuándo se instalaron las compuertas?

R=Desde Origen

¿Cómo se determinó el número de las compuertas?

R=De acuerdo al Diseño de la Planta

¿Que determina el cierre de las compuertas?

R=En base al Gasto en el que opera la Planta Internacional (PITAR).

¿Existe coordinación Binacional para los volúmenes excedentes?

R=Positivo

¿Cuándo fue construido el desarenador y rejillas?

R=2003

¿Operan adecuadamente las rejillas?

R=Negativo solo las manuales

Si no operan. ¿Cómo retiran la basura de las rejillas?

R=Ver respuesta anterior

¿Con que tipo de cemento se construyó?

R=No se cuenta con esa informacion

¿Se utilizó recubrimiento Epóxico?

R=Negativo

¿Cuál es el Gasto Medio Diario de Diseño de la Planta?

R=

PB1 B se tienen 5 trenes de Bombeo con capacidad de 500 LPS cada uno

PB1 A Dos trenes con capacidad de 500 LPS cada uno.

¿Cuál es el Gasto Medio Diario de Operación de la Planta?

R= Gasto promedio del orden de 1450 LPS

¿Cuáles son los Gastos Máximos Extraordinarios y horas pico?

R=Están limitados a la capacidad de Bombeo.

¿Cuáles son los Gastos Mínimos?

R=Depende de la demanda de agua de la Planta Binacional o de la generación estacional (Depende de la Temporada del Año).

¿Cuentan con historial de la Calidad de Agua a la llegada y Análisis Físico Químicos y Bacteriológicos.

R=Negativo

¿ Cuentan con historial de la Calidad de Agua a la Salida y Análisis Físico Químicos y Bacteriológicos.

R=Pendiente de contestar 13.05 Hrs

¿Con que Normas Mexicanas cumple el agua de llegada, Si cumplen con (NOM-001-SEMARNAT-1996 y NOM-003-SEMARNAT-1997)?

R=No esta clara la pregunta.

¿Cuál es la Pendiente Hidráulica del Interceptor Internacional?

R=No se cuenta con ese dato, ver Planos

¿Cuál es la capacidad de llegada PB1A?

R=Es variable de acuerdo a Picos y Gastos medio diario

¿Cuál es la capacidad de llegada PB1B?

R=Es variable de acuerdo a Picos y Gastos medio diario

¿Cuál es el área de influencia de la Planta PB1 A?

R=Escurrimientos del Rio Tijuana, Rio Alamar (Cuenca del Rio Tijuana)

¿Cuál es el área de influencia en PB 1 B y/o que Volúmenes de agua llegan a PB 1B (derrames de aguas negras, infiltración al interceptor internacional, excedencias de fugas de agua potable)?

R=Cuenca Rio Tijuana

¿Cuál es el tipo de Material de la Tubería del Interceptor Internacional?

R=Concreto Pres forzado por Av. Internacional y Aportación de Colonia Castillo PVC

¿En qué año se construyó?

R=1963, 1985 y Se Rehabilito en 2003.

Subestación Eléctrica para PB1 A y B R=Por consultar con Ing. Gerardo Gtz.

¿Cuál es la capacidad de la Subestación Eléctrica instalada?

R=Por consultar con Ing. Gerardo Gtz.

¿Cuál es el consumo operativo actual de la Subestación Eléctrica?

R=Por consultar con Ing. Gerardo Gtz.

¿Cuándo se pone en Operación la Subestación Eléctrica?

R=Por consultar con Ing. Gerardo Gtz.

¿Cuándo deja de Operar el Sistema de Bombeo?

R=Por consultar con Ing. Gerardo Gtz.

¿Quién es el encargado del paro y arranque del Sistema de Bombeo?

R=Por consultar con Ing. Gerardo Gtz.

¿Cómo se reanuda la operación del sistema de bombeo?

R=Por consultar con Ing. Gerardo Gtz.

¿Cuánto tiempo se queda fuera de operación?

R=Por consultar con Ing. Gerardo Gtz.

¿Cuentan con manuales de operación?

R=Por consultar con Ing. Gerardo Gtz.

¿Si tiene o cuenta con Bitácora o Registros de los tiempos fuera de Operación?

R=Por consultar con Ing. Gerardo Gtz.

¿Quién se encarga del mantenimiento de la Subestación Eléctrica?

R=Por consultar con Ing. Gerardo Gtz.

Estación de Bombeo PB1A

¿En qué año se construyó?

R=1985

¿Se tiene documentado la Construcción del Sistema?

R=Negativo

¿Se tienen las Dimensiones del Cárcamo de Bombeo?

R=Negativo

¿Qué tipo de concreto se utilizó?

R=No se cuenta con esa Info.

¿Cuentan con algún tipo de recubrimiento en Cárcamo de Bombeo?

R=No se cuenta con esa Info.

¿Cómo se determinaron la capacidad y niveles de llegada del cárcamo?

R=No se cuenta con esa Info.

¿Cuántas Bombas están instaladas?

R=2 Trenes de 2 Bombas cada uno

¿Qué capacidad tienen las Bombas?

R=1,000 LPS

¿Con que Eficiencia están Operando las Bombas?

R=No se cuenta con esa Info.

¿Qué capacidad tienen los Motores?

R=700 HP dos motores por Tren 4 en total

¿Con que eficiencia están operando los motores?

R=No se cuenta con esa Info.

¿Cuántas bombas funcionan?

R=Funcionan dos Trenes 4 Bombas.

¿Cómo operan las bombas?

R=En base al gasto de llegada

¿El predio es de la CESPT?

R=Positivo

¿Las válvulas y accesorios son para Agua Potable o especiales para Agua Residual?

R=Aguas Residuales

¿Cuál es el Gasto Medio Diario de diseño de la planta?

R=Ver respuestas anteriores.

¿Cuál es el Gasto Medio Diario de Operación de la Planta?

R=Ver respuestas anteriores

¿Cuáles son los Gastos Máximos Extraordinarios y las horas pico?

R=Depende de la política de operación de PITAR.

¿Cuáles son los Gastos Mínimos?

R=Depende de la política de operación de PITAR.

¿Cuentan con controles de Calidad de Agua en la llegada y Análisis Físico Químicos y Bacteriológicos?

R=Pendiente por buscar.

¿Calidad de Agua de la Salida y Análisis Físico Químicos y Bacteriológicos.

R=No se cuenta

¿Con que Normas Mexicanas cumple el agua de llegada, Si cumplen con (NOM-001-SEMARNAT-1996 y NOM-003-SEMARNAT-1997)?

R=No se cuenta con esa informacion

Estación de Bombeo PB1B

¿En qué año se construyó?

R=1963 y Se Rehabilito en 2003.

¿Se tiene documentado la Obra de construcción del sistema?

R=Negativo

¿Se tienen las dimensiones del cárcamo?

R=Ver planos entregados por CESPT

¿Qué tipo de concreto se utilizó?

R=Se desconoce

¿Algún tipo de recubrimiento en Cárcamo de Bombeo?

R=Negativo

¿Cómo se determinaron la capacidad y niveles de llegada del cárcamo?

R=De acuerdo a diseño (Cabe señalar que actualmente en este carcamo de bombeo se están recibiendo aguas tratadas de la Planta Arturo Herrera y La Morita, mismas que no formaban parte del criterios de diseño original)

¿Cuántas Bombas tienen instaladas?

R=10 Bombas

¿Qué capacidad tienen las Bombas?

R=3 de 300 hp, 2 de 550 hp 1 (una) de 450 HP y 4 de 170 HP.

¿Con que eficiencia están Operando las Bombas?

R=Se desconoce

¿Qué Capacidad tienen los Motores?

R=2 de 125 HP, 4 de 75 HP y 4 de 40 HP.

¿Con que eficiencia están operando los motores?

R=Se desconoce

¿Cuántas Bombas Funcionan?

R=Hasta hoy están operando la 4, 5,6,1,7,8 y 10 6

Las Bombas funcionando.

¿Cómo operan las Bombas, Ej. 1+1?

R=Según la disponibilidad de los Equipos.

¿El predio es de la CESPT?

R=Positivo

¿Las válvulas son para Agua Potable o especiales para Agua Residual?

R=Especiales para Agua Residual

¿Cuál es el Gasto Medio Diario de diseño de la planta?

R=Ver respuestas anteriores.

¿Cuál es el Gasto Medio Diario de operación de la planta?

R=del orden de 1000 LPS

¿Cuáles son los Gastos Máximos Extraordinarios y horas pico?

R=1300 lps

¿Cuáles son los Gastos Mínimos?

R=

¿Cuál es la Calidad de Agua a la llegada y Análisis Físico Químicos y Bacteriológicos.

R=Varia de acuerdo a las aportaciones en canalización del Rio Tijuana.

¿Cuál es la Calidad de Agua a la salida y análisis físico químicos y bacteriológicos.

R=No se cuenta con esa información. Los Efluentes de Arturo Herrera y La Morita cumplen con la NOM-003-SEMARNAT-1997 Para contacto directo.

¿Con que Normas Mexicanas cumple el agua de llegada, Si cumplen con (NOM-001-SEMARNAT-1996 y NOM-003-SEMARNAT-1997)?

R=No se cuenta con esa información.

Bomba de Respaldo PB1A

¿Si tienen Sistema Preventivo?

R=No esta clara la pregunta

¿Si tienen Sistema de Respaldo?

R=Negativo

¿Cuándo se adquirió la Bomba de respaldo?

R=Ver respuesta anterior

¿Cuál es la capacidad?

¿Cada cuando se utiliza?

¿Esta fija la Planta de Respaldo?

¿Se le da mantenimiento preventivo?

¿Cada cuánto tiempo?

¿Quién da el mantenimiento preventivo?

Bomba de Respaldo PB1B

¿Si tienen sistema preventivo?

R= Se puede operar

¿Si tienen sistema de respaldo?

¿Cuándo se adquirió la bomba de respaldo?

¿Cuál es la capacidad?

¿Cada cuando se utiliza?

¿Esta fija la Planta de Respaldo?

¿Se le da mantenimiento preventivo?

¿Cada cuánto tiempo?

¿Quién da el mantenimiento preventivo?

¿Las válvulas son para Agua Potable o especiales para Agua Residual?

Centro de Control de Motores (CCM) PB1A

¿Cuándo fue construido el CCM?

R= 2009

¿Si tiene telemetría?

R=No se cuenta con esa información

¿Todas las Bombas son controladas por el CCM?

R=Positivo

¿Si cuentan con Variadores de Frecuencia o Variadores de Velocidad?

R=Negativo

¿Si cuentan con Electroniveles?

R=La operación es manual

¿Si tienen Válvula electrónica operando?

R=Positivo

¿Si tienen Medidor de Gasto?

R=Negativo

¿Si tiene sistema de alarmas dentro del cárcamo para el pare de arranque de las bombas?

R=Positivo

¿Si tienen protocolo de seguridad en caso de siniestro?

R=Pendiente por (Buscar)

Centro de Control de Motores (CCM) PB1B

¿Cuándo fue construido el CCM?

R=2003

¿Si tiene telemetría?

R=Control interno

¿Todas las bombas son controladas por el CCM?

R=Positivo

¿Si cuentan con Variadores de Frecuencia o Variadores de Velocidad?

R=Negativo

¿Si Cuentan con Electroniveles?

R=Positivo y se opera manualmente

¿Si tienen Válvula operando electrónica?

R=Pendiente por confirmar

¿Si tienen Medidor de Gasto?

R=Pendiente por confirmar

¿Si tiene sistema de alarmas dentro del Cárcamo para el paro y arranque de las bombas?

R=Pendiente por confirmar

¿Si tienen protocolo de seguridad en caso de siniestro?

R=Pendiente por confirmar

SISTEMA DE OBRAS PARALELAS (Tramo de PB1 A y B a PTAR SAB)

Sistema Viejo-Nuevo

¿En qué año se construyeron las Obras Paralelas (Sistema Viejo y Sistema Nuevo)?

R=Sistema Viejo en 1985 y el Nuevo 2003

¿Se tiene documentada la fecha de construcción de los dos sistemas?

R=Por confirmar

¿Cuál son los Diámetros de las Tuberías en tramo de Impulsión y a qué velocidad impulsan actualmente el flujo?

R=las dos de Impulsión son de 48 Pulgadas y en Gravedad Canal a cielo abierto con capacidad de conducción de 2.2 metros cúbicos por segundo. Y el sistema nuevo es de Polietileno alta densidad de 54 pulgadas.

¿Cuáles son los Diámetros de las Tuberías en tramo a Gravedad, y a qué nivel fluye el Agua Residual?

R=las dos de Impulsión son de 48 Pulgadas y en Gravedad Canal a cielo abierto con capacidad de conducción de 2.2 metros cúbicos por segundo. Y el sistema nuevo es de Polietileno alta densidad de 54 pulgadas.

¿Cuáles son los diámetros de las Tuberías en los Sifones?

R= 48 Pulgadas

¿Cuál es el tipo de material utilizado en las tuberías del sistema?

R=Tuberia de FoFo.

¿Las válvulas son para Agua Potable o especiales para Agua Residual?

R=Aguas Residuales

¿Torres de oscilación cuentan con recubrimiento epóxico en paredes interiores?

R=Negativo

¿Las Válvulas de Admisión y Expulsión (VAYEA), son para Agua Potable o especiales para Agua Residual?

R=Positivo

¿Los Desfogues son para Agua Potable o especiales para Agua Residual?

R=Aguas Residuales

¿Se han Rehabilitado recientementelas estructuras especiales (VAYEA, Desfogue, Torre de Oscilación, etc.)?

R=Negativo

¿Cuentan con Manual de Operación para Estructuras Especiales?

R=Negativo

¿Tienen conocimiento de las tomas clandestinas de Agua Residual que existen y que tipo de solución se le dará al problema?

R=Positivo

¿Tienen conocimiento de que algunas Cajas de los Sifones y Pozos Visita se encuentran sin tapas y están abiertas?

R=Positivo

¿Qué tipo de cemento se utilizó en el concreto de las estructuras especiales?

R=No se cuenta con esa información.

¿Cuál es la capacidad de las Tuberías en Tramo de línea de Impulsión?

¿Cuál es la capacidad de las Tuberías en tramo de línea a gravedad?

R=2.2 M3/S

¿Cuál es el Gasto de Diseñoen tramo de Línea de Impulsión?

¿Cuál es el Gasto de Operación en Tramo de Línea de Impulsión?

¿Cuál es el Gasto de Diseño en tramo de Línea a Gravedad?

¿Cuál es el gasto de Operación en tramo de Línea a Gravedad?

¿Cuáles son las condiciones en la que se encuentra el desarenador tipo vortex?

R=No esta operando

PB SAN ANTONIO DE LOS BUENOS

¿En qué año se construyó?

R=De 1985 a 1987

¿Se tiene documentado la Construcción de la Planta?

R=Negativo

¿Se tienen las dimensiones del Cárcamo?

R=No se cuenta con esa información.

¿Qué tipo de concreto se utilizó?

R=No se cuenta con esa información.

¿Tiene algún tipo de recubrimientoepoxico en Cárcamo de Bombeo?

¿Cómo se determinó la Capacidad y niveles de llegada al Cárcamo?

¿Cuántas Bombas tiene instaladas?

R=Bombas

¿Qué capacidad tienen las Bombas?

R=504 LPS cada bomba de 250 HP

¿Con que eficiencia están operando las Bombas?

R=80 % Estimado

¿Qué Capacidad tienen los Motores?

R=250 HP

¿Con que eficiencia están Operando los Motores?

R=No se cuenta con esa informacion

¿Cuántas Bombas Funcionan?

R=3 Bombas

¿Cómo Operan las Bombas, Ej. 1+1?

R=Continua.

¿El predio es de la CESPT?

R=Positivo

¿Las válvulas son para Agua Potable o especiales para Agua Residual?

R= Aguas Reiduales

¿Cuál es el Gasto Medio Diario de diseño de la Planta?

R=1,100 LPS

¿Cuál es el Gasto Medio Diario de Operación de la Planta?

R=950 LPS

¿Cuáles son los Gastos Máximos Extraordinarios y horas pico?

R=Del orden de 1800 LPS

¿Cuáles son los Gastos Mínimos?

R=Del orden de 500 LPS

¿Cuál es la calidad del Agua a la llegada y si cuentan con Análisis Físico Químicos y Bacteriológicos.

R=del orden de 450 mg/l DBO

¿Cuál es la Calidad del Agua a la salida y si cuentan con Análisis Físico Químicos y Bacteriológicos.

R=Superior a 100 mg/l DBO

¿Con que Normas Mexicanas cumple el agua de llegada, Si cumplen con (NOM-001-SEMARNAT-1996 y NOM-003-SEMARNAT-1997)?

R=Esta en incumplimiento

¿Cuál es el Gasto de descarga al océano?

R=Del orden de 950 LPS de Planta San Antonio de los Buenos.

Bomba de Respaldo PB SAN ANTONIO DE LOS BUENOS

R=NO CUENTA CON GENERADOR DE RESPALDO

¿Si tienen sistema preventivo?

¿Si tienen sistema de respaldo?

¿Cuándo se adquirió la Bomba de respaldo?

¿Cuál es la Capacidad?

¿Cada cuando se utiliza?

¿Esta fija la Planta de Respaldo?

¿Cuentan con Mantenimiento preventivo?

¿Cada cuánto tiempo?

¿Quién da el mantenimiento preventivo?

Centro de Control de Motores (CCM) PB SAN ANTONIO DE LOS BUENOS

¿Cuándo fue construido el CCM?

R=en 1987

¿Si tiene telemetría?

R=Negativo

¿Todas las Bombas son controladas por el CCM?

R=Positivo

¿Si cuentan con Variadores de Frecuencia o Variadores de Velocidad?

R=Negativo

¿Cuentan con Electroniveles?

R= son de operación manual.

¿Si tienen Válvula electrónica operando?

R=Negativo

¿Si tienen Medidor de Gasto?

R=Si tienen pero no opera correctamente por cuestiones de instalación.

¿Si tiene sistema de alarmas dentro del cárcamo para el paro y arranque de las bombas?

R=Positivo

¿Si tienen protocolo de seguridad en caso de siniestro?

R=Positivo

SUBESTACIÓN ELÉCTRICA PARA PB SAN ANTONIO DE LOS BUENOS

¿Cuál es la capacidad de la Subestación Eléctrica Instalada?

R=Dos transformadores de 1,500 KVAs

¿Cuál es el consumo operativo actual de la subestación eléctrica?

R=No se cuenta con la información.

¿Cuándo se enciende la subestación eléctrica?

R=No está clara la pregunta.

¿Cuándo deja de operar el Sistema de Bombeo?

R=Cuando no hay gasto.

¿Quién es el encargado del paro del sistema de Bombeo?

R=Operadores.

¿Cómo se reanuda la operación del Sistema de Bombeo?

R=No esta clara la pregunta

¿Cuánto tiempo se queda fuera de operación?

¿Cuentan con manuales de operación?

R=Positivo

¿Si tiene o cuenta con Bitácora o Registros de los tiempos fuera de operación?

R=Positivo

¿Quién se encarga del Mantenimiento de la Subestación Eléctrica?

R=Depto. De Electromecánica.

¿Por qué razón apagaría?

R=

¿Volúmenes Mínimos y Máximos del Cárcamo?

¿Cuándo se inicia la operación de bombas? ¿Con que flujo se inicia la operación de 1 bomba? ¿Con que flujo se inicia la operación de 2 bombas?

¿Las bombas cuentas con variación de frecuencia?

R=Negativo

¿Cuál es la capacidad de las Bombas?

¿Variación de Volúmenes? Mañana, tarde, noche.

R=Depende de Volúmenes de llegada, cabe mencionar que los gastos

Funcionamiento de las Bombas.

¿Si son continuos o intermitentes?

Si hay algún control automático, (variadores de velocidad).

Si cuentan con telemetría.

Si las rejillas no están en función, cada cuanto tiempo retiran la basura.

¿La operación de las rejillas es Manual o Automática?

PTAR SAN ANTONIO DE LOS BUENOS

¿En qué año se construyó?

R=De 1985 a 1987

¿Se tiene documentada la construcción de la Planta?

¿Se tienen las dimensiones de las lagunas?

R= Laguna 1 y 2 tienen 4 has. De superficie con una profundidad de 4.5 Mtrs.

La Laguna 3 tiene 2 Has. de Superficie con 4.5 ;Mtrs de Profundidad.

¿Qué tipo de geomembrana se utilizó?

R=Rinohide

¿Cómo se determinó la capacidad de la PTAR?

R=De acuerdo al diseño

¿Cuántos aireadores se tienen instalados, y cuantos están en funcionamiento?

R=55 Aireadores y funcionan 7 Aireadores a la fecha.

¿El predio es de la CESPT?

R=Positivo

¿Cuál es el Gasto Medio Diario de Diseño de la Planta?

R=1100 LPS

¿Cuál es el Gasto Medio Diario de Operación de la Planta?

¿Cuáles son los Gastos Máximos Extraordinarios y horas pico?

¿Cuáles son los Gastos Mínimos?

Calidad de Agua a la llegada y Análisis Fisicoquímicos y Bacteriológicos.

Calidad de agua a la salida y Análisis Fisicoquímicos y Bacteriológicos.

¿Con que Normas Mexicanas cumple el agua de llegada, Si cumplen con (NOM-001-SEMARNAT-1996 y NOM-003-SEMARNAT-1997)?

R=Debera de cumplir la NOM-001-SEMARNAT-1996 Actualmente se está pagando por Incumplimiento a la citada norma.

¿Cuál es el Gasto de descarga al océano?

R=Aproximadamente 1800 LPS.

Conversation from Joel Mora (Arcadis) with Ing. Sergio Camacho (CESPT)

J: The capacity of your stations is adequate for your pump systems?

S: For the three (3) running systems we do have sufficient capacity, yes. But we want to add a (4) fourth pump on the next fiscal year. We have enough power capacity from our substation for two (2) pump systems at PB1B and one (1) at PB1A, or three (3) over at PB1B

J: How many pump systems can you be running at a time on each Lift Station Building?

S: I can have up to five (5) pump systems running: three (3) at PB1B and two (2) at PB1A. We have separate influent piping to five (5) pumps; however as mentioned I'm limited to having three (3) operational.

J: Ing. Camacho is stating to have capacity for three (3) systems, 3 double pumps at a capacity of 4000 amps. Sounds like the total station capacity is about 4000, 5000 amps max. Do you know the amperage of the substation?

S: That's why we want to expand to four pumps

J: How could we know the capacity of each station, the amperage?

S: Currently, we are only permitted to running three pump systems. The Federal Electricity Commission (CFE) only allow us to run at a certain electric capacity, if we use more electricity, we take away from other users.

<u>SCADA QUESTIONS:</u>

J: What do you monitor here at PB1A and is there a central control location that monitors the entire system?

S: We don't have a central control location, we can only monitor here what we have in PB1A & 1B and PBCILA. From PBCILA they only send us the wet well levels and the pumps are running.

J: How do you communicate with the other stations? Do they call you?

S: There are operators at all the other stations but no one else oversees them. There are guards and if there's a problem then a guard will call me, I'm constantly very busy.

J: There are several motors in PB1A & 1B, what is the primary failure on the motors? Vibrations, electrical outage, bearings or the gear?

S: Well the trash is a constant problem. The impellers, the bearings, and the motors are very old. The blue colored ones are from 2000 and there are others from 2009.

J: Is all the equipment rated for wastewater conditions?

S: Yes.

J: What is maintenance like?

S: There are teams for the mechanic and the electrical. There is no team for motors, those we take out and send them off to repair. They clean them up and change the gears in house. We don't have a machine shop.

J: Are the motors sync in SCADA?

S: All the PB1A & PB1B motors are in our SCADA system

J: So, your SCADA system monitors the motors, when the pumps turn on/off; what about the wet well levels?

S: We only monitor the PBCILA wet well level

J: That flow sensor that isn't working, what is it monitoring?

S: That's the monitor for the effluent to the Pacific Ocean.

J: How is the influent measured at PB1A &1B to understand much flow is coming in?

S: We take volumetric measurements of the influent channel.

J: Who develops the lift stations maintenance budget?

S: Each of us makes a budget then there are technical groups formed from different CESPT Directions that come together for proposal selection. They usually give us like a third of what we ask for.

J: Another question, how would you feel if a third party came in and was in charge of the Operations and Maintenance of PBCILA and PB1A & 1B. Having a private group in charge of O&M, that you would supervise?

S: That would be better because there are too many installations. For maintenance we only have 6 mechanics. If a job needs four people, then we only have 2 left around the city for Tijuana and Rosarito. In total there are 12 mechanics and 2 electricians. There are 20 treatment plants, 80 for potable water, and 48 for sewer. From 3-8 at night we only have electrician available and we have to call him in from home.

J: What about preventative maintenance?

S: We don't have preventative maintenance, there is no people for it. And there is one to cover me either. The PB1B building is old, 50 years old and during earthquakes you can feel it moving. Its old.

<u>ELECTRICAL FOR PB1A & 1B:</u>

S: The lift station has a substation with three (3) transformers, 500 kVA capacity each one. There is one for each plant and one as a backup.

J: Do you utilize the backup one at all?

S: Yes. 79,000 volts goes down to the three transformers. One in each plant and one as backup.

J: When do you turn the backup transformer on or switch it out with the transformer in service?

S: Only in emergency situations.

J: And if it’s an emergency do you use it briefly or do you keep it running longer?

S: In case a transformer blows out or in case of a transformer failure, we use the backup transformer. We have a bank of batteries that are used for the communications equipment, for this plant only. These go to the computer with the SCADA software, we can see the amperage, voltage, temperature, vibrations, open and close the motor operated valves.

J: The ones that are motor operated down here in PB1B, for pump No. 3, can you open and close?

S: Using the computer, yes.

S: Pumps 1,2,3 and a new pump are already established on an upcoming project for 2019 to give maintenance to the lift station to have a total of 4 pumps in-line. Because this plant is only permitted for 3 pumps in-line, at the moment we can’t have anymore or we would be facing fines from CFE.

J: How did you get that additional equipment approved?

S: It’s in a current project. That project is going to have the payment so that we can get the additional equipment.

J: Has a transformer ever failed on you?

S: Actually, the existing transformers at the substation are new, approximately 8 years old. The original ones were from 1978. In 1978 they started off this plant with diesel motors. They remodeled in 2000 and in 2009 they upgraded new ones serving pumps 3 and 4. They have done 4 set of upgrades to the lift station.

J: The control panel looks like a recent addition. What year was it built?

S: It was built in 2009. In 2009 they did an upgrade just like in PBCILA. In 2009 they completed pump 5 and 6 (at PBCILA) and that purple line from PBCILA to PB1A. Before, they had 4 pumps in-line just like pumps 1 and 2 but they were very old. There was nowhere to find a repair shop for them anymore, they were obsolete.

J: And the motors from 1 and 2 at PB1A never had problems with flooding?

S: I’ve never had issues with flooding but the person in charge before me did have issues once.

J: So, did PB1A & 1B flood?

S: Yes. The operators fell asleep.

J: When was the last time that a flooding to PB1A & 1B happened?

S: That was a long time ago. They have placed vertical turbine motors and pumps just in case there’s water, to lower the chances of water getting in. If the sump pump systems fails, then, yes, we would flood. Actually, once the pump systems failed and it flooded 50 cm. The bad thing is that electricity/mechanics only has service until 8 pm at night. After that there is no service.

J: How do you manage that?

S: Well I have to come in or call the directors of electric or mechanic. The other day I had to come in at 1 am for a substation problem.

J: Did you have issues with the temporary equipment or with the generator?

S: It was a breaker issue. We just changed it and done.

S: 5 new pieces of equipment are coming in. They just removed the cable on the 5th piece of equipment. They said that the 5 pieces of equipment are coming in October. They have been solicited, payed for, quoted. We are just waiting for them to be delivered. The equipment for 1B are coming in February, 2 new pieces.

J: What type of equipment do you ask for?

S: The same ones we have now. They are the brand Cornell and they have never failed us. The pumps 4 and 5 are a different brand and the [flecha] blew out. The pumps 1,2, and 3 are Cornell. They are also interchangeable with these.

J: Are they the same size?

S: They are 700 hp

J: And the old ones are what size?

S: They were 500 hp.

J: The new PB CILA are going to be 700 hp as well?

S: They are 125 hp.

J: What brand are the new ones?

S: They don't have a brand yet.

J: Aren't they coming from the international plant?

S: They are similar to the ones from the international plant, but they are going to be new.

APPENDIX F

Infrastructure Condition Assessment descriptions of classifications

Appendix F

F. Infrastructure Condition Assessment

Condition Assessment is an asset condition scoring exercise accounting for risk and asset criticality. This exercise is performed using the collected data to ascertain the "as-is" condition of assets on an overall level in comparison to the baseline condition. Once the condition of the system has been established, condition assessment becomes the continuous process of assessing the assets to keep track of changes in their condition.

There are two components of condition assessment:

- physical condition
- performance condition.

Physical condition refers to the current state of repair and operation of an asset, as influenced by age, historical maintenance, and operating conditions. Whereas, performance condition refers both to the current state of performance and the ability of the asset to meet operational requirements in the future.

To evaluate asset condition, we used a standard 1 to 5 scale, where 1 is excellent and 5 is very poor, which results in a comparative ranking of assets. The overall condition score of an asset is the maximum of the core physical and performance condition criteria.

The Tijuana Condition Assessment used the Arcadis AssetHound™ mobile data collection software and field tablets for data entry. AssetHound™ field tablets were configured with the core and ancillary criteria from Sections 2.1 through 2.3. Condition Assessment teams used the field tablets to visually inspect an asset, take photographs, and record asset attribute information and condition.

a. Infrastructure Physical Condition

Vertical Assets were organized into three different assessment types for condition assessment: Mechanical, Electrical/I&C, and Structural. Physical condition was evaluated for each of these asset types through visual inspection and utilizing physical condition scoring criteria defined for each assessment type, using a 1 to 5 scale. Assets receiving a condition score of 1 are in excellent condition and assets receiving a condition score of a 5 are in very poor condition, as described in the table below.

Table 1. Summary of Physical Condition Scores

Score	Description of Physical Condition
1 – Excellent	Fully operable, well maintained, and consistent with current standards. Little wear shown and no further action required.
2 – Good	Sound and well maintained but may be showing slight signs of early wear. Delivering full efficiency with little or no performance deterioration. Only minor renewal or rehabilitation may be needed in the near term.
3 – Moderate	Functionally sound and acceptable and showing normal signs of wear. May have minor failures or diminished efficiency with some performance deterioration or increase in maintenance cost. Moderate renewal or rehabilitation needed in near term.

Score	Description of Physical Condition
4 – Poor	Functions but requires a high level of maintenance to remain operational. Shows abnormal wear and is likely to cause significant performance deterioration in the near term. Replacement or major rehabilitation needed in the near term.
5 – Very Poor	Effective life exceeded, and/or excessive maintenance cost incurred. A high risk of breakdown or imminent failure with serious impact on performance. No additional life expectancy with immediate replacement needed.

Each vertical assessment type includes core and ancillary criteria as follows:

Table 2. Summary of Mechanical, Electrical and Structural Physical Condition Scores

Criteria	Evaluation	1	2	3	4	5
CORE CRITERIA						
Mechanical/HVAC Equipment Visual Condition Assessment						
Corrosion	Surface only	None	<10%	10% - <25%	25% - 50%	>50%
	Structural (loss of metal)	None	-	-	1 location	>1 location
Leakage	Gaskets / Connections	None	Historic only	Drip only	Stream 1 location	Stream >1 location
	Holes / Failures	None	-	-	1 location	>1 location
Vibration / Noise	Vibration Apparent with Noise	None	<10% normal	10% to 20% normal	>20% to 30% normal	>30% normal
	Non-Structural Damage	None	-	-	Yes	-
	Structural Damage	None	-	-	-	Yes
Concrete Supports	Surface Cracking / Loose Grout	None	<10%	10% - <25%	25% - 50%	>50%
	Through Cracks	None	-	<10%	10% - 25%	>25%
	Damaged / Missing Anchors	None	-	<5% / 1	5% - 20% / 2	>20% / >2
Steel Supports	Surface Corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Structural Corrosion	None	-	<10%	10% -25%	>=25%
	Damaged / Missing Anchors	None	-	<5% / 1	5% - 20% / 2	>=20% / >2
ANCILLARY CRITERIA						

Criteria	Evaluation	1	2	3	4	5
Electrical Connections	Conduit / J. Box - surface corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Damage - gaps / missing gaskets	None	-	-	1 location	>1 location
	Exposed wiring	None	-	-	1 location	>1 location
Electrical/I&C Visual Condition Assessment						
CORE CRITERIA						
Corrosion	Surface only	None	<10%	10% - <25%	25% - 50%	>50%
	Structural	None	-	-	1 location	>1 location
Dielectric Leakage	Transformer/Connection Leaks	None	Historic only	-	-	Active
	Holes / Failures	None	-	-	-	1 location
Vibration/Noise	Vibration Apparent with Noise	None	<10% normal	10% to 20% normal	>20% to 30% normal	>30% normal
	Non-Structural Damage	None	-	-	Yes	-
	Structural Damage	None	-	-	-	Yes
Electrical Damage	Evidence of Overheating/Arcing	None	-	-	1 location	>1 location
	Evidence of Water Damage	None	-	-	1 location	>1 location
	Grounding Missing/Damaged	None	-	-	1 location	>1 location
	Insulation Wear	None	-	-	1 location	>1 location
	Cooling System Damage	None	-	-	1 location	>1 location
	Connections Loose/Broken	None	-	-	1 location	>1 location
	Hot Spots	None	-	-	-	1 location
	Damaged / Non-Functional Devices	None	-	1 location	2 locations	>2 locations
ANCILLARY CRITERIA						
Concrete Supports	Surface Cracking / Loose Grout	None	<10%	10% - <25%	25% - 50%	>50%
	Through Cracks	None	-	<10%	10% - 25%	>25%

Criteria	Evaluation	1	2	3	4	5
	Damaged / Missing Anchors	None	-	<5% / 1	5% - 20% / 2	>20% / >2
Steel Supports	Surface Corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Structural Corrosion	None	-	<10%	10% -25%	>=25%
	Damaged / Missing Anchors	None	-	<5% /1	5% - 20% / 2	>=20% / >2
Structural Visual Condition Assessment						
CORE CRITERIA						
Leakage	Cracks / Joints	None	Historic only	Drip only	Stream 1 location	Stream >1 location
	Penetrations / Failures	None	-	-	1 location	>1 location
Concrete / Masonry Damage	Joint Deterioration	None	<10%	10% - <30%	30% - 50%	>50%
	Cracking (width of crack)	None	< 1mm	1-2mm	>2mm	Not Serviceable
	Exposed Reinforcement	None	-	-	1 location	>1 location
	Spalling, Exposed Aggregate, Pitting, Delamination,	None	-	<10%	10% - 30%	>30%
Steel Damage	Surface Corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Cracking	None	-	-	1 location	>1 location
	Fatigue/Connection Failure	None	-	-	1 location	>1 location
	Deformation / Deflection	None	-	<5%	5% to 10%	>10%
	Loss of Section	None	-	<10%	10% - 30%	>30%
Wood Damage	Dry Rot	None	-	-	1 location	>1 location
	Warping/Splitting	None	-	-	1 location	>1 location
	Connection Failure	None	-	-	1 location	>1 location
	Loss of Section	None	-	<10%	>10% - 30%	>30%
Water / Drainage	Standing Water Potential (% of foundation)	None	-	<=5%	>5% - 10%	>10%

Criteria	Evaluation	1	2	3	4	5
Roof / Cover	Leaks- Cracks/Joints	None	Historic Only	Drip Only	Stream 1 location	Stream >1 location
	Leaks- Penetrations/Failures	None	-	-	1 location	>1 location
	Sagging	None	-	<=5%	>5% - 10%	>10%
	Support Damage	None	-	-	<20%	>=20%
ANCILLARY CRITERIA						
Walkways / Platforms / Railings	Surface corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Structural damage	None	-	-	1 location	>1 location
	Loss of Section	None	-	<10%	>10% - 30%	>30%
	Deformation / Deflection	None	-	<=5%	>5% - 10%	>10%
Doors / Hatches / Windows	Leaks	None	-	-	1 location	>1 location
	Surface Corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Structural Damage	None	-	-	-	>= 1 location

b. Infrastructure Performance Condition

The performance condition captures the modes of asset failure beyond mortality, and include the following main categories:

Capacity	
Regulatory	Ability to meet current and future regulations and utility goals
Reliability	Measure of equipment uptime
Mean time between failure (MTBF)	Mean time between failure (MTBF)
O&M Issues	Frequency of O&M Issues above and beyond regular maintenance (excluding breakdowns)
Obsolescence	Equipment Technology, Operating Efficiency, Spare/Replacement Parts

Each criterion is considered for current conditions as well as expected future conditions. For example, expectations for changing regulations or capacity needs may affect the ability of an asset to adequately meet future operating goals, and this would be reflected in the rating. The scores for performance condition range from 1 (excellent) to 5 (very poor), as indicated below:

Table 3. Summary of Performance Condition Scores

Score	Description of Performance Condition
1 – Excellent	Meets all capacity and regulatory requirements in all current and future anticipated demand conditions. State of the art technology with overall excellent performance.
2 – Good	Meets all capacity and regulatory requirements in current and future anticipated average conditions. May have minor risk under current peak conditions and will not meet anticipated future peak capacity conditions. Future regulatory compliance may require some modifications. Overall performance excellent to very good with tried and true technology
3 – Moderate	Current capacity is acceptable under average conditions but does not consistently meet current peak condition and would likely not meet future peak conditions. Current regulatory requirements are met, but future requirements will likely not be met, even with modifications. Overall performance and efficiency are average.
4 – Poor	Current performance is marginal and will not meet future additional requirements or increased demand (e.g. capacity, level of service goals and/or future regulatory requirements).
5 – Very Poor	Current performance unacceptable and does not meet currently required performance criteria (e.g. capacity, level of service goals and/or regulatory requirements).

Performance condition was scored by interviewing appropriate CESPT staff regarding the performance of an asset process or group and reviewing any existing supporting data such as data from the advanced maintenance programs, as available. The discussion points presented in the table below are examples to consider when assigning performance condition scores.

Table 4. Process Level Criteria Discussion Points

Criteria	Condition	1	2	3	4	5
Capacity	Ability to meet current capacity	Average – Yes*	Average – Yes*	Average – Yes*	Average – Yes**	Average – No**
		Peak – Yes*	Peak – Yes**	Peak – No**	Peak – No**	Peak Max Day – No**
	Ability to meet future capacity	Average – Yes*	Average – Yes*	Average – Yes**	Average – No*	Average – No**
		Peak – Yes*	Peak – No*	Peak – No**	Peak – No**	Peak Max Day – No**
Regulatory	Ability to meet current regulations and utility goals	Yes	Yes	Yes	Yes – with some modification s required	No
	Ability to meet future regulations and utility goals	Yes	Yes – with some	No	No	No

Criteria	Condition	1	2	3	4	5
			modifications required			
Reliability	Average time equipment is available when needed	99-100%	95-99%	90-94%	85-89%	< 84%
		(4 days O/S)	(up to 18 days O/S)	(up to 36 days O/S)	(up to 55 days O/S)	(over 55 days per year)
O&M Issues	Frequency of O&M Issues (Excluding Breakdowns)	None	Very Infrequently (Quarterly)	Infrequently (Monthly)	Frequently (Weekly)	Very Frequently (Daily)
Obsolescence	Equipment Technology	Technology Best Available/ State of the Art	Technology Industry Standard/ "Tried and True"	Technology Considered Appropriate	Technology Nearing Obsolescence	Technology Obsolete / Out of Date

* - with one unit out of service
** - with all units in service
O/S - out of service

c. Linear Assets

Linear assets were originally not included within the scope of this project. However, as progress was made it became clear that some assessment of linear assets was required. AssetHound™ was not used to collect the information, instead, data was provided by the Client and a visual inspection of internal and external corrosion levels was carried out to confirm the condition assessment. The scoring below was utilized to assess the visually inspected linear assets:

Table 5. Summary of Corrosion Condition Scores

Score	Description of Horizonal Asset Corrosion Condition
1 – Excellent	No corrosion observed
2 – Good	Minor corrosion observed
3 – Moderate	Average corrosion observed
4 – Poor	Widespread corrosion observed
5 – Very Poor	Extensive corrosion observed

Once the corrosion scoring was calculated, these were used to derive the assets Remaining Useful Life – based on industry standard Estimated Useful Life for similar assets. This was done by applying a % reduction in remaining life as per the table below

Table 6. % Remaining Useful Life remaining

Score	Life remaining
1 – Excellent	95%
2 – Good	75%
3 – Moderate	40%
4 – Poor	15%
5 – Very Poor	1 year

APPENDIX G

Consequence of Failure, Redundancy and Risk description of criteria and score descriptions

Appendix G

G. Consequence of Failure, Redundancy and Risk

Risk and criticality are fundamental to Asset Management. Understanding what drives expenditure and the causes of asset failure helps to effectively target maintenance programmes and prioritize assets. This section describes the methodology used when reviewing consequence of failure, redundancy and risk for the assessed assets.

Consequence of Failure (COF)

The consequence of failure analysis is based on a triple bottom line (TBL) evaluation, which considers the economic, social and environmental consequences of a failure. Where applicable, the potential costs of failure are assigned to specific criteria within each TBL category to develop the best approximation of the overall potential cost. The following COF criteria and scoring are presented below:

Economic Consequence	The criteria and measures for evaluating direct economic impact considers repair costs and disruption to operations, including effort to repair (time, cost, and need for outside expertise) and impact to operations (loss of redundancy, impacts to upstream and/or downstream processes.)
Environmental Consequence	The criteria and measures for evaluating environmental impact consider timing and magnitude of consequence.
Social Consequence	The criteria and measures for evaluating social impact consider timing and magnitude of consequence.

Consequence of Failure Scoring uses a 1 to 5 scale, with 1 indicating “No Impact” and 5 indicating “Very High Impact.” The highest COF score for any one of the evaluated criteria determines the COF for that asset. For instance, an asset that scored a ‘5’ for asset replacement in the economic TBL category would have an overall asset COF score of ‘5’.

Table 1. Summary of COF Criteria and Scores

Score	Economic	Environmental	Social
1	1 = Minimal to No impacts	1 = Minimal to No impact	1 = Minimal to No impacts
2	2 = Low Impact/ Minor Consequence	2 = Low impact, minor permit violations	2 = Occasionally cannot meet requirements for customers
3	3 = Moderate Impact/ Moderate Consequence	3 = Moderate impact, significant permit violations	3 = Frequently cannot meet requirements for localized area of customer base
4	4 = Significant Impact/Major Consequence	4 = Significant impact, major permit violations	4 = Frequently cannot meet requirements for several areas of customer base

Score	Economic	Environmental	Social
5	5 = Major Impact/Catastrophic Consequence	5 = Major impact, permit violations may involve federal and state actions	5 = Continuously cannot meet requirements for customers

The asset consequence of failure considers the impacts of asset failure using the triple bottom line (TBL) approach. Where applicable, the potential costs of failure are assigned to specific criteria within each TBL category to develop the best approximation of the overall potential cost to COP and SROG. The TBL approach evaluates the *economic, social and environmental* impacts of asset failure.

The components of the triple bottom line are defined as follows:

Economic	(generally scored at the asset level) O&M Impacts
Environmental	(generally scored at the group level) Regulatory compliance (overflow volume) Impacts to environmentally sensitive areas (water bodies, wetlands)
Social	(generally scored at the group level) Level of Service Delivery (loss of service, overflows, back-ups, odors) Health & Safety (employee and public)

The criteria and measures within each TBL category have been developed with input from COP staff.

A complete COF evaluation must also properly consider redundancy in the evaluation of failure impacts. COP determined that redundancy should be calculated at the peak operating conditions for their assets.

Table 2. Summary of COF Criteria Weights

Criteria	Weight	1	2	3	4	5
Health and Safety Impact $CoF_{(safe)}$	**20%**	No Impact		Failure creates potential for minor injury to employee or public		Deficiency creates potential for severe injury to employee or public
Level of Service $CoF_{(Los)}$	**20%**	No Impact		Impact will occur if no response is made within 8 hours		Immediate and/or widespread impact.
Regulatory Compliance $CoF_{(Comp)}$	**10%**	No Impact		Impact will occur if no response is made within 8 hours		Immediate and/or widespread impact
O&M Impacts $CoF_{(O\&M)}$	**30%**	No Impact		Moderate O&M Cost/Effort		Large O&M Cost/Effort
Impacts to sensitive areas	**20%**	Full generator		Mobile generator ready		No ability for backup power connection

CoF(Backup)		backup available

Redundancy

Redundancy is a specific measure in place to reduce the impact of an asset failure. In practice, risk mitigation can be achieved through any number of techniques including design measures such as redundancy and pump-arounds, operational measures such as diversions, heightened monitoring, and offline spares. Scores are assigned to indicate the amount of risk reduction achieved through the measure, with a score of 1 representing no reduction and a score of 0 representing the complete elimination of all risk.

Risk

To calculate risk, an evaluation is performed on the physical condition and performance condition of an asset. The maximum condition criteria score is carried through as the asset's overall condition score (on a scale from 1- excellent to 5 – very poor). Next, the average of the highest score in each TBL category is carried through for the asset's overall COF score (on a scale from 1- minimal/no impact to 5 – high impact. Last, any operating redundancy pertaining to the asset is considered in the Redundancy Factor (on a scale from 0 to 1). The risk score is calculated using the following formula:

Risk = Likelihood of Failure x Consequence of Failure x Redundancy Factor

Where:

- LOF = the maximum score from the physical and performance condition assessment
- COF = the average of the highest score in each TBL category
- Rf = the redundancy factor

Risk will be distributed on a scale of 1 (low risk) to 25 (highest risk). Based on the risk score, assets are organized into one of five risk groupings: High (24-25), Medium High (20-23), Medium (15-19), Medium Low (10-14) and Low (<10). These risk groupings will help determine the year the asset is addressed in the capital improvement plan.

The following example of a pump illustrates how the risk score is calculated for an asset.

Table 3. Risk Calculation Example

<table>
<tr><th>Equipment</th><th>Physical Score</th><th colspan="2">Performance Score</th><th>Criticality (COF)</th><th>Redundancy Factor</th></tr>
<tr><td rowspan="7">Pump</td><td>Core Criteria:
Corrosion = 2
Leakage = 2
Vibration = 1
Conc. Ped = 2
Steel Supp. = 2</td><td>Capacity</td><td>3</td><td>Economic:
O&M Impact = 2</td><td rowspan="6">1</td></tr>
<tr><td>Ancill. Criteria:
Piping/Vlvs = 2
LCP = 2
Field Inst. = 2
Elec. Conn. = 3</td><td>Regulatory</td><td>1</td><td>Social:
LOS = 2
H&S = 2</td></tr>
<tr><td rowspan="3"></td><td>Reliability</td><td>2</td><td rowspan="3">Environmental:
Regulatory = 3
Sens. Area = 2</td></tr>
<tr><td>O&M Issues</td><td>2</td></tr>
<tr><td>Obsolescence</td><td>2</td></tr>
<tr><td>Overall Phys. Condition = 2 (Good)</td><td colspan="2">Overall Performance Condition = 3 (Fair)</td><td>COF = (0.3*2)+(.2*2)+(.2*2)+(.1*3)+(.2*2)</td></tr>
<tr><td colspan="3">LOF = 3</td><td>COF = 2.8</td><td>Rf = 1</td></tr>
<tr><td colspan="6">Risk = LOF x COF x Rf = 3 x 2.8 x 1 = 6.3 (out of 25)</td></tr>
</table>

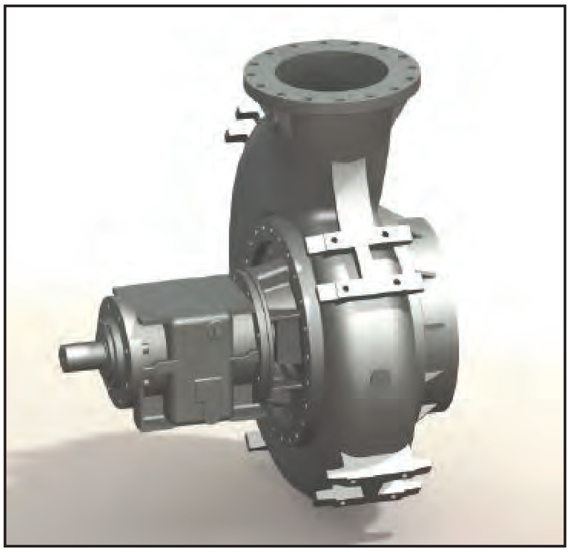
APPENDIX H

Pump Manufacturer Information

Standby Generators Manufacturer Information

16NHG22F12DTR

Efficient by Design



STANDARD SPECIFICATION

DISCHARGE	40.6 cm discharge
SUCTION	40.6 cm suction
IMPELLER	Enclosed, threaded, 3 vane: handles 11.43 cm solids
VOLUTE	Centerline discharge
MECHANICAL SEAL	See Cycloseal® design below
MATERIALS OF CONSTRUCTION	Cast iron casing, cast iron impeller

CYCLOSEAL® DESIGN

Cornell's Cycloseal® design, with its unique deflector vanes, works wit the impeller backvanes to create a cyclo-action. This action removes solids and abrasive material from the seal area while purging air and gas pockets – extending seal life and eliminating any need for venting or water flush. The Cycloseal® design is available in all solids handling pumps and many clear liquids, hot oil and food handling pumps.

MOUNTING OPTIONS

FRAME MOUNT	F12dtr
Oil Filled Bearing Frame	Optional
Redi-Prime® Self Priming system	Optional

FEATURES AND BENEFITS

- **Highest quality products**
- **Experience**
  - Over 50 years in the centrifugal pump business
- **Optimum Hydraulics**
  - In house engineering staff and test lab
- **Exceptional design and efficienc**
  - Converts energy into fluid flow and pressu
- **Long product life**
  - Thick walled castings
  - Heavy duty shafts
  - 20,000 hour bearings
  - Replaceable wear rings and shaft sleeves

CYCLOSEAL® BENEFITS

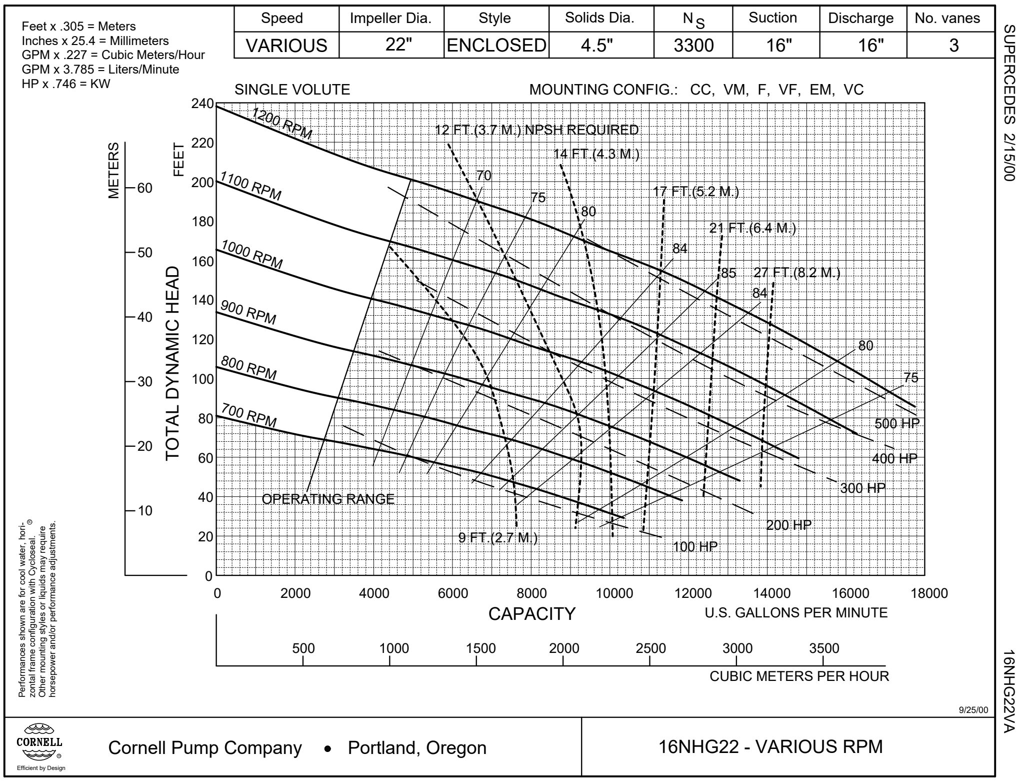
Extended Seal Life: Cornell's Cycloseal® design has proven itself in the toughest applications from manure slurry to starch recovery to clear water, food processing, self-priming and hot cooking oil applications – in some cases more than tripling the normally expected mechanical seal life.

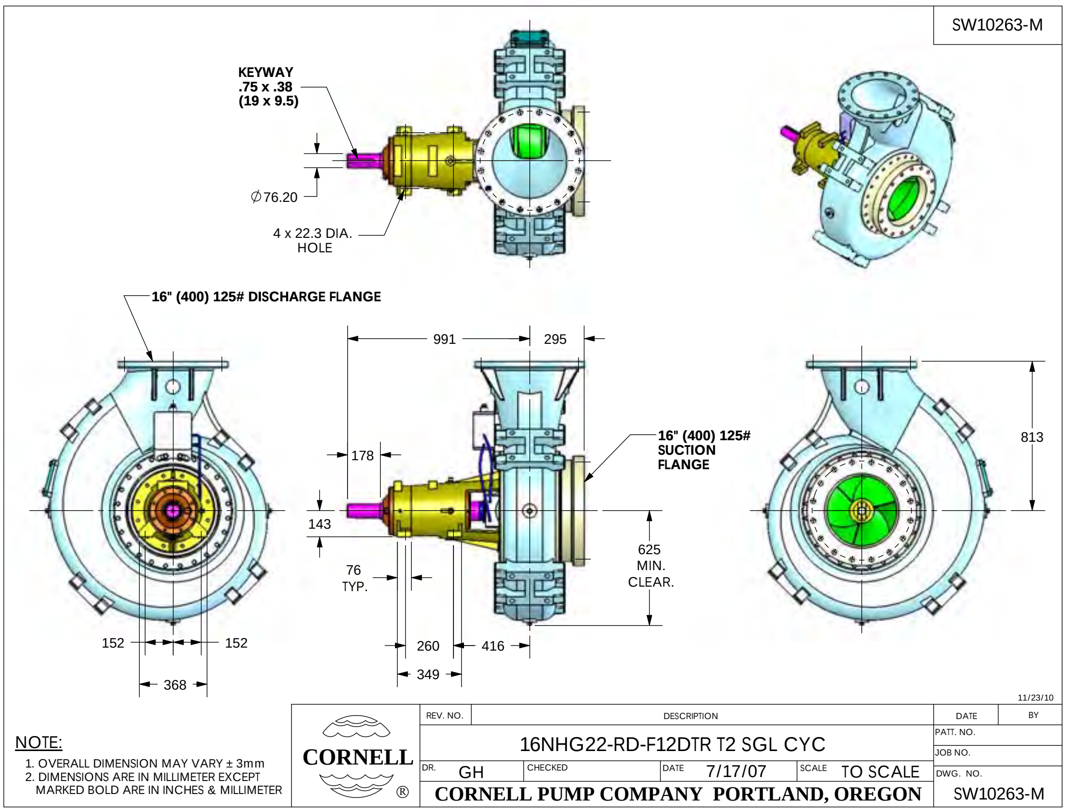
Run-Dry Option:All pumps equipped with Cornell's Cycloseal® system have an optional run-dry feature available, which serves to lubricate the seal faces even when there is no liquid in the pump casing. In situations where the pump must run dry for several hours, or where the pump may suddenly lose prime without being shut off, the Run-Dry™ feature is a must.

System Savings: The Cycloseal® system requires no external water flush, filters grease cups, piping or instrumentation normally associated with packing or double mechanical seals.

Maintenance Savings: Longer seal life which translates into less pump down time and lower maintenance costs.

16NHG22


Feet x .305 = Meters
Inches x 25.4 = Millimeters
GPM x .227 = Cubic Meters/Hour
GPM x 3.785 = Liters/Minute
HP x .746 = KW
Speed: VARIOUS
Impeller Dia.: 22"
Style: ENCLOSED
Solids Dia.: 4.5"
NS: 3300
Suction: 16"
Discharge: 16"
No. vanes: 3
SUPERCEDES 2/15/00
SINGLE VOLUTE
MOUNTING CONFIG.: CC, VM, F, VF, EM, VC
1200 RPM
1100 RPM
1000 RPM
900 RPM
800 RPM
700 RPM
12 FT.(3.7 M.) NPSH REQUIRED
14 FT.(4.3 M.)
17 FT.(5.2 M.)
21 FT.(6.4 M.)
27 FT.(8.2 M.)
9 FT.(2.7 M.)
OPERATING RANGE
500 HP
400 HP
300 HP
200 HP
100 HP
TOTAL DYNAMIC HEAD
FEET
METERS
CAPACITY
U.S. GALLONS PER MINUTE
CUBIC METERS PER HOUR
Performances shown are for cool water, horizontal frame configuration with Cycloseal®. Other mounting styles or liquids may require horsepower and/or performance adjustments.
9/25/00
16NHG22VA
CORNELL Efficient by Design
Cornell Pump Company • Portland, Oregon
16NHG22 - VARIOUS RPM


SW10263-M
KEYWAY .75 x .38 (19 x 9.5)
∅76.20
4 x 22.3 DIA. HOLE
16" (400) 125# DISCHARGE FLANGE
16" (400) 125# SUCTION FLANGE
991
295
178
143
76 TYP.
260
416
349
625 MIN. CLEAR.
813
152
152
368
11/23/10
NOTE:
1. OVERALL DIMENSION MAY VARY ± 3mm
2. DIMENSIONS ARE IN MILLIMETER EXCEPT MARKED BOLD ARE IN INCHES & MILLIMETER
CORNELL
REV. NO.
DESCRIPTION
DATE
BY
16NHG22-RD-F12DTR T2 SGL CYC
PATT. NO.
JOB NO.
DR. GH
CHECKED
DATE 7/17/07
SCALE TO SCALE
DWG. NO.
CORNELL PUMP COMPANY PORTLAND, OREGON
SW10263-M

CATERPILLAR

Project Sizing Report

Price List: U.S.

Modified Date	12-Jul-2019	**Electricity Supply**	60 Hz 480/277 V
Customer Name	Tijuana Diversion System	**Connection**	STAR
Project Name/Ref #	PBCILA Backup GEN	**Max. Ambient Temperature**	77.0 F 30% Humidity
Prepared By	Joel Mora	**Altitude**	500.0 Ft. A.S.L

Load Analysis Summary

Max Transient Load Step	1,984.5 SkVA	697.0 SkW	
Peak Transient Load	1,984.5 SkVA	697.0 SkW	
Final Running Load	342.5 kVA	302.3 kW	0.88 PF
Max Running Non Linear Load	0.0 RkVA		
Maximum Running Load	342.5 kVA	302.3 kW	

Generator Set

Genset Model	(1) of C27	**Nameplate Rating**	750.0 kW / 937.0 kVA
Voltage Regulator and Slope	CDVR, 2:1 slope		0.8 PF
Feature Code	C27DRA0	**Site Output**	750 kW / 937 kVA
Fuel	Diesel	**Rating Type**	Standby
Dry Weight	0.0 lbs		
Length / Width / Height	0.0in / 0.0in / 0.0in	**Cooling System**	
		UL Listed	No

Alternator Motor Starting Capability *		Block Load (only) Transient Response *			
Instantaneous Voltage Dip * **	**skVA Capability**	**Load Change %**	**FDip %**	**VDip %**	**Recovery Time (sec)**
10%	549	**0 - 25**	2.2	3.5	< 3
20%	1,235	**0 - 50**	4.5	6.7	< 3
30%	2,117	**0 - 75**	10.6	16.1	< 3
35%	2,660	**0 - 100**	16.9	26.0	3.7

Engine Technical Data at 100% Rated Load

Make/Model	C27	**Emissions/Certifications**	EPA ESE
Aspiration	TA	**Governor**	ADEM4
Cylinder Configuration	VEE - 12	**Aftercooler Type**	ATAAC
Displacement	1,649 Cubic Inch / 27 Liter	**Rejection To Jacket Water**	18,168 BTU/min
Speed	1800 RPM	**Rejection To Aftercooler**	7,653 BTU/min
Fuel Rate	52.5 gph	**Rejection To Oil Cooler**	6,001 BTU/min
Exhaust Sound Level	0 dBA at 23 ft/7 m	**Rejection To Atmosphere**	6,121 BTU/min
Mechanical Sound Level	0 dBA at 23 ft/7 m	**Rejection To Exhaust**	41,248 BTU/min
Max Combustion Inlet Air Temp	120.2 F	**Exhaust Recoverable**	23,382 BTU/min
Combustion Airflow	2,048.1 cfm	**Exhaust Stack Temperature**	946 F
Cooling System Ambient Capability	140.0 F	**Exhaust Flow Rate**	5,524.0 cfm
Cooling System Airflow **	42,378 cfm		
Engine Performance Number	DM9071		

Alternator Technical Data

Alternator Arrangement Number	3850622	**Insulation**	H
Alternator Type / Frame Size	SR5 / 1266	**Temperature Rise**	150 C
Alternator Winding Pitch	0.6667	**Rejection To Atmosphere**	2,672.8 BTU/min
Number Of Poles	4	**Peak Amps / Rated Amps**	**** / 1,127.0
Excitation / Winding Type	PM / RANDOM	**Short Circuit Ratio**	0.3900

Reactances		**per unit**	**ohms**	**Generator Time Constants**		**sec**
Subtransient - Direct Axis	X"d	0.1265	0.0311	**Open Circuit Transient - Direct Axis**	T'd0	2.0450
Subtransient - Quadrature Axis	X"q	0.1416	0.0348	**Short Circuit Transient - Quadrature Axis**	T'd	0.1000
Transient - Saturated	X'd	0.1579	0.0388	**Open Circuit Subtransient - Direct Axis**	T"d0	0.0130
Synchronous - Direct Axis	Xd	3.2275	0.7932	**Short Circuit Subtransient - Direct Axis**	T"d	0.0100
Synchronous - Quadrature Axis	Xq	1.9364	0.4759	**Open Circuit Subtransient - Quadrature Axis**	T"q0	0.1370
Negative Sequence	X2	0.1343	0.0330	**Short Circuit Subtransient - Quadtrature Axis**	T"q	0.0100
Zero Sequence	X0	0.0098	0.0024	**Armature Short Circuit**	TA	0.0150

Notes:

* Block Load (only) Transient Response values are at factory conditions. Genset block load capabilities at site conditions may vary from factory transient response test results due to a variance in site altitude or ambient conditions.

** Based on 1/2 inch water (0.12 kPa) external restriction and 1000 ft (300m) altitude.

*** Based on instantaneous voltage dip as defined per NEMA MG-1.

**** See your Caterpillar dealer and/or Spec Sheet for technical information.

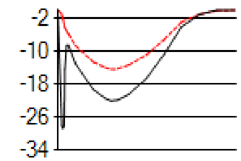
***** Package Power Tolerance: +/- 5%

Overall dimensions and weight not to be used for installation. Contact your Caterpillar dealer for specific dimension drawings.

Project Load Report

Modified Date	12-Jul-2019	**Rating Type**	Standby	**Max Ambient Temperature**	77 Deg. F
Customer Name	Tijuana Diversion System	**Fuel**	Diesel	**Altitude**	500.0 Ft. A.S.L
Project Name/Ref #	PBCILA Backup GEN	**Electricity Supply**	60 Hz 480/277 V		
Prepared By	Joel Mora				

Load Details			**Permitted Dip**		**Predicted Dip**		**Load Analysis**										
Load Step		Load Description	Frequency	Voltage	Frequency	Voltage	Transient Inrush		Running		Resultant Peak		Cumulative Running		Fdip:	Vdip 1:	Vdip 2:
							SkVA	SkW	kVA	kW	SkVA	SkW	kVA	kW			
Step 1			**Step Passed**														
															14.3%	28.6%	22.0%
1.1	1	125.00 HP - Pump 6 NEMA, Centrifugal Pump, Across the line, Loaded, Single Operating Point	30%	30%			662.5	198.8	110.2	99.2							
1.2	1	75.00 HP - Pump 1 NEMA, Centrifugal Pump, Across the line, Loaded, Single Operating Point	30%	30%			397.5	135.2	67.6	60.1							
1.3	4	25.00 HP - Motors NEMA, 3-Phase Motor, Across the line, Loaded, Single Operating Point	30%	30%			530.0	227.9	97.5	82.9							
1.4	1	75.00 HP - Pump 2 NEMA, Centrifugal Pump, Across the line, Loaded, Single Operating Point	30%	30%			397.5	135.2	67.6	60.1							
		Step 1 Total	**30%**	**30%**	**14.3%**	**28.6%**	**1,984.5**	**697.0**	**342.5**	**302.3**							
		Total Through Step 1									**1,984.5**	**697.0**	**342.5**	**302.3**			



Load Analysis Summary

Maximum Step		Maximum Peak		Final Running	
SkVA	SkW	SkVA	SkW	kVA	kW
1,984.5	697.0	1,984.5	697.0	342.5	302.3

Transient Performance Report

Price List:
U.S.

Modified Date	12-Jul-2019	**Electricity Supply**	60 Hz 480/277 V	**Rating Type**	Standby
Customer Name	Tijuana Diversion System	**Fuel**	Diesel		
Project Name/Ref #	PBCILA Backup GEN	**Max. Ambient Temperature**	77.0 F		
Prepared By	Joel Mora	**Altitude**	500.0 Ft. A.S.L		

Load Scenario

Step 1

Voltage Dip

Permitted-30.0%

Predicted - 28.6%

Synchronous (Vdip 1) - 28.6%

Frequency-induced (Vdip 2) - 22.0%

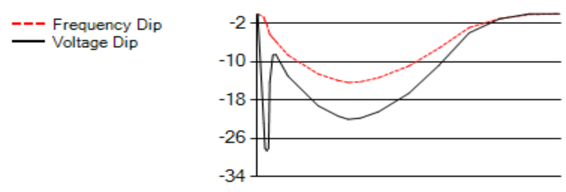
Step 1

Frequency Dip

Permitted-30.0%

Predicted - 14.3%

Step 1



Fdip:	Vdip 1:	Vdip 2:
14.3%	28.6%	22.0%

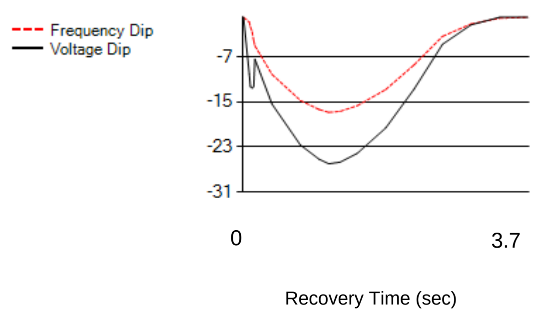
Selected Generator Set

750.0 EkW / 937.0 kVA 60 Hz Standby, 480/277V, C27 ATAAC EPA ESE, 1266 PM SR5 RANDOM, CDVR 2:1 slope

Block Load (only) Transient Response *

Load Change %	FDip %	VDip %	Recovery Time (sec)
0 - 25	2.2	3.5	< 3
0 - 50	4.5	6.7	< 3
0 - 75	10.6	16.1	< 3
0 - 100	16.9	26.0	3.7

0 - 100 Load Change %



Transient Performance

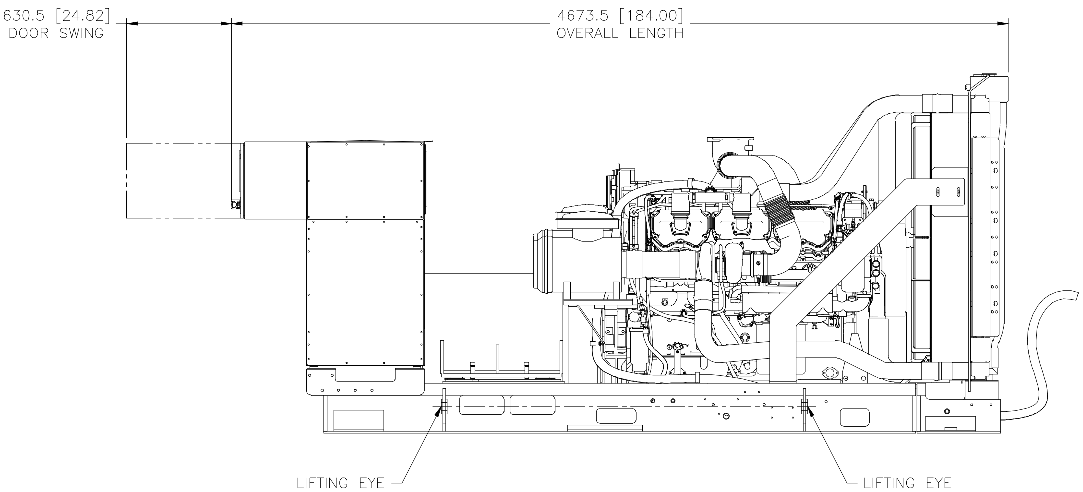
The selected representative generator set was factory tested in accordance to NFPA 110 block load step capability and acceptable frequency and voltage response on load addition and rejection.

* Block Load (only) Transient Response values are at factory conditions. Genset block load capabilities at site conditions may vary from factory transient response test results due to a variance in site altitude or ambient conditions.

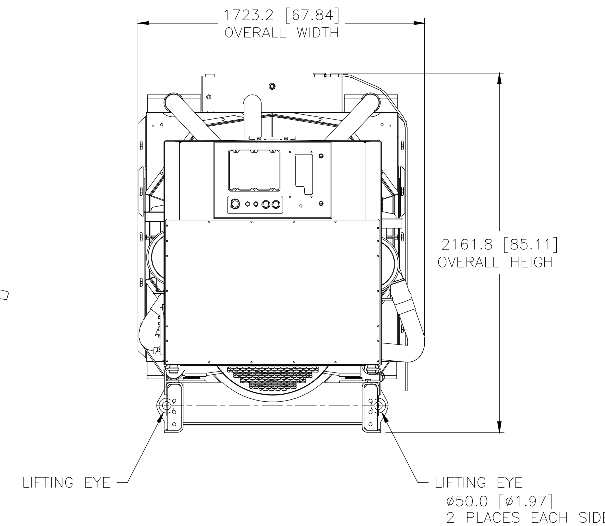
Note: This information is representative of a typical Caterpillar GenSet, but is not guaranteed. This estimate has tolerances, and there are also GenSet-to-GenSet variations.

METRIC 533-1403

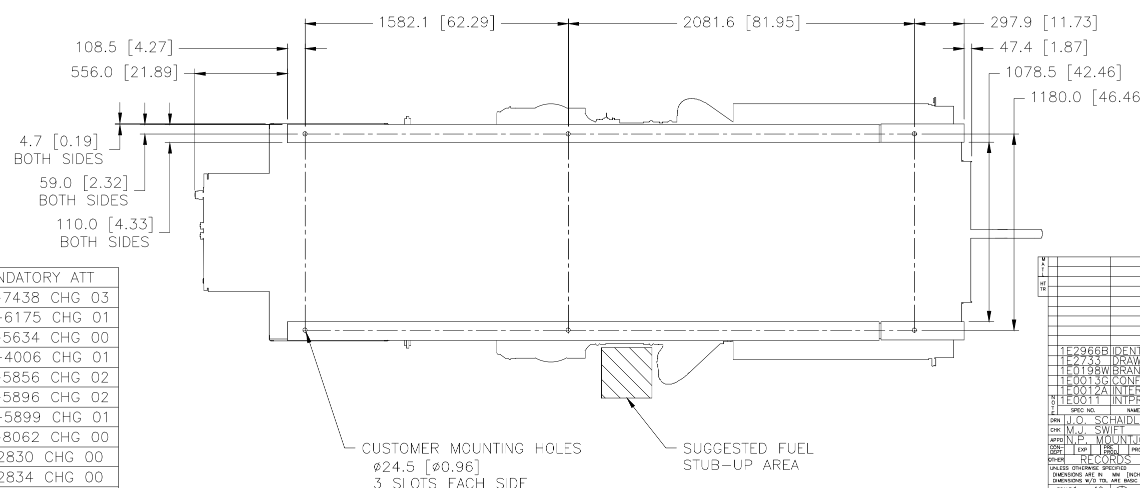
QTY	ENGINE CONNECTIONS	SIZE	SHEETS
1	EXCESS FUEL RETURN	3/4-16 THD	2, 3
1	EXHAUST	SEE DETAIL SHEET 7	4, 6, 7
1	FUEL INLET	7/8-14 THD	2, 3
1	FUMES DISPOSAL TUBE	ø62.0 [ø2.44] OD	2, 6
1	OIL DRAIN	1 11-1/2 NPTF THD	2, 3



RIGHT SIDE VIEW



REAR VIEW



FOOTPRINT
(DIMENSIONED OUTLINE VIEW FROM ABOVE)

MODEL	TYPE	PRICING AR	GENERATORS	MANDATORY ATT
C27	–	LS-3126 CHG 00	LS-1208 CHG 01	252-7438 CHG 03
				435-6175 CHG 01
				446-5634 CHG 00
				491-4006 CHG 01
				491-5856 CHG 02
		LS-3128 CHG 00	LS-1209 CHG 01	491-5896 CHG 02
				491-5899 CHG 01
				508-8062 CHG 00
				LF-2830 CHG 00
				LF-2834 CHG 00
		LS-3130 CHG 00	LS-1219 CHG 01	LF-2844 CHG 01
				LF-2848 CHG 00
				LS-0178 CHG 01
				LS-0481 CHG 00
				LS-1249 CHG 02

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT EXP PRE PROD. PROD.
OTHER RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

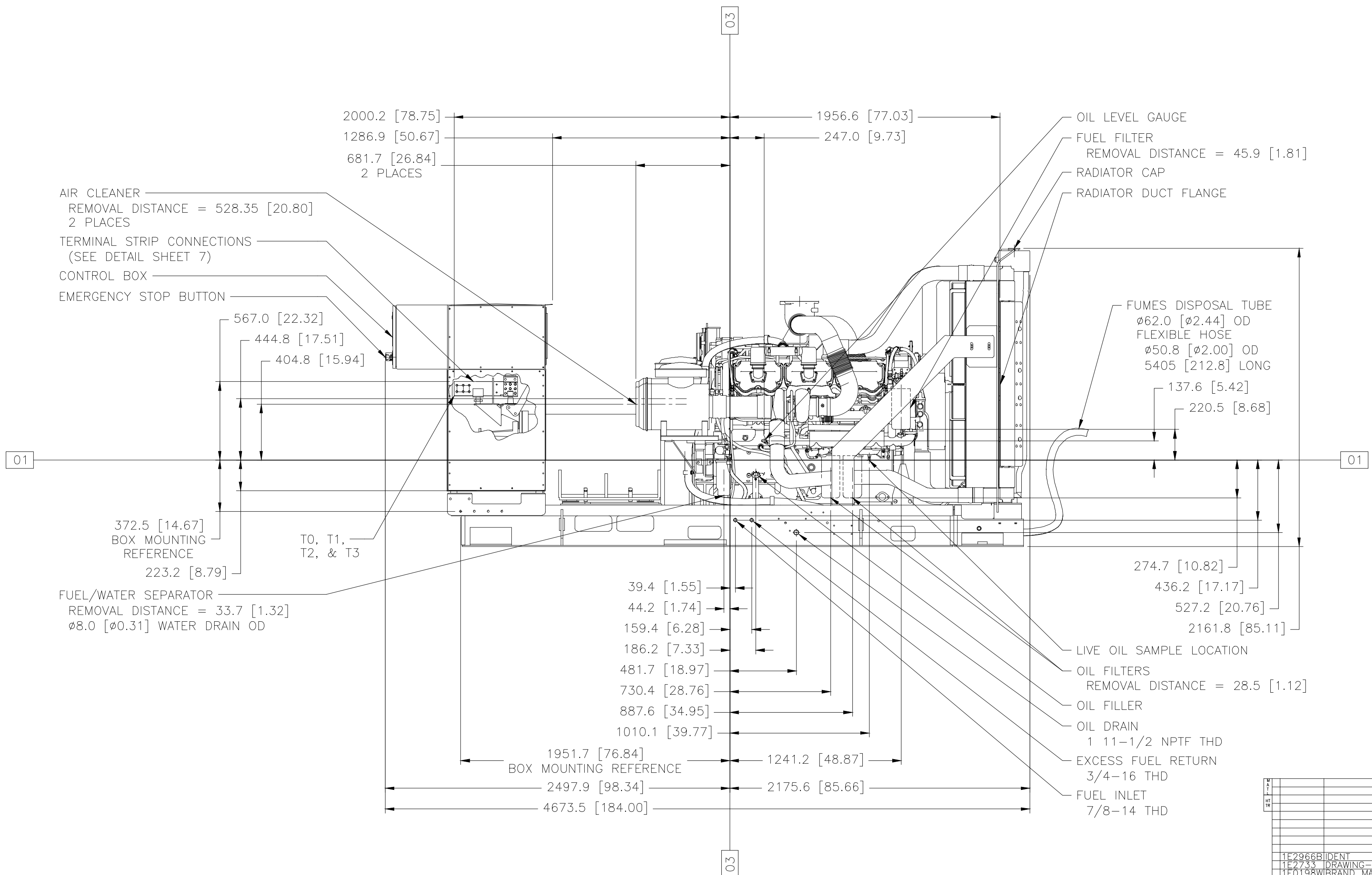
SCALE 1 = 10
SHEET 1 OF 8
THIRD ANGLE PROJECTION

CHG	DATE
01	03AUG18

CATERPILLAR INC.

INSTALLATION-ENGINE
C27 PACKAGE GENSET

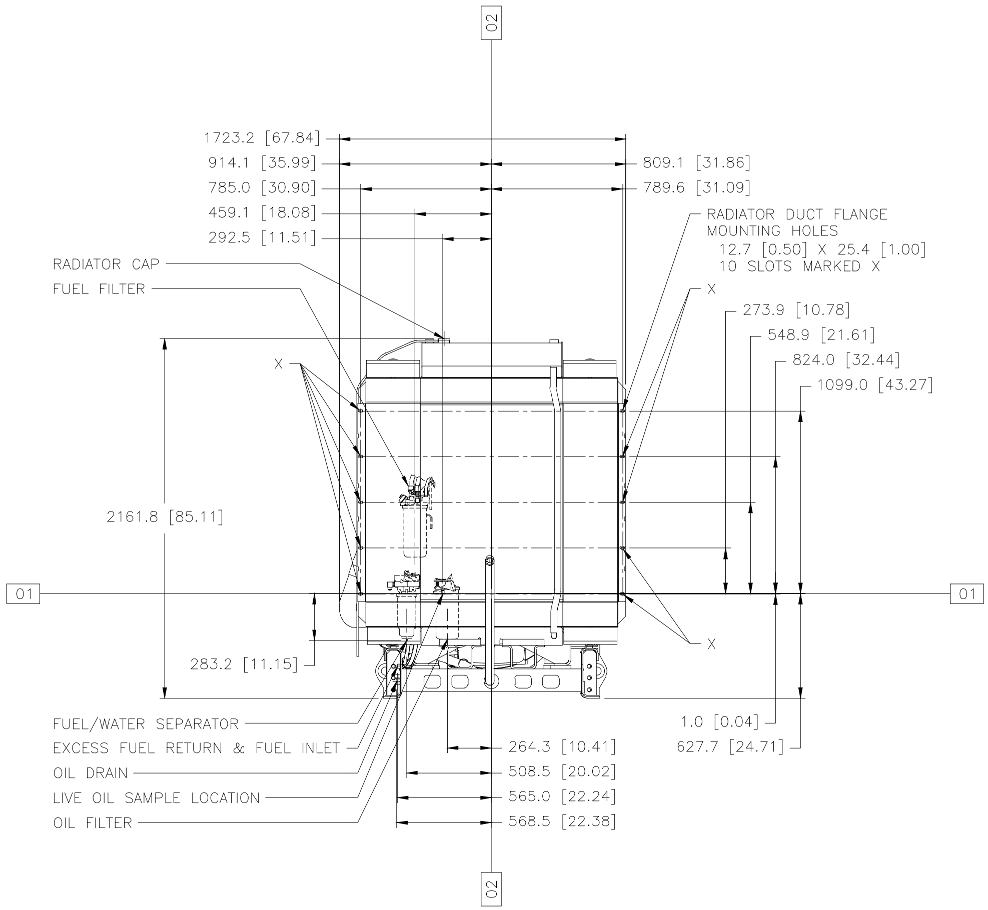
533-1403 VER – CONTROL DES SUB W927 E



CAT C27 PACKAGE GENSET
DWG# 533-1403 CHG 01
METRIC [INCH]
RIGHT SIDE VIEW
LS-3126 CHG 00 W/ MANDATORY ATTACHMENTS SHOWN

1E2966B IDENT
1E2733 DRAWING-AUTOCAD
1E0198W BRAND MARKINGS
1E0013G CONFIDENTIALITY
1E0012A INTERPRETATION
1E0011 INTPR & TOL
SPEC NO. NAME
DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
RECORDS X
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC
SCALE 1 = 10
SHEET 2 OF 8
THIRD ANGLE PROJECTION
01 03AUG18
CATERPILLAR INC.
INSTALLATION-ENGINE
C27 PACKAGE GENSET
533-1403
W927
E

METRIC 533-1403



CAT C27 PACKAGE GENSET
DWG# 533-1403 CHG 01
METRIC [INCH]
FRONT VIEW
LS-3126 CHG 00 W/ MANDATORY ATTACHMENTS SHOWN

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT | EXP | PRE PROD. | PROD.
OTHER RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

SCALE 1 = 10
SHEET 3 OF 8
THIRD ANGLE PROJECTION

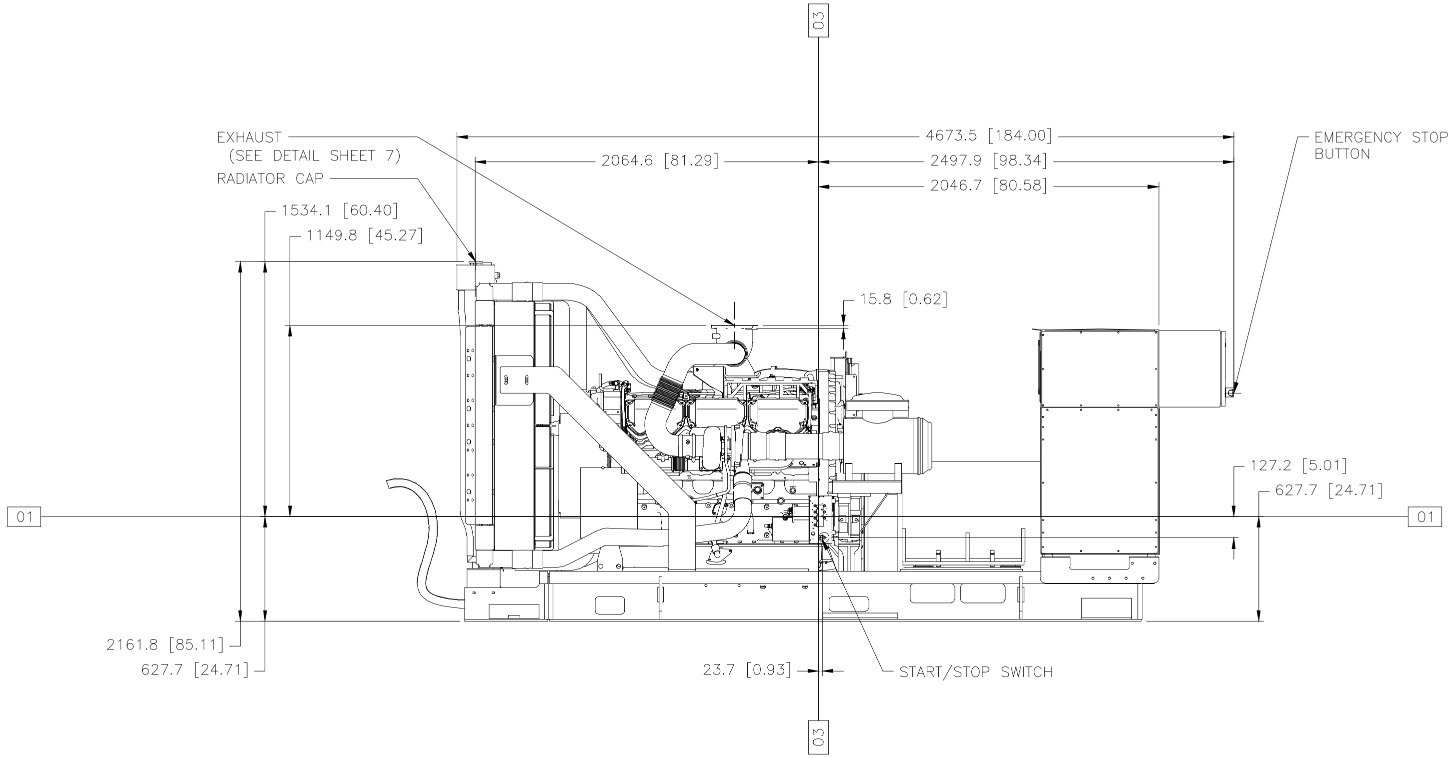
CHG	DATE
01	03AUG18

CATERPILLAR INC.

INSTALLATION-ENGINE
C27 PACKAGE GENSET

533-1403 | VER – | CONTROL DES X SUB | W927 | E

METRIC 533-1403



CAT C27 PACKAGE GENSET
DWG# 533-1403 CHG 01
METRIC [INCH]
LEFT SIDE VIEW
LS-3126 CHG 00 W/ MANDATORY ATTACHMENTS SHOWN

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT | EXP | PRE PROD. | PROD.
OTHER RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

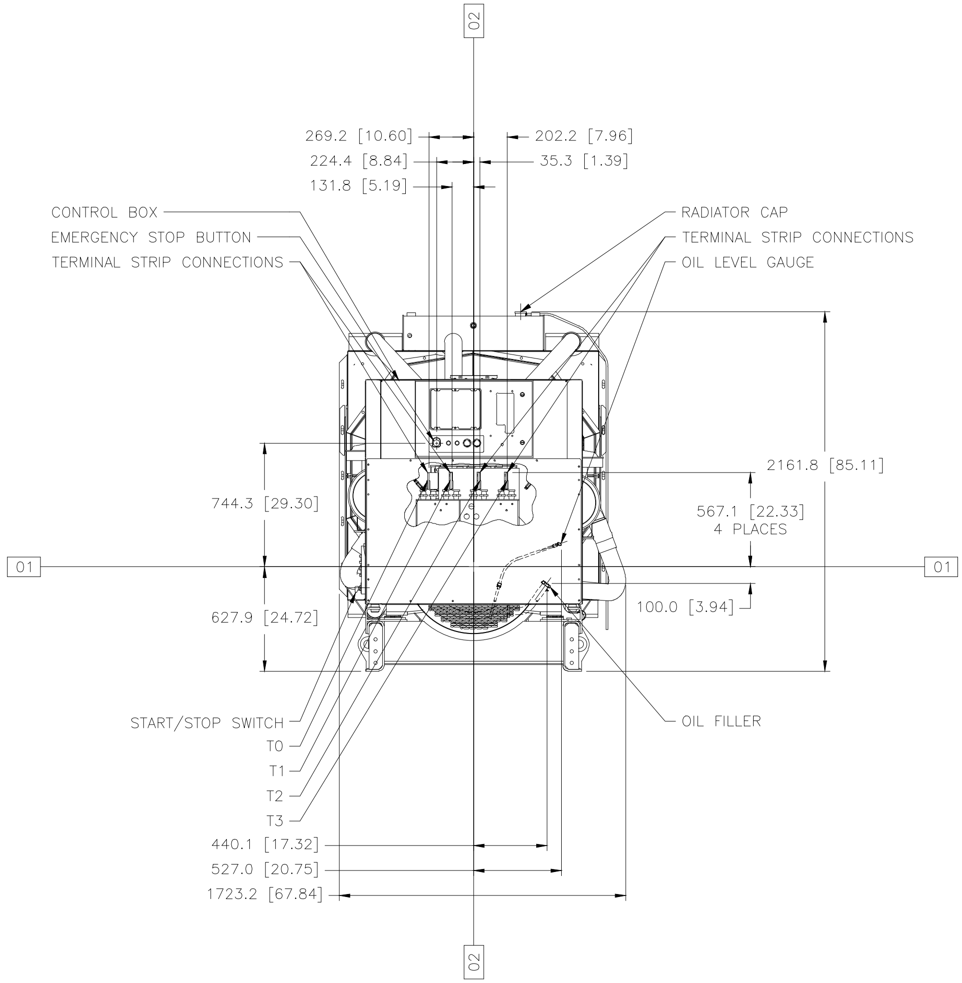
SCALE 1 = 10
SHEET 4 OF 8
THIRD ANGLE PROJECTION

CHG	DATE
01	03AUG18

CATERPILLAR INC.

INSTALLATION-ENGINE
C27 PACKAGE GENSET
533-1403 VER - CONTROL DES SUB W927 E

METRIC 533-1403



CAT C27 PACKAGE GENSET
DWG# 533-1403 CHG 01
METRIC [INCH]
REAR VIEW
LS-3126 CHG 00 W/ MANDATORY ATTACHMENTS SHOWN

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT | EXP | PRE PROD. | PROD.
OTHER RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

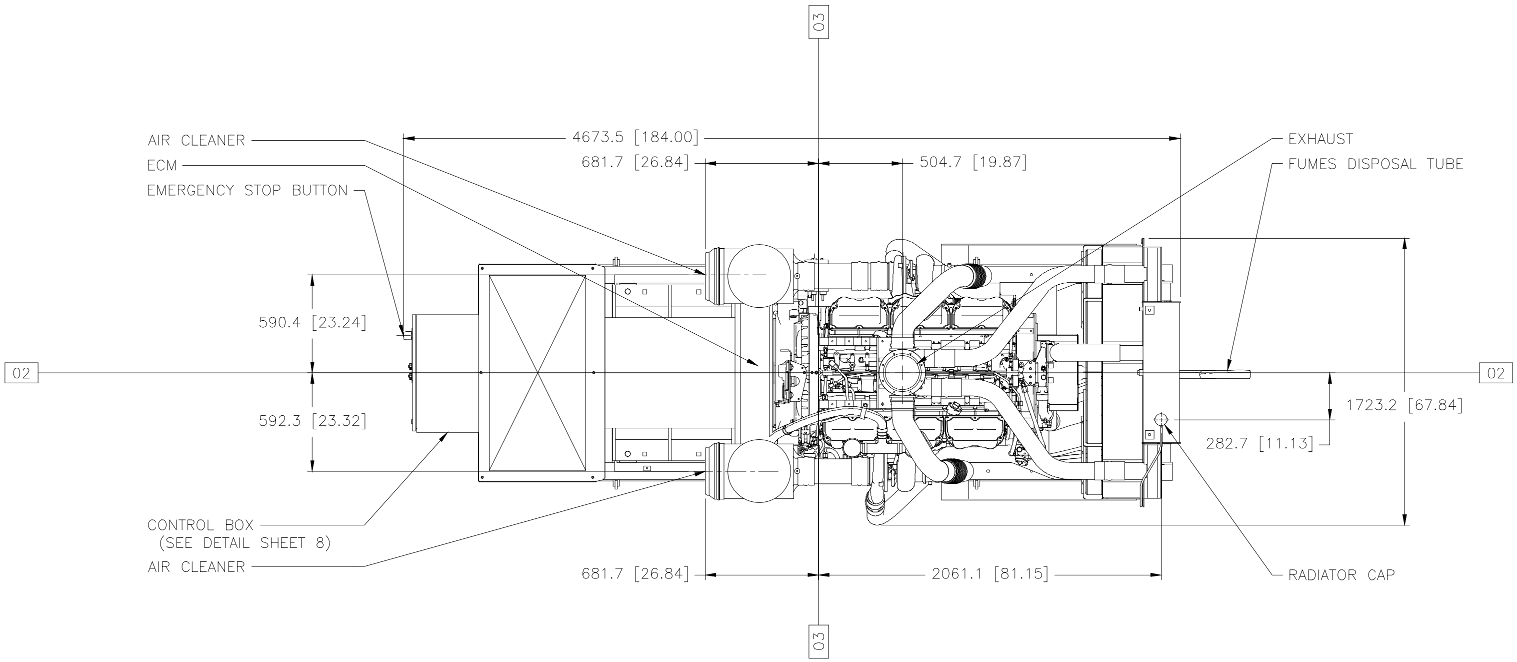
SCALE 1 = 10
SHEET 5 OF 8
THIRD ANGLE PROJECTION
CHG 01 DATE 03AUG18

CATERPILLAR INC.

INSTALLATION-ENGINE
C27 PACKAGE GENSET

533-1403 VER - CONTROL DES ☒ SUB W927 E

METRIC 533–1403



CAT C27 PACKAGE GENSET
DWG# 533–1403 CHG 01
METRIC [INCH]
TOP VIEW
LS–3126 CHG 00 W/ MANDATORY ATTACHMENTS SHOWN

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING–AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CON-CEPT EXP PRE PROD. PROD.
OTHER RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

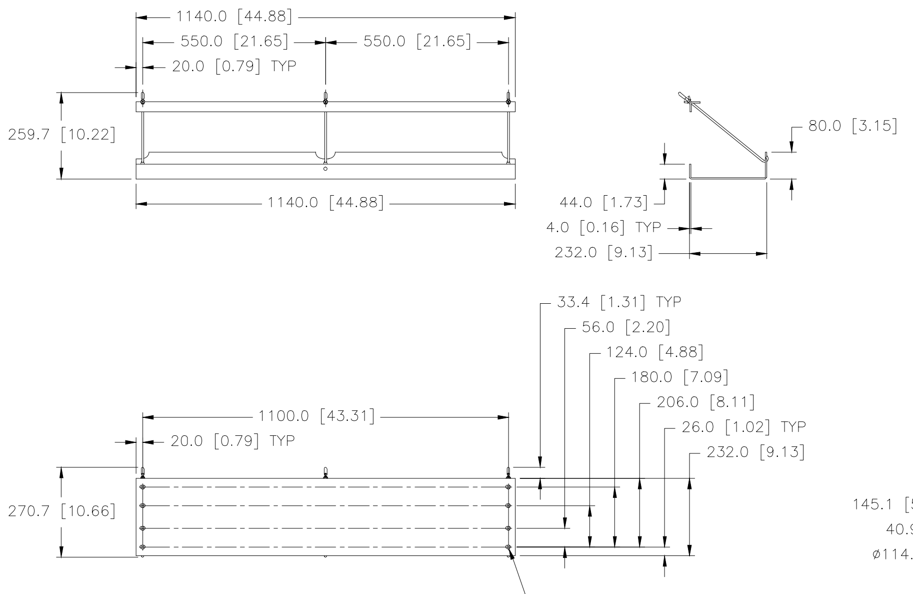
SCALE 1 = 10
SHEET 6 OF 8
THIRD ANGLE PROJECTION

CHG	DATE
01	03AUG18

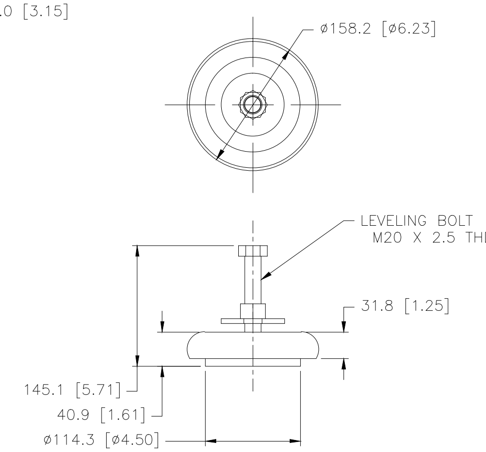
CATERPILLAR INC.

INSTALLATION–ENGINE
C27 PACKAGE GENSET
533–1403 VER – CONTROL DES X SUB W927 E

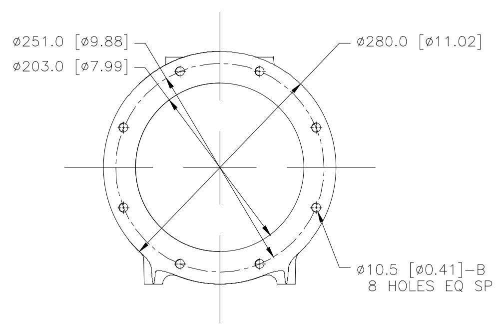
METRIC 533-1403



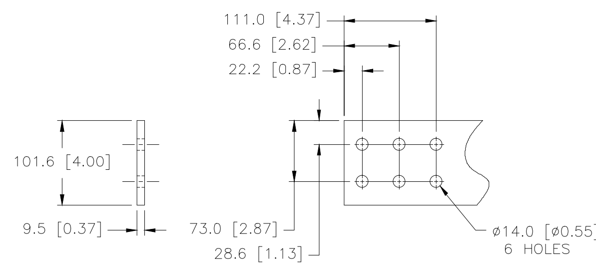
DETAIL OF BATTERY SUPPORT
342-5296 CHG 01
(SHIPPED LOOSE)
SCALE 1=5



DETAIL OF MOUNTING GROUP ISOLATOR
(SHIPPED LOOSE)
SCALE 1=2



DETAIL OF EXHAUST
SCALE 1=2



DETAIL OF TERMINAL STRIP CONNECTIONS
SCALE 1=2

1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL
SPEC NO.	NAME
DRN	J.O. SCHAIDLE
CHK	M.J. SWIFT
APPD	N.P. MOUNTJOY

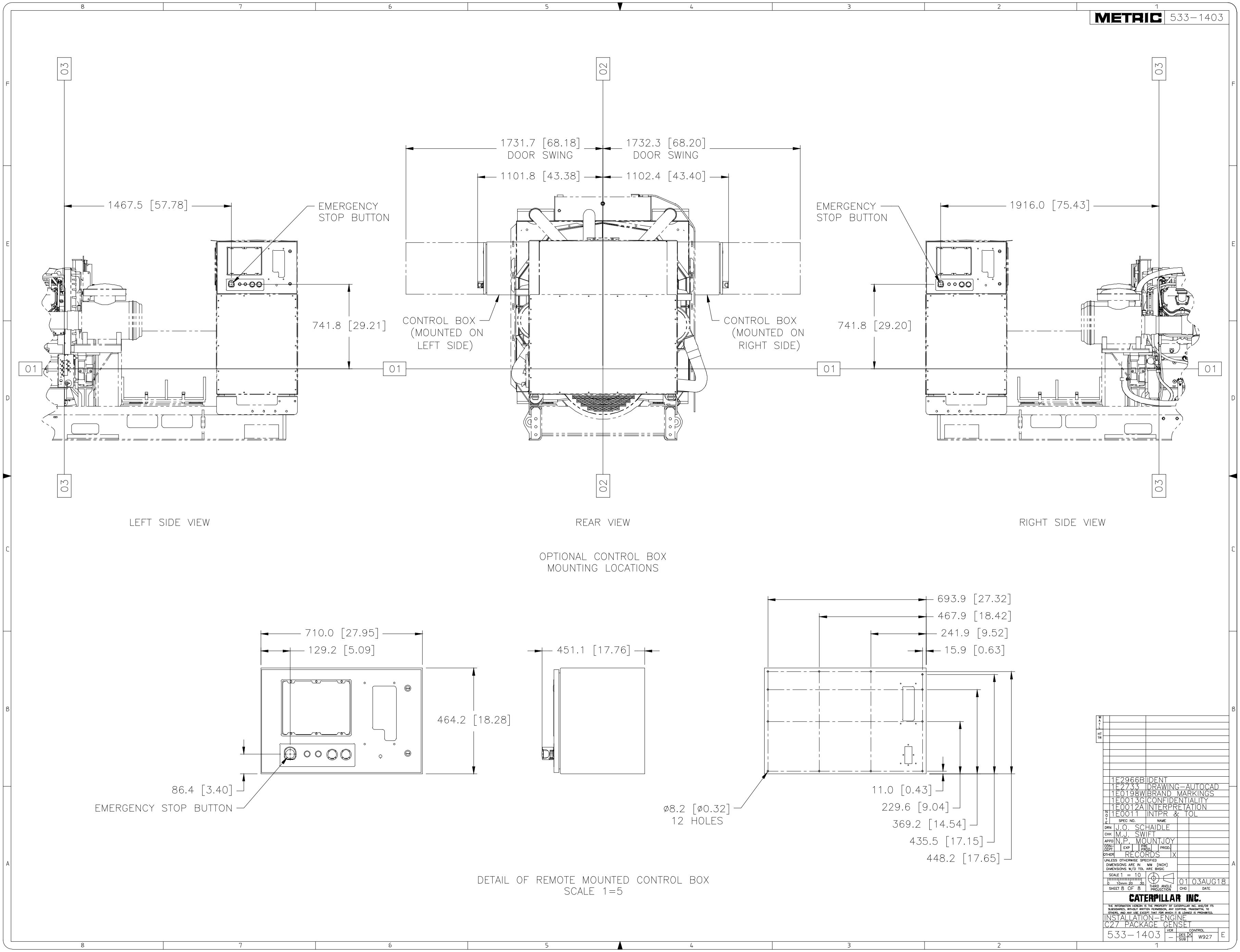
RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

SCALE 1 = 10
SHEET 7 OF 8
THIRD ANGLE PROJECTION
01 03AUG18

CATERPILLAR INC.

INSTALLATION-ENGINE
C27 PACKAGE GENSET
533-1403 W927 E



METRIC 533-1403
1731.7 [68.18] DOOR SWING
1732.3 [68.20] DOOR SWING
1101.8 [43.38]
1102.4 [43.40]
1467.5 [57.78]
EMERGENCY STOP BUTTON
1916.0 [75.43]
EMERGENCY STOP BUTTON
741.8 [29.21]
CONTROL BOX (MOUNTED ON LEFT SIDE)
CONTROL BOX (MOUNTED ON RIGHT SIDE)
741.8 [29.20]
01
02
03
LEFT SIDE VIEW
REAR VIEW
RIGHT SIDE VIEW
OPTIONAL CONTROL BOX MOUNTING LOCATIONS
710.0 [27.95]
129.2 [5.09]
464.2 [18.28]
86.4 [3.40]
EMERGENCY STOP BUTTON
451.1 [17.76]
693.9 [27.32]
467.9 [18.42]
241.9 [9.52]
15.9 [0.63]
ø8.2 [ø0.32] 12 HOLES
11.0 [0.43]
229.6 [9.04]
369.2 [14.54]
435.5 [17.15]
448.2 [17.65]
DETAIL OF REMOTE MOUNTED CONTROL BOX SCALE 1=5
1E2966B IDENT
1E2733 DRAWING-AUTOCAD
1E0198W BRAND MARKINGS
1E0013G CONFIDENTIALITY
1E0012A INTERPRETATION
1E0011 INTPR & TOL
SPEC NO. NAME
DRN J.O. SCHAIDLE
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT EXP PRE PROD. PROD.
OTHER RECORDS X
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM [INCH] DIMENSIONS W/O TOL ARE BASIC
SCALE 1 = 10
SHEET 8 OF 8
THIRD ANGLE PROJECTION
01 03AUG18
CHG DATE
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INSTALLATION-ENGINE
C27 PACKAGE GENSET
533-1403
VER CONTROL DES SUB W927 E

DATA SHEET

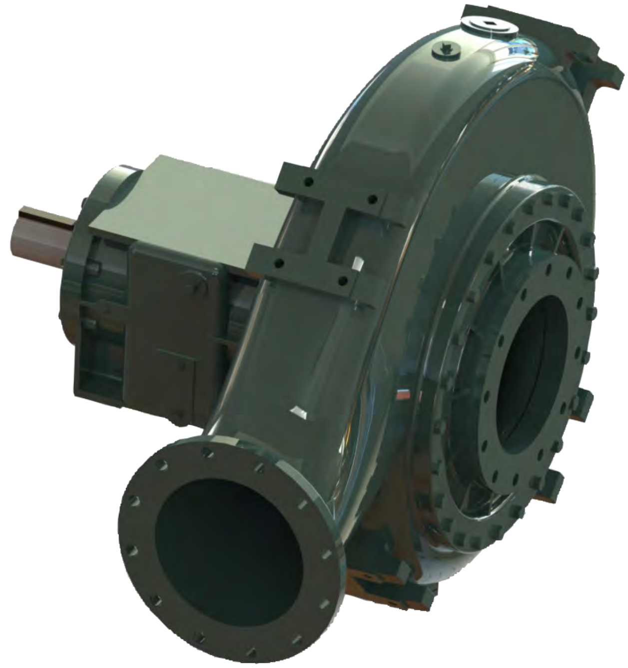
14NHG28

AVAILABLE MOUNTING CONFIGURATIONS

14NHG28-F FRAME MOUNT
14NHG28-RP-F REDI-PRIME FRAME MOUNT
14NHG28-EM ENGINE MOUNT
14NHG28-RP-EM REDI-PRIME ENGINE MOUNT
14NHG28-VF VERTICAL FRAME MOUNT

OPERATING LEVELS

MIN FLOW	3000 GPM	681 m^3/h
MAX FLOW	13800 GPM	3132.6 m^3/h
DISCHARGE SIZE	14”	356 mm
SUCTION SIZE	16”	406.4 mm
SOLIDS HANDLING	4.25”	10.6 cm
MAX SPEED	1200 RPM	1200 RPM
SHUT-OFF HEAD	425’	129.5 m
BEP HEAD	300’	91.5 m
BEP FLOW	11600 GPM	2633 m^3/h
BEP PERCENT	85%	85%



A typical picture of the pump is shown. Please contact Cornell Pump Company for further details. All information is approximate and for general guidance only.

PARTS	STANDARD MATERIAL (ALL IRON)
WEAR RING	CAST IRON ASTM A48
IMPELLER	CAST IRON ASTM A48
VOLUTE	DUCTILE IRON
SHAFT	17-4PH STAINLESS STEEL
SHAFT SLEEVE	416 STAINLESS STEEL
SUCTION COVER	CAST IRON ASTM A48
MECHANICAL SEAL	TUNGSTEN CARBIDE VS. SILICON CARBIDE
BEARING FRAME	CAST IRON ASTM A48

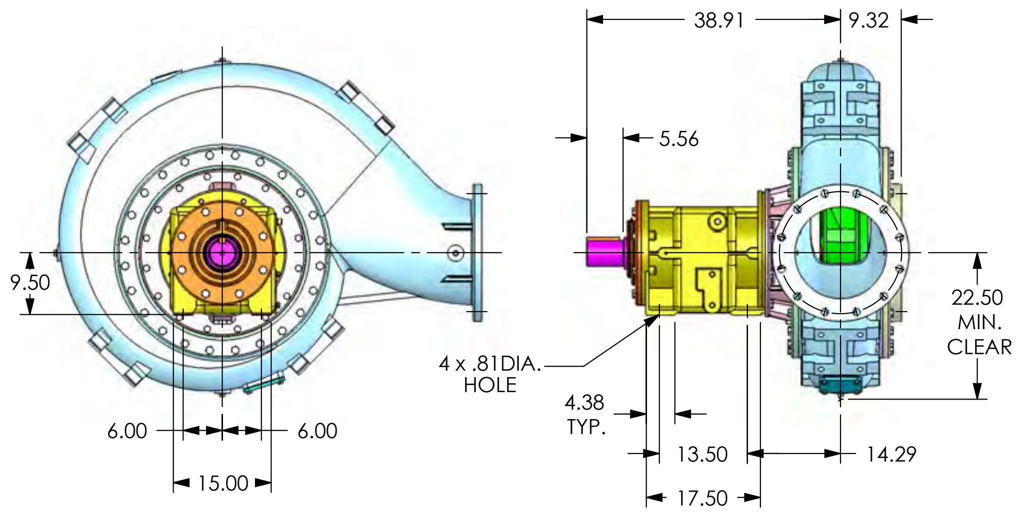
The 14NHG28 pump is designed with Cornell’s renowned quality and durability. It features a 14” discharge, 14” suction, and double volute. Cornell’s patented Cycloseal® design is standard, with a Type 2 single mechanical seal, stainless steel hardware and tungsten carbide vs. silicon carbide seal faces for abrasion resistance. Bearings are a heavy duty grease-lubricated ball bearings with a minimum life of 50,000 hours.

- Superior lift capability
- Robust solids handling capability
- Premium hydraulic efficiency
- Cycloseal® design mechanical seal
- Heavy-duty construction
- RunDry™ option
- Redi-Prime® fully automatic self-priming; dry-priming available

Cornell Pump Company | Clackamas, OR 97015 USA | www.cornellpump.com| P: +1 (503) 653-0330 | F: +1 (503) 653-0338

DATA SHEET

14NHG28



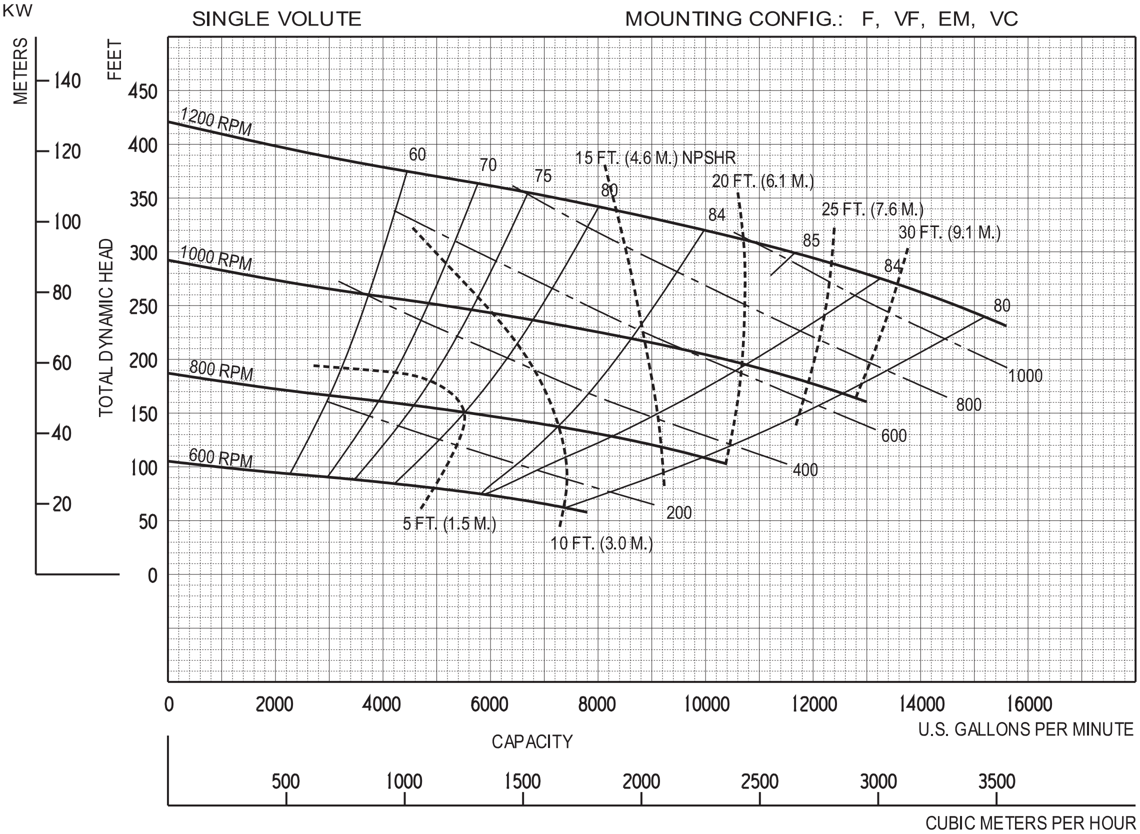
Feet x .305 = Meters
Inches x 25.4 = Millimeters
GPM x .227 = Cubic Meters/Hour
GPM x 3.785 = Liters/Minute
HP x .746 = KW

Speed	Impeller Dia.	Style	Solids Dia.	N_S	Suction	Discharge	No. vanes
VARIOUS	28"	ENCLOSED	4.25"	1800	14"	14"	3

NEW PAGE

SINGLE VOLUTE

MOUNTING CONFIG.: F, VF, EM, VC



Performances shown are for cool water, close-coupled electric configurations with Cycloseal® Other mounting configurations, seal arrangements or liquids may require horsepower and/or performance adjustments.

5/02/11

14NHG28VA

Cornell Pump Company • Portland, Oregon

14NHG28 - VARIOUS RPM

DS14NHG28-52215

CATERPILLAR

Project Sizing Report

Price List: U.S.

Modified Date	12-Jul-2019	**Electricity Supply**	60 Hz 480/277 V
Customer Name	Tijuana Diversion System	**Connection**	STAR
Project Name/Ref #	PB1A - Backup Gen- Optimized	**Max. Ambient Temperature**	77.0 F 30% Humidity
Prepared By	Joel Mora	**Altitude**	500.0 Ft. A.S.L

Load Analysis Summary

Max Transient Load Step	8,723.7 SkVA	1,931.8 SkW	
Peak Transient Load	8,723.7 SkVA	1,931.8 SkW	
Final Running Load	1,367.3 kVA	1,214.3 kW	0.89 PF
Max Running Non Linear Load	0.0 RkVA		
Maximum Running Load	1,367.3 kVA	1,214.3 kW	

Generator Set

Genset Model	(1) of C175-16	**Nameplate Rating**	3,000.0 kW / 3,750.0 kVA
Voltage Regulator and Slope	CDVR, 2:1 slope		0.8 PF
Feature Code	175DRA9	**Site Output**	3,000 kW / 3,750 kVA
Fuel	Diesel	**Rating Type**	Standby
Dry Weight	0.0 lbs		
Length / Width / Height	313.2in / 113.7in / 134.2in	**Cooling System**	
		UL Listed	No

Alternator Motor Starting Capability *		Block Load (only) Transient Response *			
Instantaneous Voltage Dip * **	**skVA Capability**	**Load Change %**	**FDip %**	**VDip %**	**Recovery Time (sec)**
10%	2,345	**0 - 25**	2.6	4.6	< 3
20%	5,277	**0 - 50**	5.7	11.0	< 3
30%	9,046	**0 - 75**	10.9	21.6	3.5
35%	11,366	**0 - 100**	16.6	33.4	5.2

Engine Technical Data at 100% Rated Load

Make/Model	C175-16	**Emissions/Certifications**	EPA ESE
Aspiration	TA	**Governor**	ADEM4
Cylinder Configuration	VEE - 16	**Aftercooler Type**	SCAC
Displacement	5,167 Cubic Inch / 85 Liter	**Rejection To Jacket Water**	78,436 BTU/min
Speed	1800 RPM	**Rejection To Aftercooler**	0 BTU/min
Fuel Rate	214.2 gph	**Rejection To Oil Cooler**	24,486 BTU/min
Exhaust Sound Level	0 dBA at 23 ft/7 m	**Rejection To Atmosphere**	8,336 BTU/min
Mechanical Sound Level	0 dBA at 23 ft/7 m	**Rejection To Exhaust**	179,063 BTU/min
Max Combustion Inlet Air Temp	32.0 F	**Exhaust Recoverable**	101,475 BTU/min
Combustion Airflow	9,773.3 cfm	**Exhaust Stack Temperature**	892 F
Cooling System Ambient Capability	109.4 F	**Exhaust Flow Rate**	25,622.8 cfm
Cooling System Airflow **	112,583 cfm		
Engine Performance Number	DM8448		

Alternator Technical Data

Alternator Arrangement Number	3723068			**Insulation**	H	
Alternator Type / Frame Size	SR5 / 1868			**Temperature Rise**	125 C	
Alternator Winding Pitch	0.6667			**Rejection To Atmosphere**	6,557.0 BTU/min	
Number Of Poles	4			**Peak Amps / Rated Amps**	**** / 4,510.5	
Excitation / Winding Type	PM / FORM			**Short Circuit Ratio**	0.4700	
Reactances		**per unit**	**ohms**	**Generator Time Constants**		**sec**
Subtransient - Direct Axis	X"d	0.1270	0.0078	**Open Circuit Transient - Direct Axis**	T'd0	5.5950
Subtransient - Quadrature Axis	X"q	0.1237	0.0076	**Short Circuit Transient - Quadrature Axis**	T'd	0.3618
Transient - Saturated	X'd	0.1855	0.0114	**Open Circuit Subtransient - Direct Axis**	T"d0	0.0087
Synchronous - Direct Axis	Xd	2.8630	0.1759	**Short Circuit Subtransient - Direct Axis**	T"d	0.0073
Synchronous - Quadrature Axis	Xq	1.2744	0.0783	**Open Circuit Subtransient - Quadrature Axis**	T"q0	0.0080
Negative Sequence	X2	0.1628	0.0100	**Short Circuit Subtransient - Quadtrature Axis**	T"q	0.0068
Zero Sequence	X0	0.0456	0.0028	**Armature Short Circuit**	TA	0.0463

Notes:

* Block Load (only) Transient Response values are at factory conditions. Genset block load capabilities at site conditions may vary from factory transient response test results due to a variance in site altitude or ambient conditions.

** Based on 1/2 inch water (0.12 kPa) external restriction and 1000 ft (300m) altitude.

*** Based on instantaneous voltage dip as defined per NEMA MG-1.

**** See your Caterpillar dealer and/or Spec Sheet for technical information.

***** Package Power Tolerance: +/- 5%

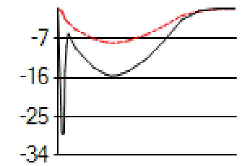
Overall dimensions and weight not to be used for installation. Contact your Caterpillar dealer for specific dimension drawings.

CATERPILLAR

Project Load Report

Modified Date	12-Jul-2019	**Rating Type**	Standby	**Max Ambient Temperature**	77 Deg. F
Customer Name	Tijuana Diversion System	**Fuel**	Diesel	**Altitude**	500.0 Ft. A.S.L
Project Name/Ref #	PB1A - Backup Gen-Optimized	**Electricity Supply**	60 Hz 480/277 V		
Prepared By	Joel Mora				

Load Details			**Permitted Dip**		**Predicted Dip**		**Load Analysis**										
Load Step		Load Description	Frequency	Voltage	Frequency	Voltage	Transient Inrush		Running		Resultant Peak		Cumulative Running		Fdip:	Vdip 1:	Vdip 2:
							SkVA	SkW	kVA	kW	SkVA	SkW	kVA	kW			
Step 1			**Step Passed**														
															7.9%	29.1%	15.6%
1.1	1	500.00 kVA - Transformer 1 Steady State Magnetization, 98% Efficiency, 480V Secondary Voltage	-	-			0.0	0.0	25.0	2.5							
1.2	1	700.00 HP - Pump 1 NEMA, Centrifugal Pump, Across the line, Loaded, Single Operating Point	30%	30%			3,975.0	795.0	604.2	543.7							
1.3	1	700.00 HP - pump 2 NEMA, Centrifugal Pump, Across the line, Loaded, Single Operating Point	30%	30%			3,975.0	795.0	604.2	543.7							
1.4	6	25.00 HP - Load 4 NEMA, 3-Phase Motor, Across the line, Loaded, Single Operating Point	30%	30%			795.0	341.9	146.2	124.3							
		Step 1 Total	**30%**	**30%**	**7.9%**	**29.1%**	**8,723.7**	**1,931.8**	**1,367.3**	**1,214.3**							
		Total Through Step 1									**8,723.7**	**1,931.8**	**1,367.3**	**1,214.3**			



Load Analysis Summary

Maximum Step		Maximum Peak		Final Running	
SkVA	SkW	SkVA	SkW	kVA	kW
8,723.7	1,931.8	8,723.7	1,931.8	1,367.3	1,214.3

Transient Performance Report

Price List:
U.S.

Modified Date	12-Jul-2019	**Electricity Supply**	60 Hz 480/277 V	**Rating Type**	Standby
Customer Name	Tijuana Diversion System	**Fuel**	Diesel		
Project Name/Ref #	PB1A - Backup Gen-Optimized	**Max. Ambient Temperature**	77.0 F		
Prepared By	Joel Mora	**Altitude**	500.0 Ft. A.S.L		

Load Scenario

Step 1

Voltage Dip

Permitted-30.0%

Predicted - 29.1%

Synchronous (Vdip 1) - 29.1%

Frequency-induced (Vdip 2) - 15.6%

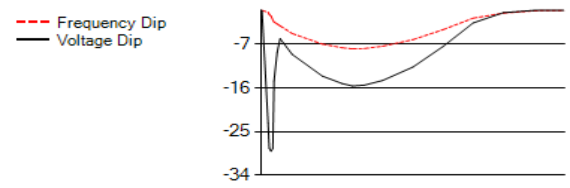
Step 1

Frequency Dip

Permitted-30.0%

Predicted - 7.9%

Step 1



Fdip:	Vdip 1:	Vdip 2:
7.9%	29.1%	15.6%

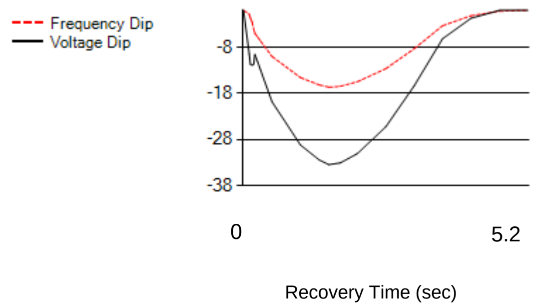
Selected Generator Set

3,000.0 EkW / 3,750.0 kVA 60 Hz Standby, 480/277V, C175-16 SCAC EPA ESE, 1868 PM SR5 FORM, CDVR 2:1 slope

Block Load (only) Transient Response *

Load Change %	FDip %	VDip %	Recovery Time (sec)
0 - 25	2.6	4.6	< 3
0 - 50	5.7	11.0	< 3
0 - 75	10.9	21.6	3.5
0 - 100	16.6	33.4	5.2

0 - 100 Load Change %



Transient Performance

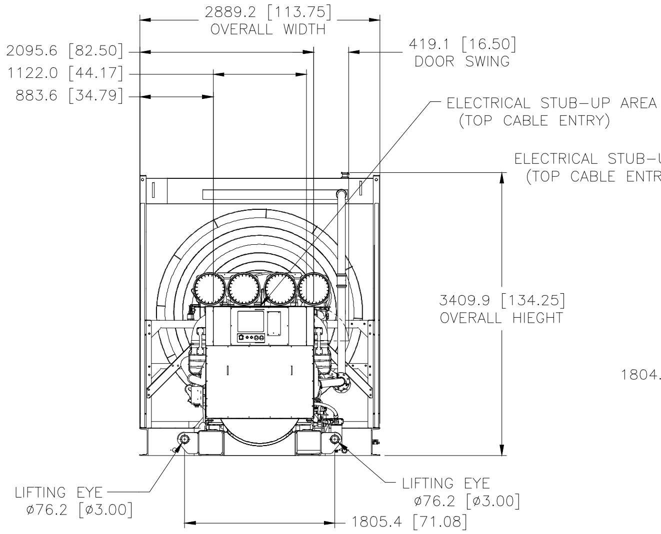
The selected representative generator set was factory tested in accordance to NFPA 110 block load step capability and acceptable frequency and voltage response on load addition and rejection.

* Block Load (only) Transient Response values are at factory conditions. Genset block load capabilities at site conditions may vary from factory transient response test results due to a variance in site altitude or ambient conditions.

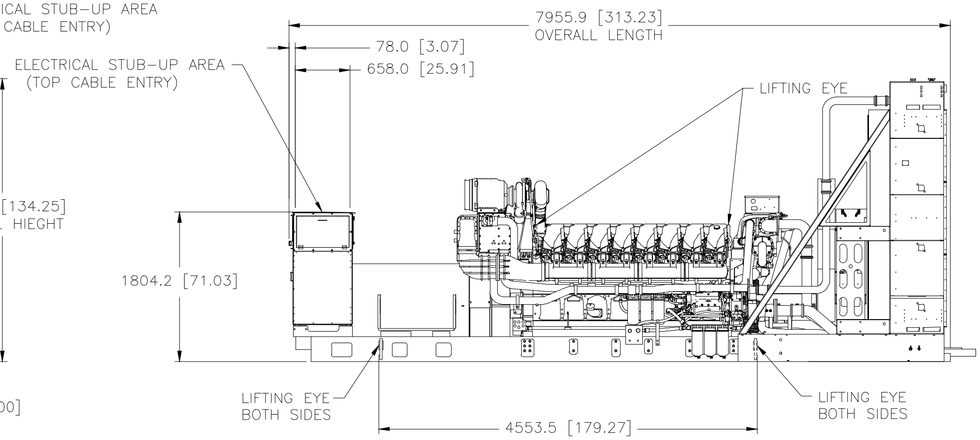
Note: This information is representative of a typical Caterpillar GenSet, but is not guaranteed. This estimate has tolerances, and there are also GenSet-to-GenSet variations.

METRIC 574-6096

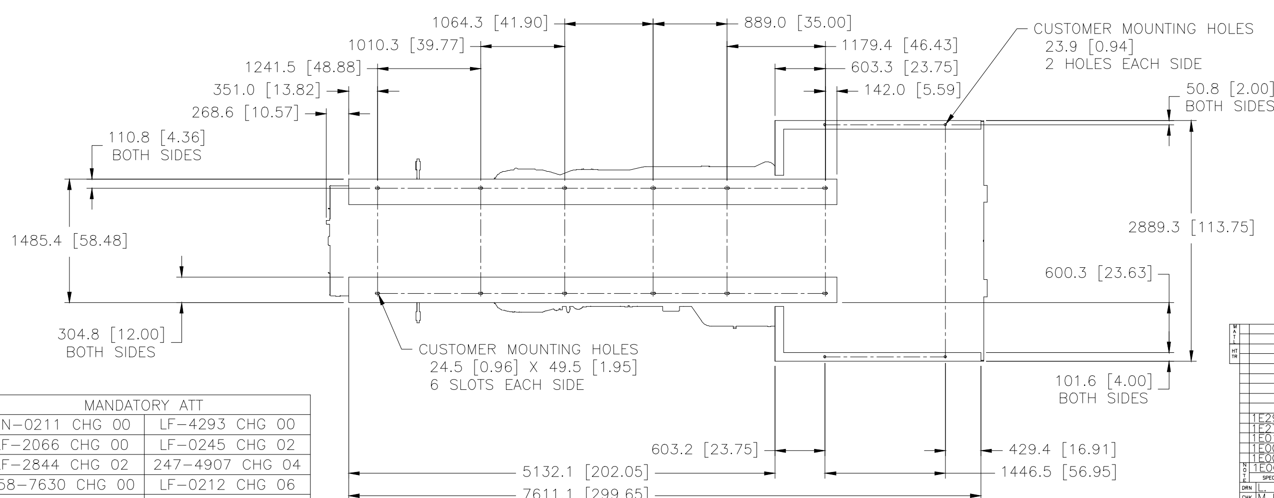
QTY	CONNECTION	SIZE	SHEETS
1	FUEL INLET	1 7/16-12 THD	2,5
1	EXCESS FUEL RETURN	1 3/16-12 THD	2,5
1	EXHAUST	ø168.0 [ø6.61] OD	2,4,6
2	FUMES DISPOSAL HOSE	ø76.2 [ø3.00] ID	2,3,4
1	OIL DRAIN	ø15.9 [ø0.63] OD	4,6
1	OIL DRAIN	1 7/16-12 THD	2,5
2	COOLANT DRAIN	3/4-16 THD	2,5
1	WATER DRAIN	M27 X 2-6H	2,3



REAR VIEW



RIGHT SIDE VIEW



FOOTPRINT
(DIMENSIONED OUTLINE VIEW FROM ABOVE)
(RIGHT SIDE ORIENTATION)

MODEL	TYPE	PRICING AR	MANDATORY ATT	
C175-16	–	LF-4159 CHG 00	DN-0211 CHG 00	LF-4293 CHG 00
			LF-2066 CHG 00	LF-0245 CHG 02
			LF-2844 CHG 02	247-4907 CHG 04
		LF-4160 CHG 00	358-7630 CHG 00	LF-0212 CHG 06
			LF-2850 CHG 00	LF-0788 CHG 01
			LF-3359 CHG 00	LF-0093 CHG 09
		LF-4157 CHG 00	491-5899 CHG 01	LF-0242 CHG 02
			491-5896 CHG 02	366-0382 CHG 00
			491-5856 CHG 02	LF-4174 CHG 00
		LF-4158 CHG 00	375-2296 CHG 01	LF-0057 CHG 04
			311-7115 CHG 01	LF-2051 CHG 00
			247-6981 CHG 00	

PACKAGE LIFTED IN 4 PLACES ON THE RAIL
PACKAGR SHOWN MORE DETAIL ON FOLLOWING SHEETS

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

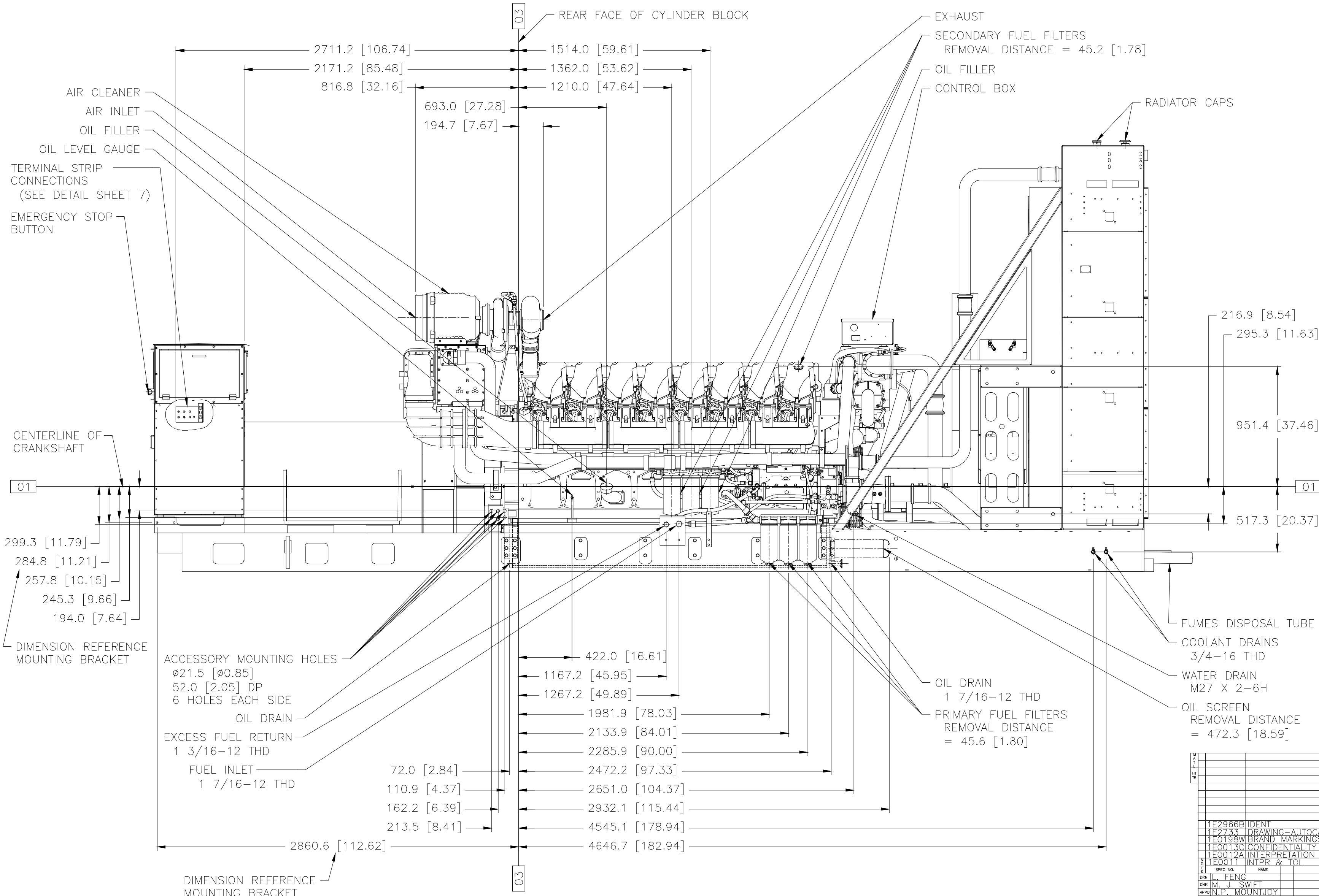
DRN L. FENG
CHK M.J. SWIFT
APPD N.P. MOUNTJOY
CON-CEPT | EXP | PRE PROD. | PROD.
RECORDS X
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC
SCALE 1 = 20
0 10mm 20 30
SHEET 1 OF 7
THIRD ANGLE PROJECTION
CHG 00 DATE 19NOV18

CATERPILLAR INC.

INSTALLATION-ENGINE
C175-16 LV/MV 60HZ

574-6096 VER - CONTROL DES SUB W982 E

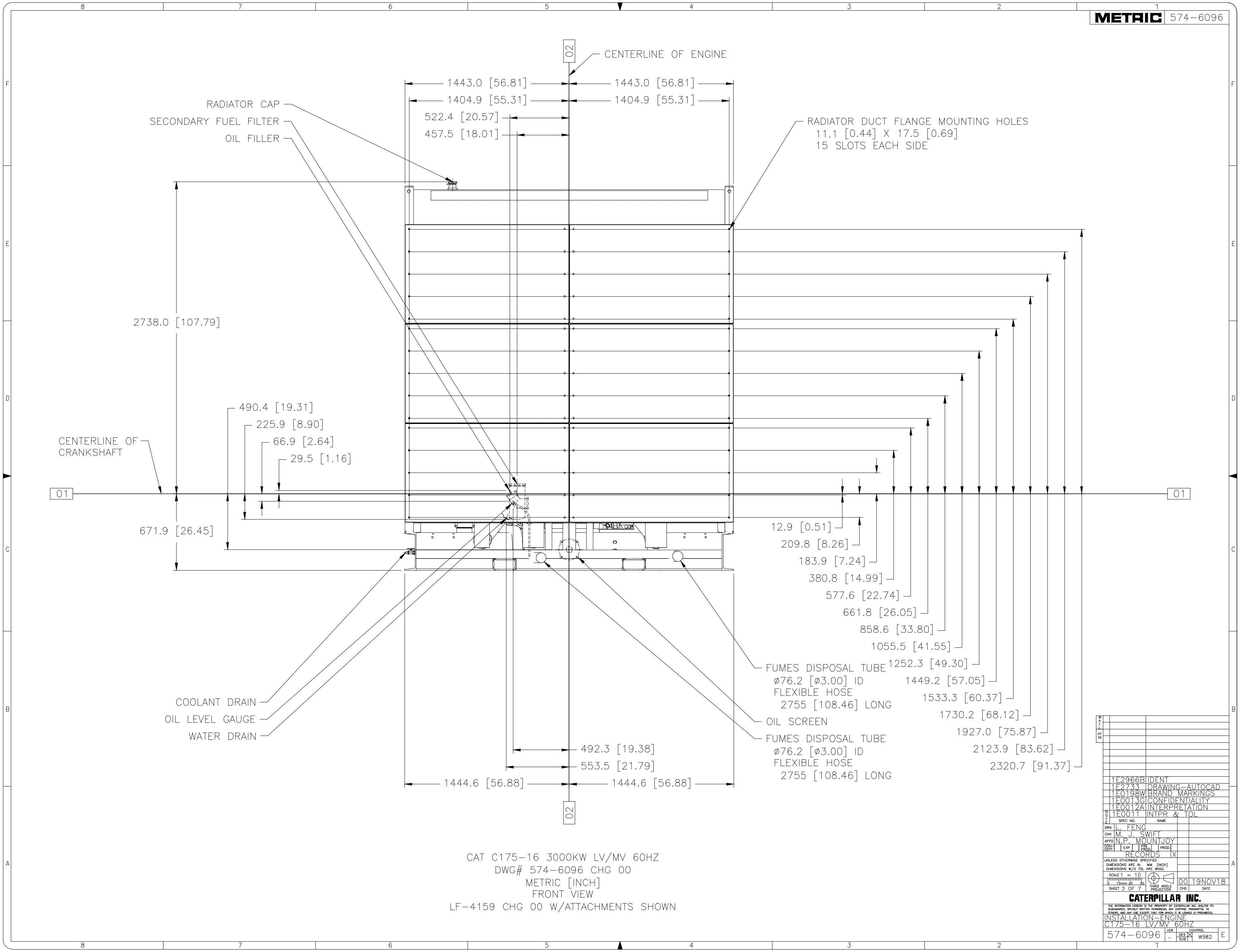
METRIC 574-6096



CAT C175-16 3000KW LV/MV 60HZ
DWG# 574-6096 CHG 00
METRIC [INCH]
RIGHT SIDE VIEW
LF-4159 CHG 00 W/ATTACHMENTS SHOWN

1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL
SPEC NO.	NAME

DRN L. FENG
CHK M. J. SWIFT
APPD N.P. MOUNTJOY
RECORDS X
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MM [INCH]
SCALE 1 = 10
SHEET 2 OF 7
THIRD ANGLE PROJECTION
00 19NOV18
CATERPILLAR INC.
INSTALLATION-ENGINE
C175-16 LV/MV 60HZ
574-6096 W982 E



METRIC 574-6096
CENTERLINE OF ENGINE
1443.0 [56.81]
1443.0 [56.81]
1404.9 [55.31]
1404.9 [55.31]
522.4 [20.57]
457.5 [18.01]
RADIATOR CAP
SECONDARY FUEL FILTER
OIL FILLER
RADIATOR DUCT FLANGE MOUNTING HOLES
11.1 [0.44] X 17.5 [0.69]
15 SLOTS EACH SIDE
2738.0 [107.79]
490.4 [19.31]
225.9 [8.90]
66.9 [2.64]
29.5 [1.16]
CENTERLINE OF CRANKSHAFT
01
671.9 [26.45]
12.9 [0.51]
209.8 [8.26]
183.9 [7.24]
380.8 [14.99]
577.6 [22.74]
661.8 [26.05]
858.6 [33.80]
1055.5 [41.55]
1252.3 [49.30]
1449.2 [57.05]
1533.3 [60.37]
1730.2 [68.12]
1927.0 [75.87]
2123.9 [83.62]
2320.7 [91.37]
FUMES DISPOSAL TUBE
ø76.2 [ø3.00] ID
FLEXIBLE HOSE
2755 [108.46] LONG
OIL SCREEN
FUMES DISPOSAL TUBE
ø76.2 [ø3.00] ID
FLEXIBLE HOSE
2755 [108.46] LONG
COOLANT DRAIN
OIL LEVEL GAUGE
WATER DRAIN
492.3 [19.38]
553.5 [21.79]
1444.6 [56.88]
1444.6 [56.88]
02
CAT C175-16 3000KW LV/MV 60HZ
DWG# 574-6096 CHG 00
METRIC [INCH]
FRONT VIEW
LF-4159 CHG 00 W/ATTACHMENTS SHOWN
1E2966B IDENT
1E2733 DRAWING-AUTOCAD
1E0198W BRAND MARKINGS
1E0013G CONFIDENTIALITY
1E0012A INTERPRETATION
1E0011 INTPR & TOL
SPEC NO. NAME
DRN L. FENG
CHK M. J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT EXP PRE PROD. PROD.
RECORDS X
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC
SCALE 1 = 10
SHEET 3 OF 7
THIRD ANGLE PROJECTION
00 19NOV18
CHG DATE
CATERPILLAR INC.
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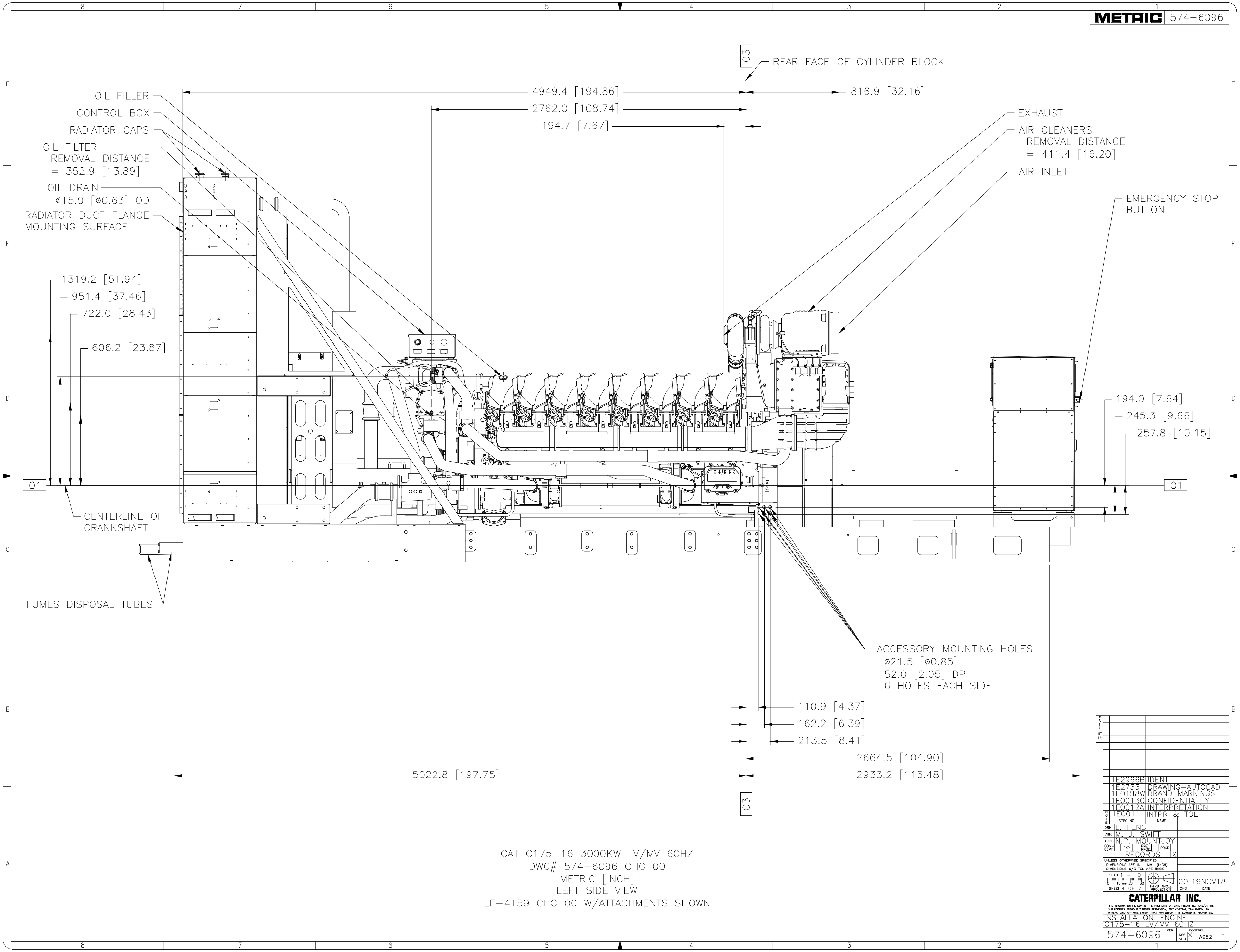
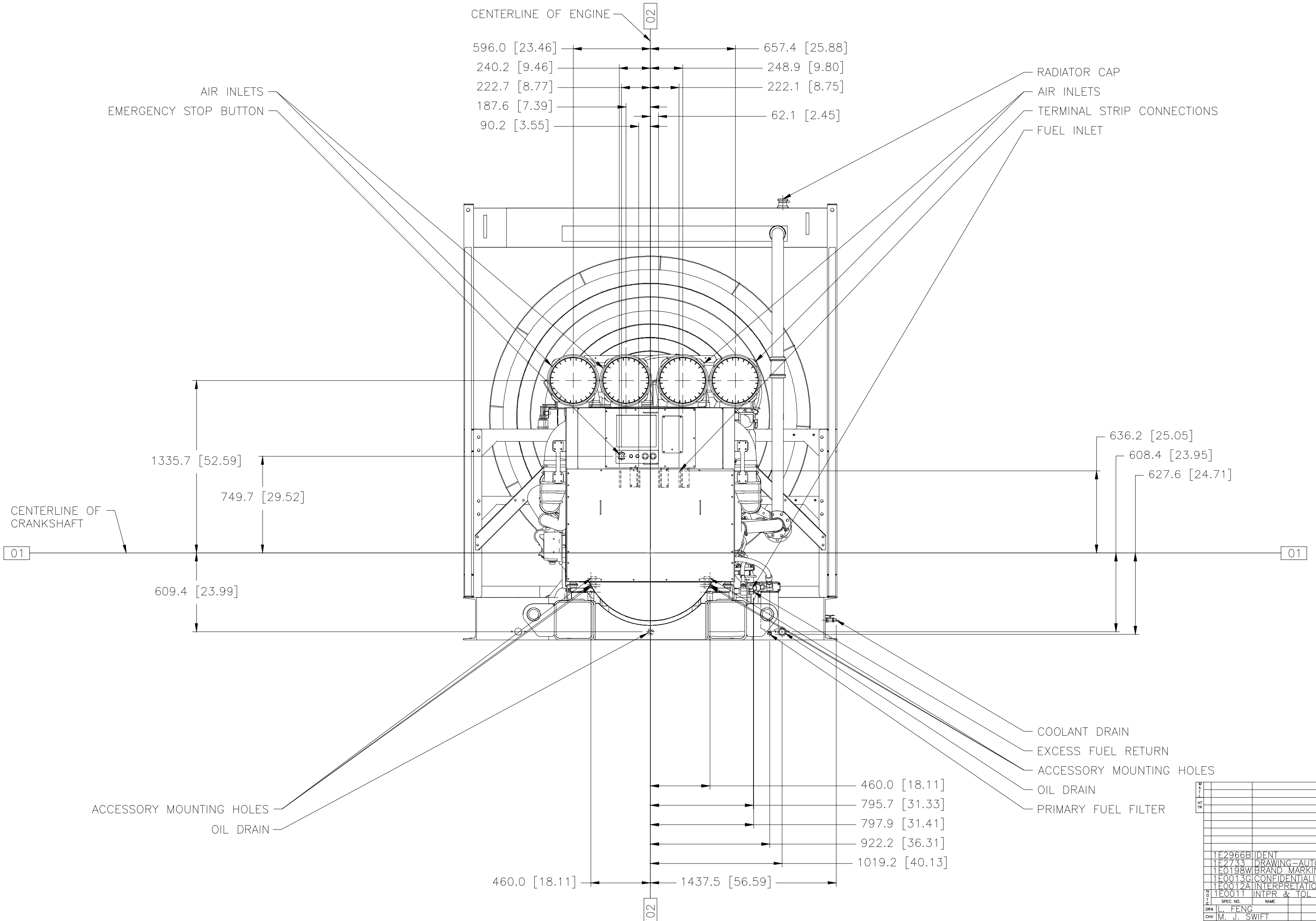
INSTALLATION-ENGINE
C175-16 LV/MV 60HZ
574-6096
VER CONTROL DES SUB W982 E



METRIC 574-6096
REAR FACE OF CYLINDER BLOCK
4949.4 [194.86]
2762.0 [108.74]
194.7 [7.67]
816.9 [32.16]
OIL FILLER
CONTROL BOX
RADIATOR CAPS
OIL FILTER
REMOVAL DISTANCE
= 352.9 [13.89]
OIL DRAIN
ø15.9 [ø0.63] OD
RADIATOR DUCT FLANGE
MOUNTING SURFACE
EXHAUST
AIR CLEANERS
REMOVAL DISTANCE
= 411.4 [16.20]
AIR INLET
EMERGENCY STOP
BUTTON
1319.2 [51.94]
951.4 [37.46]
722.0 [28.43]
606.2 [23.87]
194.0 [7.64]
245.3 [9.66]
257.8 [10.15]
01
03
CENTERLINE OF
CRANKSHAFT
FUMES DISPOSAL TUBES
ACCESSORY MOUNTING HOLES
ø21.5 [ø0.85]
52.0 [2.05] DP
6 HOLES EACH SIDE
110.9 [4.37]
162.2 [6.39]
213.5 [8.41]
2664.5 [104.90]
5022.8 [197.75]
2933.2 [115.48]
CAT C175-16 3000KW LV/MV 60HZ
DWG# 574-6096 CHG 00
METRIC [INCH]
LEFT SIDE VIEW
LF-4159 CHG 00 W/ATTACHMENTS SHOWN
1E2966B IDENT
1E2733 DRAWING-AUTOCAD
1E0198W BRAND MARKINGS
1E0013G CONFIDENTIALITY
1E0012A INTERPRETATION
1E0011 INTPR & TOL
DRN L. FENG
CHK M. J. SWIFT
APPD N.P. MOUNTJOY
RECORDS
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
SCALE 1 = 10
SHEET 4 OF 7
00 19NOV18
CATERPILLAR INC.
INSTALLATION-ENGINE
C175-16 LV/MV 60HZ
574-6096
W982
E

METRIC 574-6096



CAT C175-16 3000KW LV/MV 60HZ
DWG# 574-6096 CHG 00
METRIC [INCH]
REAR VIEW
LF-4159 CHG 00 W/ATTACHMENTS SHOWN

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN L. FENG
CHK M. J. SWIFT
APPD N.P. MOUNTJOY
CON-CEPT | EXP | PRE PROD. | PROD.
RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

SCALE 1 = 10
SHEET 5 OF 7
THIRD ANGLE PROJECTION

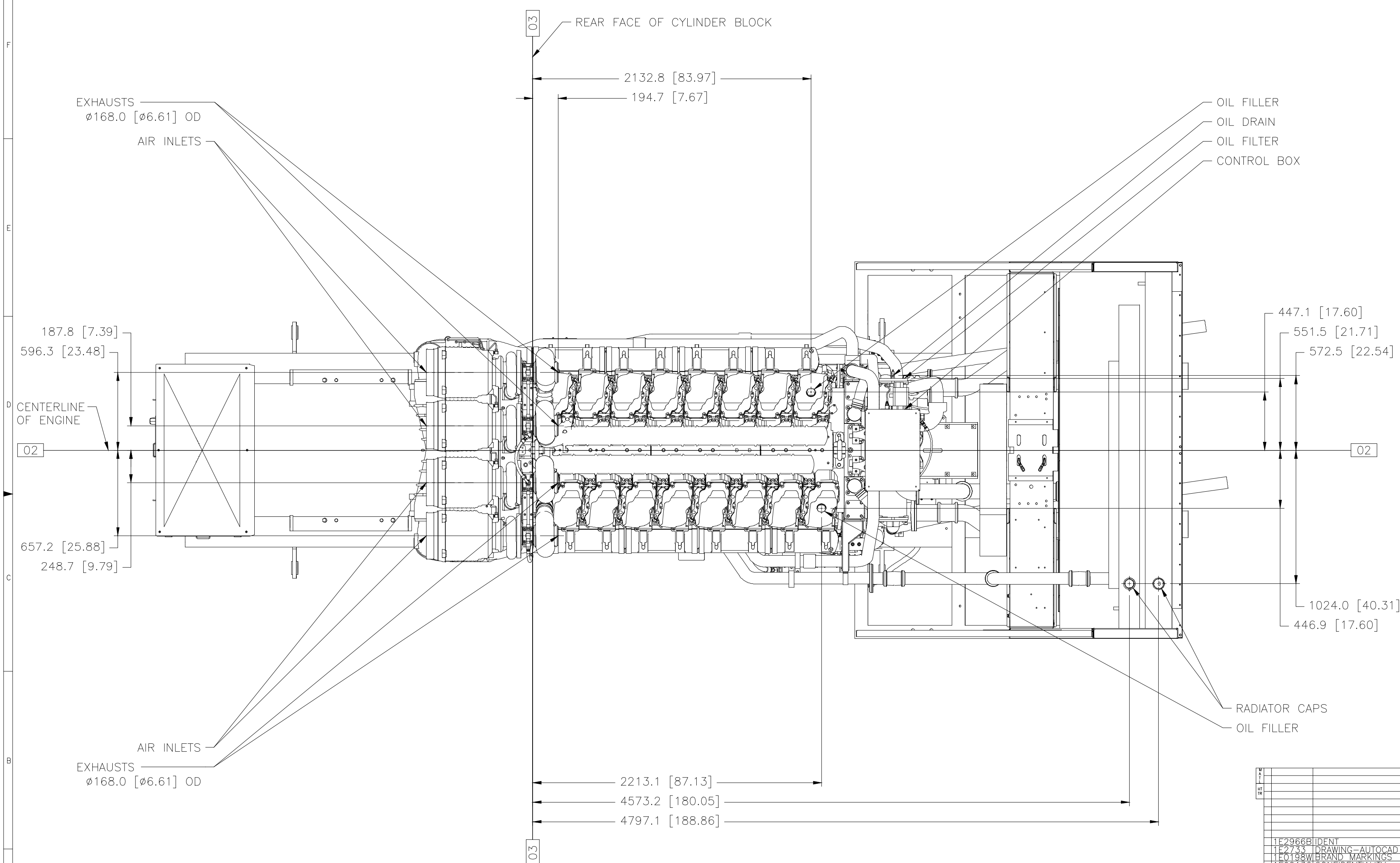
CHG 00 DATE 19NOV18

CATERPILLAR INC.

INSTALLATION-ENGINE
C175-16 LV/MV 60HZ

574-6096 VER - CONTROL DES SUB W982 E

METRIC 574-6096



CAT C175-16 3000KW LV/MV 60HZ
DWG# 574-6096 CHG 00
METRIC [INCH]
TOP VIEW
LF-4159 CHG 00 W/ATTACHMENTS SHOWN

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN L. FENG
CHK M. J. SWIFT
APPD N.P. MOUNTJOY
CON-CEPT | EXP | PRE PROD. | PROD.
RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

SCALE 1 = 10
SHEET 6 OF 7
THIRD ANGLE PROJECTION

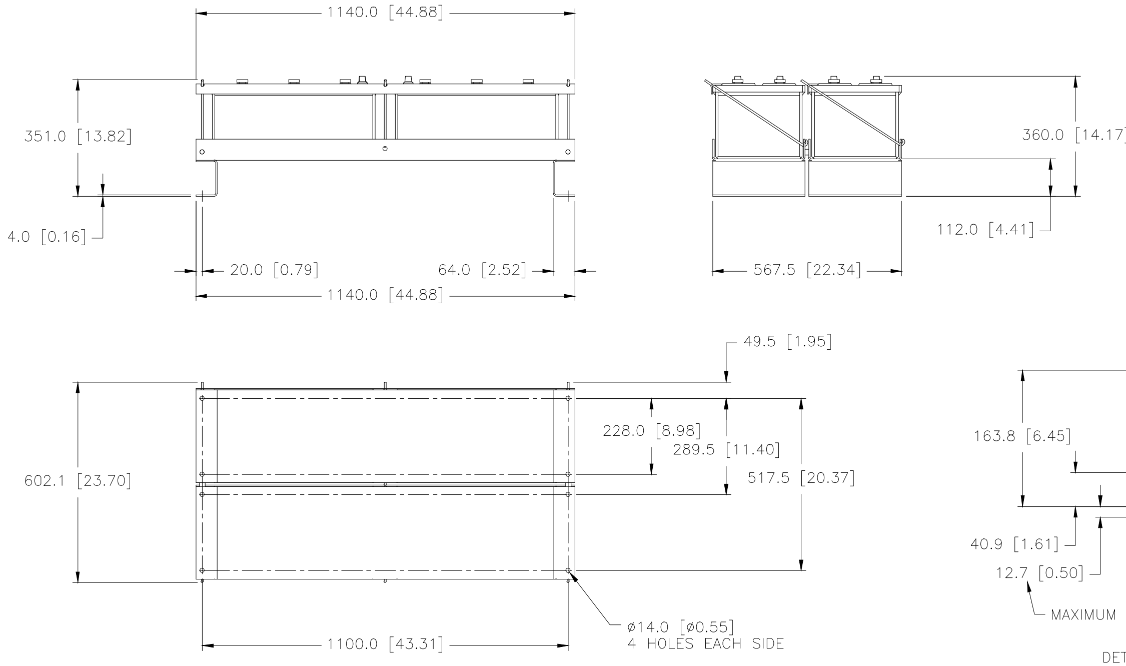
CHG	DATE
00	19NOV18

CATERPILLAR INC.

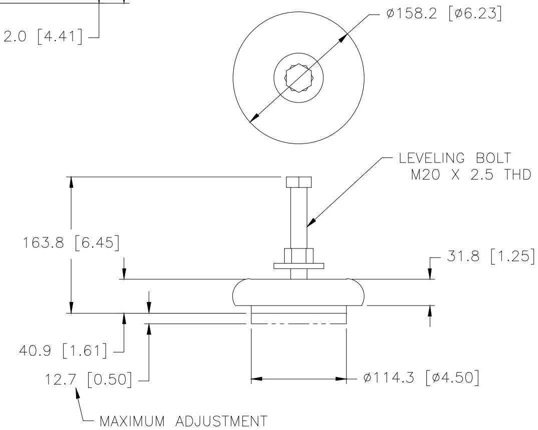
INSTALLATION-ENGINE
C175-16 LV/MV 60HZ

574-6096 | VER - | CONTROL DES W982 | E

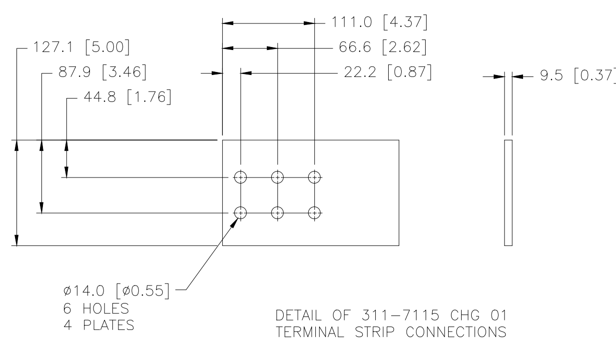
METRIC 574-6096



DETAIL OF BATTERY GP
LF-2051 CHG 00
(SHIPPED LOOSE)
SCALE 1=5



DETAIL OF MOUNTING GROUP ISOLATOR
247-6981 CHG 00
(SHIPPED LOOSE)
SCALE 1=2



DETAIL OF 311-7115 CHG 01
TERMINAL STRIP CONNECTIONS
(T0, T1, T2, T3)
SCALE 1=2

SPEC NO.	NAME
1E2966B	IDENT
1E2733	DRAWING-AUTOCAD
1E0198W	BRAND MARKINGS
1E0013G	CONFIDENTIALITY
1E0012A	INTERPRETATION
1E0011	INTPR & TOL

DRN L. FENG
CHK M. J. SWIFT
APPD N.P. MOUNTJOY
CONCEPT | EXP | PRE PROD. | PROD.
RECORDS X

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN MM [INCH]
DIMENSIONS W/O TOL ARE BASIC

SCALE 1 = 10
0 10mm 20 30
SHEET 7 OF 7
THIRD ANGLE PROJECTION

CHG	DATE
00	19NOV18

CATERPILLAR INC.

INSTALLATION-ENGINE
C175-16 LV/MV 60HZ

574-6096 VER - CONTROL DES SUB W982 E

APPENDIX I

Study Level Capital and O&M costs sheets for all alternatives

Alternative 1a. No Action (baseline): Historical diversions of Tijuana River flows, November 2009 - March 2016

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 13,972.74		$ 13,973
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 13,815.79		$ 82,895
	Piping and Valve Maintenance	LS	6	$ 6,782.30		$ 40,694
	Miscellaneous	LS	1	$ 28,940.32		$ 28,940
						$ 710,800
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 43,062.20		$ 172,249
	Piping and Valve Maintenance	LS	4	$ 9,689.00		$ 38,756
	Miscellaneous	LS	1	$ 40,221.98		$ 40,222
						$ 1,002,915
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 43,062.20		$ 172,249
	Piping and Valve Maintenance	LS	4	$ 9,689.00		$ 38,756
	Miscellaneous	LS	1	$ 39,459.86		$ 39,460
						$ 986,911
GRAND TOTAL ANNUAL O&M COSTS						**$ 2,700,000**

ROUNDED TOTAL CONSTRUCTION COST	
PRESENT WORTH OF O&M	
NET PRESENT VALUE	
ANNUALIZED O&M COST	**$ 2,700,000**

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK
SOLTA-C-18-001

Alternative 2a - Optimize Existing Facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps

PROJECT: **Tijuana River Diversion**
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**

UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[TJ Diversion Tech Alts Table (100%).xlsx]top six Alts

PAY ITEM	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		1	EA	$4,785.23	10%	$478.52	$5,263.75
	2	Frames and covers 30" to 36" wide frame		1	EA	$870.00	10%	$87.00	$957.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		2	EA	$1,500.00	10%	$300.00	$3,300.00
		River Cross Sectional Weir - PBCILA Intake							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$148.00	10%	$2,220.00	$24,420.00
	5	Steel rebar # 4		3,000	LB	$1.25	10%	$375.00	$4,125.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		New Concrete Riser - PBCILA Intake							
	7	Concrete, ready mix delivered, 4,500 to 6,000 psi		35	CY	$170.00	10%	$595.00	$6,545.00
	8	Steel rebar # 4		1,000	LB	$1.25	10%	$125.00	$1,375.00
	9	Multi-Rake Bar Screen (Coarse)		5	EA	$1,500.00	10%	$750.00	$8,250.00
		Earthwork							
	10	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	10%	$4,500.00	$49,500.00
		PBCILA							
	11	Replace pumps 2,3,4,5 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		4	EA	$ 205,000.00	10%	$82,000.00	$902,000.00
	12	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		4	EA	$ 189,625.91	10%	$75,850.36	$834,353.99
	13	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
	14	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	15	24" Check Valve: Includes stem, accessories, complete in place		4	EA	$ 57,000.00	10%	$22,800.00	$250,800.00
	16	24" Plug Valve: ductile iron, includes bolts, gaskets, restrained joints, other parts. Complete in place		4	EA	$ 60,000.00	10%	$24,000.00	$264,000.00
	17	Concrete, ready mix delivered, 4,500 to 6,000 psi		250	CY	$148.00	10%	$3,700.00	$40,700.00
	18	24" Ductile Iron Piping: lining for WW, furnish and install		500	LF	$285.00	10%	$14,250.00	$156,750.00
	19	Demolish pumps 2,3,4,5		1	EA	$57,000.00	10%	$5,700.00	$62,700.00
		Hoist System							
	19	W12 x 72 steel beam. Material only		180	LF	$125.00	10%	$2,250.00	$24,750.00
	20	W10 x 49 steel beam. Material only		600	LF	$90.00	10%	$5,400.00	$59,400.00
	21	2 ton Hoist		1	EA	$5,000.00	10%	$500.00	$5,500.00
	22	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	23	Electrical Controls and Istrumentation		1	LS	$69,863.20	10%	$6,986.32	$76,849.52
		Electrical							
	24	350 kVA demolition		1	EA	$1,749.00	10%	$174.90	$1,923.90
	25	Isolating Transformer, 300 kVA		1	EA	$31,800.00	10%	$3,180.00	$34,980.00
	25	Loop-Feed Switch		1	EA	$6,727.50	10%	$672.75	$7,400.25
	26	Electrical Conduit replacement		2	EA	$16,966.67	10%	$3,393.33	$37,326.67
	27	Incoming Switchboards, 600 amp		1	LS	$20,013.25	10%	$2,001.33	$22,014.58
	28	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
		Earthwork							
	29	Trench cut, fill, compaction, and haul away excess		3,000	CY	$18.00	10%	$5,400.00	$59,400.00
		Process Intigration							
	30	SCADA and Telemetry System		1	LS	$231,776.36	10%	$23,177.64	$254,954.00
		PB1A							
	31	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$360,000.00	10%	$144,000.00	$1,584,000.00
	32	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		4	EA	$ 189,625.91	10%	$75,850.36	$834,353.99
	33	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	34	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	35	24" Check valve		4	EA	$57,000.00	10%	$22,800.00	$250,800.00
	36	24" Globe Valve		4	EA	$45,900.00	10%	$18,360.00	$201,960.00
	37	24" Ductile Iron Piping: lining for WW, furnish and install		640	LF	$285.00	10%	$18,240.00	$200,640.00
	38	Demolish pumps (4)		1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork							
	39	Trench cut, fill, compaction, and haul away excess		3,500	CY	$18.00	10%	$6,300.00	$69,300.00
		Hoist System							
	40	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	41	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	42	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	43	5 Ton Hoist		1	EA	$6,750.00	10%	$675.00	$7,425.00
	44	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	10%	$4,500.00	$49,500.00
	45	Electrical Controls and Istrumentation		1	LS	$67,993.20	10%	$6,799.32	$74,792.52
		Electrical							

PAY ITEM	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	46	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$34,800.00	10%	$3,480.00	$38,280.00
	47	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	48	Electrical Conduit replacement		1	LS	$18,165.58	10%	$1,816.56	$19,982.13
	49	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	50	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
		Process Intigration							
	51	SCADA and Telemetry System		1	LS	$273,770.25	10%	$27,377.02	$301,147.27
		PB1B							
	52	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	53	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$360,000.00	10%	$144,000.00	$1,584,000.00
	54	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	55	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	56	24" Check valve		4	EA	$57,000.00	10%	$22,800.00	$250,800.00
	57	24" Globe Valve		4	EA	$45,900.00	10%	$18,360.00	$201,960.00
	58	24" Ductile Iron Piping: lining for WW, furnish and install		640	LF	$285.00	10%	$18,240.00	$200,640.00
	59	Demolish pumps (4)		1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork							
	60	Trench cut, fill, compaction, and haul away excess		4,000	CY	$18.00	10%	$7,200.00	$79,200.00
		Hoist System							
	61	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	62	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	63	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$23.90	10%	$573.60	$6,309.60
	64	5 Ton Hoist		1	EA	$9,112.50	10%	$911.25	$10,023.75
	65	Trench cut, fill, compaction, and haul away excess		6,000	CY	$18.00	10%	$10,800.00	$118,800.00
		Electrical							
	67	New Transformer, liquid filled Pad mounted, 500 KVA		2	EA	$34,800.00	10%	$6,960.00	$76,560.00
	68	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	69	Isolating Transformer, 300 kVA		2	EA	$31,800.00	10%	$6,360.00	$69,960.00
	70	Electrical Conduit replacement		1	LS	$35,573.74	10%	$3,557.37	$39,131.11
	71	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
		Process Intigration							
	72	SCADA and Telemetry System		1		$304,937.68	10%	$30,493.77	$335,431.45
		ROUNDED SUBTOTAL THIS SHEET							**$10,900,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				3.00%			$320,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				4.00%			$440,000.00
		Construction Phase Services				5.00%			$550,000.00
		Construction Contingecy				30.00%			$3,600,000.00
		General Contractor OH&P				5.00%			$580,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$16,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 2a - Optimize Existing Facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps

Study Level Opinion of Probable Annual Operation and Maintenance Costs							
Item No.	Item Description	Unit	Quantity	Unit Cost			TOTAL COST
PBCILA							
	Personnel Labor	LS	1	$ 64,100.00		$	64,100
	Intake Maintenance	LS	1	$ 16,206.35		$	16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$	99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$	76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$	381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$	75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$	37,679
	Miscellaneous	LS	1	$ 32,774.68		$	32,775
						$	**782,500**
PB1A							
	Personnel Labor	LS	1	$ 126,750.00		$	126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$	167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$	144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$	457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$	143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$	35,885
	Miscellaneous	LS	1	$ 47,067.38		$	47,067
						$	**1,122,984**
PB1B							
	Personnel Labor	LS	1	$ 126,750.00		$	126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$	152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$	152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$	457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$	143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$	35,885
	Miscellaneous	LS	1	$ 46,686.32		$	46,686
						$	**1,114,982**
GRAND TOTAL ANNUAL O&M COSTS						**$**	**3,020,467**
			ROUNDED TOTAL CONSTRUCTION COST			**$**	**16,000,000**
			PRESENT WORTH OF O&M			**$**	**49,916,000**
			NET PRESENT VALUE			**$**	**65,915,800**
			ANNUALIZED O&M COST			**$**	**4,350,000**

Alternative 2a - Optimize Existing Facilities: Diversion of all Tijuana River flows up to 1,000 lps, no diversion when flow exceeds 1,000 lps

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 2a	1		$16,000,000	$16,000,000	
	Total Anticipated Capital Costs:			$16,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
	Total Anticipated O&M Costs:			$3,020,467	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$2,743,726	

Net Present Value Total:	**$65,915,800**
O&M Present/Future Worth:	**$49,916,000**
Per Year O&M:	**$4,350,000**

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	Present /Future Worth (p/f)	Annual O&M Costs	Debt Service Payment on Capital Investment	Repair/ Replacement Costs	Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs
0	1.000000	$0		$0	$0
1	0.943396	$3,126,183	$1,394,953	$0	$4,265,222
2	0.889996	$3,235,599	$1,394,953	$0	$4,121,175
3	0.839619	$3,348,845	$1,394,953	$0	$3,982,984
4	0.792094	$3,466,055	$1,394,953	$0	$3,850,373
5	0.747258	$3,587,367	$1,394,953	$685,932	$4,235,647
6	0.704961	$3,712,925	$1,394,953	$0	$3,600,852
7	0.665057	$3,842,877	$1,394,953	$0	$3,483,456
8	0.627412	$3,977,378	$1,394,953	$0	$3,370,667
9	0.591898	$4,116,586	$1,394,953	$0	$3,262,271
10	0.558395	$4,260,666	$1,394,953	$2,743,726	$4,690,151
11	0.526788	$4,409,790	$1,394,953	$0	$3,057,866
12	0.496969	$4,564,132	$1,394,953	$0	$2,961,483
13	0.468839	$4,723,877	$1,394,953	$0	$2,868,746
14	0.442301	$4,889,213	$1,394,953	$0	$2,779,493
15	0.417265	$5,060,335	$1,394,953	$685,932	$2,979,781
16	0.393646	$5,237,447	$1,394,953	$0	$2,610,820
17	0.371364	$5,420,758	$1,394,953	$0	$2,531,112
18	0.350344	$5,610,484	$1,394,953	$342,966	$2,574,467
19	0.330513	$5,806,851	$1,394,953	$0	$2,380,290
20	0.311805	$6,010,091	$1,394,953	$0	$2,308,928
					$65,915,785

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE:	**PROJECT:** **Tijuana River Diversion**
PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK** **SOLTA-C-18-001**	**Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
	REGION: **R9** / **ESTIMATE LEVEL:** **PLANNING** / **UNIT PRICE LEVEL:** **February 2019**
Alternative 2b - Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 2a

PLANT ACCOUNT	PAY ITEM	DESCRIPTION		QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$4,785.23	10%	$957.05	$10,527.51
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	10%	$174.00	$1,914.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		2	EA	$1,500.00	10%	$300.00	$3,300.00
	4	Multi-Rake Bar Screen (Coarse)		2	EA	$243,000.00	10%	$48,600.00	$534,600.00
	5	Concrete, ready mix delivered, 4,500 to 6,000 psi		500	CY	$100.00	10%	$5,000.00	$55,000.00
		River Cross Sectional Weir - PBCILA Intake							
	6	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$100.00	10%	$1,500.00	$16,500.00
	7	Steel rebar # 4		3,000	LB	$0.59	10%	$177.69	$1,954.62
	8	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		2,000	CY	$12.56	10%	$2,512.00	$27,632.00
		PBCILA							
	10	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	10%	$18,000.00	$198,000.00
	11	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	10%	$22,000.00	$242,000.00
	12	Replace pumps 2,3,4,5 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		6	EA	$ 205,000.00	10%	$123,000.00	$1,353,000.00
	13	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		6	EA	$189,625.91	10%	$113,775.54	$1,251,530.99
	14	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
	15	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$1,225.00	10%	$735.00	$8,085.00
	16	24" Check Valve: Includes stem, accessories, complete in place		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	17	24" Globe Valve		6	EA.	$45,900.00	10%	$27,540.00	$302,940.00
	18	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$100.00	10%	$3,500.00	$38,500.00
	19	24" Ductile Iron Piping: lining for WW, furnish and install		720	LF	$85.89	10%	$6,184.32	$68,027.49
	20	Demolish pumps 2,3,4,5		1	EA	$57,000.00	10%	$5,700.00	$62,700.00
		Wet Well Modifications							
	21	Pump Station Wet well, cast in place, complete in place		1	LS	$229,500.00	10%	$22,950.00	$252,450.00
		Hoist System							
	22	W12 x 72 steel beam. Material only		180	LF	$41.76	10%	$751.68	$8,268.48
	23	W10 x 49 steel beam. Material only		600	LF	$25.30	10%	$1,518.00	$16,698.00
	24	2 ton Hoist		1	EA	$5,000.00	10%	$500.00	$5,500.00
	25	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	26	Electrical Controls and Istrumentation		1	LS	$46,189.79	10%	$4,618.98	$50,808.77
		Electrical							
	27	350 kVA demolition		1	EA	$1,749.00	10%	$174.90	$1,923.90
	28	Isolating Transformer, 300 kVA		1	EA	$18,000.00	10%	$1,800.00	$19,800.00
	28	Loop-Feed Switch		1	EA	$6,727.50	10%	$672.75	$7,400.25
	29	Electrical Conduit replacement		2	EA	$16,966.67	10%	$3,393.33	$37,326.67
	30	Incoming Switchboards, 600 amp		1	LS	$16,563.25	10%	$1,656.33	$18,219.58
	31	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
	32	Diesel Power Generator Set : 60 Hz-350 kVA, includes enclosure, switch, battery, charger, muffler, complete in plac		1	EA	$160,000.00	10%	$16,000.00	$176,000.00
		Earthwork							
	33	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		Process Intigration							
	34	SCADA and Telemetry System		1	LS	$340,482.21	10%	$34,048.22	$374,530.43
		PB1A							
	35	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$360,000.00	10%	$144,000.00	$1,584,000.00
	36	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		4	EA	$ 189,625.91	10%	$75,850.36	$834,353.99
	37	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	38	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	39	24" Check valve		4	EA	$57,000.00	10%	$22,800.00	$250,800.00
	40	24" Globe Valve		4	EA	$45,900.00	10%	$18,360.00	$201,960.00
	41	24" Ductile Iron Piping: lining for WW, furnish and install		800	LF	$85.89	10%	$6,871.46	$75,586.10
	42	Demolish pumps (4)		1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork							
	43	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Influent Channel							
	44	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	45	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	46	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		Building						
	47	Demolish and replace with new structure	1,600	CY	$170.00	10%	$27,200.00	$368,016.00
		Hoist System						
	48	W12 x 72 steel beam. Material only	60	LF	$41.76	10%	$250.56	$2,756.16
	49	W10 x 49 steel beam. Material only	200	LF	$25.30	10%	$506.00	$5,566.00
	50	Weld steel structure to extend existing hoist. Includes labor and welding material.	240	LH	$322.00	10%	$7,728.00	$85,008.00
	51	5 Ton Hoist	1	EA	$6,750.00	10%	$675.00	$7,425.00
	52	Trench cut, fill, compaction, and haul away excess	2,500	CY	$12.56	10%	$3,140.00	$34,540.00
	53	Electrical Controls and Istrumentation	1	LS	$54,118.06	10%	$5,411.81	$59,529.87
		Electrical						
	54	New Transformer, liquid filled Pad mounted, 500 KVA	1	EA	$20,700.00	10%	$2,070.00	$22,770.00
	55	Transformer handling	1	EA	$3,500.00	10%	$350.00	$3,850.00
	56	Electrical Conduit replacement	1	LS	$14,640.58	10%	$1,464.06	$16,104.63
	57	Incoming Switchboards, 600 amp	3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	58	Electrical Improvements	1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	59	Diesel Power Generator Set : 60 Hz-1,330 kVA, includes enclosure, switch, battery, charger, muffler, complete in pl	1	EA	$353,968.36	10%	$35,396.84	$389,365.20
		Process Intigration						
	60	SCADA and Telemetry System	1	LS	$380,960.34	10%	$38,096.03	$419,056.37
		PB1B						
	61	Multi-Rake Bar Screen (Coarse)	2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	62	Multi-Rake Bar Screen (Fine)	2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	63	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump	4	EA	$360,000.00	10%	$144,000.00	$1,584,000.00
	64	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.	1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	65	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place	6	EA	$1,225.00	10%	$735.00	$8,085.00
	66	24" Check valve	5	EA	$57,000.00	10%	$28,500.00	$313,500.00
	67	24" Globe Valve	5	EA	$45,900.00	10%	$22,950.00	$252,450.00
	68	24" Ductile Iron Piping: lining for WW, furnish and install	800	LF	$85.89	10%	$6,871.46	$75,586.10
	69	Demolish pumps (4)	1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork						
	70	Trench cut, fill, compaction, and haul away excess	8,000	CY	$12.56	10%	$10,048.00	$110,528.00
		Influent Channel						
	71	Dredge and clean sediment from all influent concrete channels	1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	72	Scrubb and patch all concrete influent channel walls and invert	1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	73	Misellaneous Concrete Repair Work	2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Building						
	74	Demolish and replace with new structure	1,600	CY	$170.00	10%	$27,200.00	$418,880.00
		Hoist System						
	75	W12 x 72 steel beam. Material only	60	LF	$41.76	10%	$250.56	$2,756.16
	76	W10 x 49 steel beam. Material only	200	LF	$25.30	10%	$506.00	$5,566.00
	78	5 Ton Hoist	1	EA	$56.38	10%	$5.64	$62.01
	79	Trench cut, fill, compaction, and haul away excess	6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Electrical						
	80	New Transformer, liquid filled Pad mounted, 500 KVA	2	EA	$20,700.00	10%	$4,140.00	$45,540.00
	81	Transformer handling	1	EA	$3,500.00	10%	$350.00	$3,850.00
	82	Isolating Transformer, 300 kVA	2	EA	$18,000.00	10%	$3,600.00	$39,600.00
	83	Electrical Conduit replacement	1	LS	$12,012.50	10%	$1,201.25	$13,213.75
	84	Incoming Switchboards, 600 amp	3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	85	Diesel Power Generator Set : 60 Hz-1,330 kVA, includes enclosure, switch, battery, charger, muffler, complete in pl	1	EA	$353,968.36	10%	$35,396.84	$389,365.20
		Process Intigration						
	86	SCADA and Telemetry System	1		$392,662.98	10%	$39,266.30	$431,929.27
					ROUNDED SUBTOTAL THIS SHEET			**$15,400,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses			3.00%			$500,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)			5.00%			$800,000.00
		Construction Phase Services			5.00%			$800,000.00
		Contingecy			30.00%			$5,300,000.00
		General Contractor OH&P			10.00%			$1,700,000.00
					ROUNDED TOTAL CONSTRUCTION COST			**$24,500,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 2b. Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
PBCILA						
	Personnel Labor	LS	1	$ 64,040.00		$ 64,040
	Intake Maintenance	LS	1	$ 17,551.20		$ 17,551
	Vehicles usage and Maintenance	LS	1	$ 106,696.80		$ 106,697
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 419,166.00		$ 419,166
	Pump Equipment Maintenance	LS	6	$ 18,839.71		$ 113,038
	Piping and Valve Maintenance	LS	6	$ 6,782.30		$ 40,694
	Miscellaneous	LS	1	$ 35,464.40		$ 35,464
						$ 872,900
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 182,908.80		$ 182,909
	Electrical System & Equipment Maintenance	LS	1	$ 480,135.60		$ 480,136
	Pump Equipment Maintenance	LS	4	$ 46,650.72		$ 186,603
	Piping and Valve Maintenance	LS	4	$ 10,047.85		$ 40,191
	Structures Maintenance	LS	1	$ 38,030.98		$ 38,031
	Miscellaneous	LS	1	$ 52,609.52		$ 52,610
						$ 1,274,896
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 167,666.40		$ 167,666
	Electrical System & Equipment Maintenance	LS	1	$ 480,135.60		$ 480,136
	Pump Equipment Maintenance	LS	4	$ 46,650.72		$ 186,603
	Piping and Valve Maintenance	LS	4	$ 9,689.00		$ 38,756
	Structures Maintenance	LS	1	$ 37,445.93		$ 37,446
	Miscellaneous	LS	1	$ 51,800.20		$ 51,800
						$ 1,256,823
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,404,619**

ROUNDED TOTAL CONSTRUCTION COST	**$ 24,500,000**
PRESENT WORTH OF O&M	**$ 56,770,000**
TOTAL PRESENT WORTH	**$ 81,270,000**
ANNUALIZED O&M COST	**$ 4,950,000**

Alternative 2b. Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 2b. Optimize existing facilities with improvements: Allow diversions up to 1,300 lps and improve reliability	1		**$24,500,000.00**	$24,500,000	
	Total Anticipated Capital Costs:			$24,500,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$9,328	$3,404,619	
	Total Anticipated O&M Costs:			$3,404,619	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$3,658,302	

Net Present Value Total:	**$81,270,000**
O&M Present/Future Worth:	**$56,770,000**
Per Year O&M:	$4,950,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$3,523,781	$2,136,022	$0	$5,339,436
2	0.889996	$3,647,113	$2,136,022	$0	$5,146,969
3	0.839619	$3,774,762	$2,136,022	$0	$4,962,808
4	0.792094	$3,906,879	$2,136,022	$0	$4,786,543
5	0.747258	$4,043,619	$2,136,022	$914,575	$5,301,211
6	0.704961	$4,185,146	$2,136,022	$0	$4,456,174
7	0.665057	$4,331,626	$2,136,022	$0	$4,301,355
8	0.627412	$4,483,233	$2,136,022	$0	$4,153,002
9	0.591898	$4,640,146	$2,136,022	$0	$4,010,803
10	0.558395	$4,802,551	$2,136,022	$3,658,302	$5,917,239
11	0.526788	$4,970,641	$2,136,022	$0	$3,743,701
12	0.496969	$5,144,613	$2,136,022	$0	$3,618,252
13	0.468839	$5,324,674	$2,136,022	$0	$3,497,865
14	0.442301	$5,511,038	$2,136,022	$0	$3,382,302
15	0.417265	$5,703,924	$2,136,022	$914,575	$3,652,956
16	0.393646	$5,903,562	$2,136,022	$0	$3,164,752
17	0.371364	$6,110,186	$2,136,022	$0	$3,062,348
18	0.350344	$6,324,043	$2,136,022	$457,288	$3,124,139
19	0.330513	$6,545,384	$2,136,022	$0	$2,869,318
20	0.311805	$6,774,473	$2,136,022	$0	$2,778,334
					$81,269,509

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK
SOLTA-C-18-001

Alternative 2c - Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements

PROJECT: **Tijuana River Diversion**
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**
ESTIMATE LEVEL: **PLANNING**
UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 2c

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$4,785.23	10%	$957.05	$10,527.51
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	10%	$174.00	$1,914.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		2	EA	$1,500.00	10%	$300.00	$3,300.00
	4	Multi-Rake Bar Screen (Coarse)		2	EA	$243,000.00	10%	$48,600.00	$534,600.00
	5	Concrete, ready mix delivered, 4,500 to 6,000 psi		500	CY	$100.00	10%	$5,000.00	$55,000.00
		River Cross Sectional Weir - PBCILA Intake							
	6	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$100.00	10%	$1,500.00	$16,500.00
	7	Steel rebar # 4		3,000	LB	$0.59	10%	$177.69	$1,954.62
	8	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		2,000	CY	$12.56	10%	$2,512.00	$27,632.00
		PBCILA							
	10	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	10%	$18,000.00	$198,000.00
	11	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	10%	$22,000.00	$242,000.00
	12	Replace pumps 2,3,4,5 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		6	EA	$ 205,000.00	10%	$123,000.00	$1,353,000.00
	13	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		6	EA	$189,625.91	10%	$113,775.54	$1,251,530.99
	14	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
	15	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$1,225.00	10%	$735.00	$8,085.00
	16	24" Check Valve: Includes stem, accessories, complete in place		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	17	24" Globe Valve		6	EA.	$45,900.00	10%	$27,540.00	$302,940.00
	18	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$100.00	10%	$3,500.00	$38,500.00
	19	24" Ductile Iron Piping: lining for WW, furnish and install		720	LF	$85.89	10%	$6,184.32	$68,027.49
	20	Demolish pumps 2,3,4,5		1	EA	$57,000.00	10%	$5,700.00	$62,700.00
		Wet Well Modifications							
	21	Pump Station Wet well, cast in place, complete in place		1	LS	$229,500.00	10%	$22,950.00	$252,450.00
		Hoist System							
	22	W12 x 72 steel beam. Material only		180	LF	$41.76	10%	$751.68	$8,268.48
	23	W10 x 49 steel beam. Material only		600	LF	$25.30	10%	$1,518.00	$16,698.00
	25	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	26	Electrical Controls and Istrumentation		1	LS	$46,189.79	10%	$4,618.98	$50,808.77
		Electrical							
	27	350 kVA demolition		1	EA	$1,749.00	10%	$174.90	$1,923.90
	28	Isolating Transformer, 300 kVA		1	EA	$18,000.00	10%	$1,800.00	$19,800.00
	28	Loop-Feed Switch		1	EA	$6,727.50	10%	$672.75	$7,400.25
	29	Electrical Conduit replacement		2	EA	$16,966.67	10%	$3,393.33	$37,326.67
	30	Incoming Switchboards, 600 amp		1	LS	$16,563.25	10%	$1,656.33	$18,219.58
	31	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
	32	Natural gas generator: 60 Hz-350 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$130,000.00	10%	$13,000.00	$143,000.00
		Earthwork							
	33	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		Process Intigration							
	34	SCADA and Telemetry System		1	LS	$331,482.21	10%	$33,148.22	$364,630.43
		PB1A							
	35	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$360,000.00	10%	$144,000.00	$1,584,000.00
	36	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		4	EA	$ 189,625.91	10%	$75,850.36	$834,353.99
	37	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	38	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	39	24" Check valve		4	EA	$57,000.00	10%	$22,800.00	$250,800.00
	40	24" Globe Valve		4	EA	$45,900.00	10%	$18,360.00	$201,960.00
	41	24" Ductile Iron Piping: lining for WW, furnish and install		800	LF	$85.89	10%	$6,871.46	$75,586.10
	42	Demolish pumps (4)		1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork							
	43	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Influent Channel							
	44	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	45	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	46	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Building							
	47	Demolish and replace with new structure		1,600	CY	$170.00	10%	$27,200.00	$368,016.00
		Hoist System							
	48	W12 x 72 steel beam. Material only		60	LF	$41.76	10%	$250.56	$2,756.16
	49	W10 x 49 steel beam. Material only		200	LF	$25.30	10%	$506.00	$5,566.00
	50	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	52	Trench cut, fill, compaction, and haul away excess		2,500	CY	$12.56	10%	$3,140.00	$34,540.00
	53	Electrical Controls and Istrumentation		1	LS	$54,118.06	10%	$5,411.81	$59,529.87
		Electrical							
	54	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$20,700.00	10%	$2,070.00	$22,770.00
	55	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	56	Electrical Conduit replacement		1	LS	$14,640.58	10%	$1,464.06	$16,104.63
	57	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	58	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	59	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	60	SCADA and Telemetry System		1	LS	$319,769.83	10%	$31,976.98	$351,746.81
		PB1B							
	61	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	62	Multi-Rake Bar Screen (Fine)		2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	63	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$360,000.00	10%	$144,000.00	$1,584,000.00
	64	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	65	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$1,225.00	10%	$735.00	$8,085.00
	66	24" Check valve		4	EA	$57,000.00	10%	$22,800.00	$250,800.00
	67	24" Globe Valve		4	EA	$45,900.00	10%	$18,360.00	$201,960.00
	68	24" Ductile Iron Piping: lining for WW, furnish and install		800	LF	$85.89	10%	$6,871.46	$75,586.10
	69	Demolish pumps (4)		1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork							
	70	Trench cut, fill, compaction, and haul away excess		7,000	CY	$12.56	10%	$8,792.00	$96,712.00
		Influent Channel							
	71	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	72	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	73	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Building							
	74	Demolish and replace with new structure		1,600	CY	$170.00	10%	$27,200.00	$418,880.00
		Trolley Hoist							
	75	W12 x 72 steel beam. Material only		60	LF	$41.76	10%	$250.56	$2,756.16
	76	W10 x 49 steel beam. Material only		200	LF	$25.30	10%	$506.00	$5,566.00
	77	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$23.90	10%	$573.60	$6,309.60
	78	5 Ton Hoist		1	EA	$56.38	10%	$5.64	$62.01
	79	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Electrical							
	80	New Transformer, liquid filled Pad mounted, 500 KVA		2	EA	$20,700.00	10%	$4,140.00	$45,540.00
	81	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	82	Isolating Transformer, 300 kVA		2	EA	$18,000.00	10%	$3,600.00	$39,600.00
	83	Electrical Conduit replacement		1	LS	$12,012.50	10%	$1,201.25	$13,213.75
	84	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	85	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	86	SCADA and Telemetry System		1		$331,472.47	10%	$33,147.25	$364,619.72
		Inflatable Dam							
	87	16' Inflatable Dam		4	EA	$293,658.75	10%	$117,463.50	$1,292,098.50
	88	Cam-lock fittings fill tubes (2 per dam)		8	EA	$55.00	10%	$44.00	$484.00
		Bypass Piping							
	89	Trench cut, fill, compaction, and haul away excess		600	CY	$12.56	10%	$753.60	$8,289.60
	90	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		160	LF	$290.00	10%	$4,640.00	$51,040.00
	91	42" MOV: Includes valve box, stem, accessories, complete in place		4	EA	$484,962.19	10%	$193,984.88	$2,133,833.63
	92	Tunneling. Includes labor, steel casing, carrier pipe, spacers, excatvation of pits, complete in place.		250	CY	$495.00	10%	$12,375.00	$136,125.00
		Electrical Control Room							
	93	Trench cut, fill, compaction, and haul away excess		2,400	CY	$12.56	10%	$3,014.40	$132,633.60
	94	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		4,000	LF	$8.25	10%	$3,300.00	$145,200.00
	95	Scructural Brick, Standard unit		4,400	SF	$16.45	10%	$7,238.00	$318,472.00
	96	Placing concrete footing, including labor and equipment to place, level and consolidate		4,000	CY	$35.50	10%	$14,200.00	$624,800.00

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	97	Finishing contret floors, high tolerance, bull float and manual steel trowel		1,000	SF	$1.34	10%	$134.00	$5,896.00
	98	Cast Roof Deck cementittious/wood fiber planks		5,000	SF	$4.72	10%	$2,360.00	$103,840.00
	99	Solid wood roof decking western white srpuce		3,000	SF	$8.80	10%	$2,640.00	$116,160.00
	100	Plywood, prefinished, 3/4" thick 4'x8'		3,000	SF	$11.15	10%	$3,345.00	$147,180.00
	101	Asphalt roof shingles, pneumatic nailed		1,000	SQ	$178.00	10%	$17,800.00	$783,200.00
		Miscellaneous							
	102	Freight		4	EA	$34,100.00	10%	$13,640.00	$150,040.00
	103	On-site inspection		12	EA	$18,000.00	10%	$21,600.00	$237,600.00
	104	Deployement and/or recovery of dams		1	EA	$5,700.00	10%	$570.00	$6,270.00
	105	One-day training		1	EA	$5,700.00	10%	$570.00	$6,270.00
		ROUNDED SUBTOTAL THIS SHEET							**$20,263,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				3.00%			$700,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				4.00%			$820,000.00
		Construction Phase Services				5.00%			$1,100,000.00
		Construction Contingecy				30.00%			$6,800,000.00
		General Contractor OH&P				8.00%			$1,700,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$31,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 2c. Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	Item Description	Unit	Quantity	Unit Cost		TOTAL COST
PBCILA						
	Personnel Labor	LS	1	$ 64,040.00		$ 64,040
	Intake Maintenance	LS	1	$ 17,551.20		$ 17,551
	Vehicles usage and Maintenance	LS	1	$ 106,696.80		$ 106,697
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 419,166.00		$ 419,166
	Pump Equipment Maintenance	LS	6	$ 18,839.71		$ 113,038
	Piping and Valve Maintenance	LS	6	$ 6,782.30		$ 40,694
	Miscellaneous	LS	1	$ 35,464.40		$ 35,464
						$ 872,900
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 182,908.80		$ 182,909
	Electrical System & Equipment Maintenance	LS	1	$ 480,135.60		$ 480,136
	Pump Equipment Maintenance	LS	4	$ 46,650.72		$ 186,603
	Piping and Valve Maintenance	LS	4	$ 10,047.85		$ 40,191
	Structures Maintenance	LS	1	$ 38,030.98		$ 38,031
	Miscellaneous	LS	1	$ 78,914.28		$ 78,914
						$ 1,301,200
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 167,666.40		$ 167,666
	Electrical System & Equipment Maintenance	LS	1	$ 480,135.60		$ 480,136
	Pump Equipment Maintenance	LS	4	$ 46,650.72		$ 186,603
	Piping and Valve Maintenance	LS	4	$ 9,689.00		$ 38,756
	Structures Maintenance	LS	1	$ 37,445.93		$ 37,446
	Miscellaneous	LS	1	$ 77,700.30		$ 77,700
						$ 1,282,723
Inflatable Dams						
	Personnel Labor	LS	1	$ 80,615.00		$ 80,615
	Heavy Equipment Usage and Maintenance	LS	1	$ 184,000.00		$ 184,000
	Disposal Services	LS	1	$ 49,680.00		$ 49,680
	Miscellaneous	LS	1	$ 31,429.50		$ 31,430
						$ 345,725
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,802,548**

ROUNDED TOTAL CONSTRUCTION COST	**$ 32,000,000**
PRESENT WORTH OF O&M	**$ 63,678,000**
TOTAL PRESENT WORTH	**$ 95,678,000**
ANNUALIZED O&M COST	**$ 5,552,000**

Alternative 2c. Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 2c. Optimize existing facilities with improvements: Added detention storage upstream of PBCILA in combination with 2b improvements	1		$32,000,000.00	$32,000,000	
	Total Anticipated Capital Costs:			$32,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$10,418	$3,802,548	
	Total Anticipated O&M Costs:			$3,802,548	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$4,389,962	

Net Present Value Total:	**$95,681,000**
O&M Present/Future Worth:	**$63,678,000**
Per Year O&M:	$5,552,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$3,935,637	$2,789,906	$0	$6,344,852
2	0.889996	$4,073,385	$2,789,906	$0	$6,108,304
3	0.839619	$4,215,953	$2,789,906	$0	$5,882,254
4	0.792094	$4,363,512	$2,789,906	$0	$5,666,177
5	0.747258	$4,516,235	$2,789,906	$1,097,490	$6,279,682
6	0.704961	$4,674,303	$2,789,906	$0	$5,261,973
7	0.665057	$4,837,903	$2,789,906	$0	$5,072,929
8	0.627412	$5,007,230	$2,789,906	$0	$4,892,019
9	0.591898	$5,182,483	$2,789,906	$0	$4,718,845
10	0.558395	$5,363,870	$2,789,906	$4,389,962	$7,004,358
11	0.526788	$5,551,605	$2,789,906	$0	$4,394,204
12	0.496969	$5,745,912	$2,789,906	$0	$4,242,040
13	0.468839	$5,947,018	$2,789,906	$0	$4,096,211
14	0.442301	$6,155,164	$2,789,906	$0	$3,956,413
15	0.417265	$6,370,595	$2,789,906	$1,097,490	$4,280,301
16	0.393646	$6,593,566	$2,789,906	$0	$3,693,769
17	0.371364	$6,824,340	$2,789,906	$0	$3,570,389
18	0.350344	$7,063,192	$2,789,906	$559,720	$3,648,066
19	0.330513	$7,310,404	$2,789,906	$0	$3,338,284
20	0.311805	$7,566,268	$2,789,906	$0	$3,229,104
					$95,680,173

A/P for 25 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK
SOLTA-C-18-001

Alternative 3a - Diversion capacity expansion: Diversion system expansion in Mexico up to 2,600 lps (60 mgd)

PROJECT: **Tijuana River Diversion**
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**

UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[O&M Costs.JM_3.4.19.xlsx]Alternative 3a

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box Expansion - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		4	EA	$4,785.23	10%	$478.52	$19,619.45
	2	Frames and covers 30" to 36" wide frame		4	EA	$870.00	10%	$87.00	$3,567.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	10%	$150.00	$6,150.00
	4	Multi-Rake Bar Screen (Coarse)		4	EA	$243,000.00	10%	$97,200.00	$1,069,200.00
	5	Concrete, ready mix delivered, 4,500 to 6,000 psi		700	CY	$100.00	10%	$7,000.00	$77,000.00
		River Cross Sectional Weir - PBCILA Intake							
	6	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$100.00	10%	$1,500.00	$16,500.00
	7	Steel rebar # 4		3,000	LB	$0.59	10%	$177.69	$1,954.62
	8	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		PBCILA to PB1A Forcemain							
	10	Trench cut, fill, compaction, and haul away excess		18,400	CY	$12.56	10%	$1.26	$231,105.26
	11	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		4,600	LF	$855.00	10%	$85.50	$3,933,085.50
	12	36" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$137,700.00	10%	$13,770.00	$289,170.00
	13	36" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$114,000.00	10%	$11,400.00	$239,400.00
	14	42" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$240,975.00	10%	$24,097.50	$506,047.50
	15	42" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$20.00	10%	$2.00	$42.00
	16	Tie-in 42" to PB1A, including all accessories, complete in place		2	EA	$65,000.00	10%	$6,500.00	$136,500.00
	17	Hydrostatic Leak Testing		3	EA	$80,000.00	10%	$8,000.00	$248,000.00
		PBCILA							
	18	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	10%	$18,000.00	$198,000.00
	19	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	10%	$22,000.00	$242,000.00
	20	Replace pumps 2,3,4 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		4	EA	$205,000.00	10%	$82,000.00	$902,000.00
	21	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		4	EA	$189,625.91	10%	$75,850.36	$834,353.99
	22	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
	23	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	24	24" Check Valve: Includes stem, accessories, complete in place		4	EA	$57,000.00	10%	$22,800.00	$250,800.00
	25	24" Globe Valve		4	EA.	$45,900.00	10%	$18,360.00	$201,960.00
	26	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$100.00	10%	$3,500.00	$38,500.00
	27	24" Ductile Iron Piping: lining for WW, furnish and install		640	LF	$85.89	10%	$5,497.17	$60,468.88
		Wet Well Modifications							
	28	Pump Station Wet well, cast in place, complete in place		1	LS	$357,000.00	10%	$35,700.00	$392,700.00
		Hoist System							
	29	W12 x 72 steel beam. Material only		180	LF	$41.76	10%	$751.68	$8,268.48
	30	W10 x 49 steel beam. Material only		600	LF	$25.30	10%	$1,518.00	$16,698.00
	32	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	33	Electrical Controls and Istrumentation		1	LS	$46,189.79	10%	$4,618.98	$50,808.77
		Electrical							
	34	350 kVA demolition		1	EA	$1,749.00	10%	$174.90	$1,923.90
	35	Isolating Transformer, 300 kVA		1	EA	$18,000.00	10%	$1,800.00	$19,800.00
	35	Loop-Feed Switch		1	EA	$6,727.50	10%	$672.75	$7,400.25
	36	Electrical Conduit replacement		2	EA	$16,966.67	10%	$1,696.67	$35,630.00
	37	Incoming Switchboards, 600 amp		1	LS	$16,563.25	10%	$1,656.33	$18,219.58
	38	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
	39	Diesel Power Generator Set : 60 Hz-350 kVA, includes enclosure, switch, battery, charger, muffler, complete in place		2	EA	$160,000.00	10%	$16,000.00	$336,000.00
		Earthwork							
	39	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		Process Intigration							
	40	SCADA and Telemetry System		1	LS	$405,017.13	10%	$40,501.71	$445,518.85
		PB1A							
	41	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		6	EA	$360,000.00	10%	$216,000.00	$2,376,000.00
	42	Concrete Patching - Walls, including chipping, celaning and epoxy grout		6	EA	$ 189,625.91	10%	$113,775.54	$1,251,530.99
	43	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	44	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	45	24" Check valve		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	46	24" Globe Valve		6	EA	$45,900.00	10%	$27,540.00	$302,940.00

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	47	24" Ductile Iron Piping: lining for WW, furnish and install		800	LF	$285.00	10%	$22,800.00	$250,800.00
	48	Demolish pumps (6)		1	EA	$98,325.00	10%	$9,832.50	$108,157.50
		Earthwork							
	49	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Influent Channel							
	50	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	51	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	52	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Building							
	53	Demolish and replace with new structure		1,600	CY	$170.00	10%	$27,200.00	$368,016.00
		Hoist System							
	54	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$12.50	$7,512.50
	56	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$32.20	$77,312.20
	57	5 Ton Hoist		1	EA	$6,750.00	10%	$675.00	$7,425.00
	58	Trench cut, fill, compaction, and haul away excess		2,500	CY	$12.56	10%	$1.26	$31,401.26
	59	Electrical Controls and Istrumentation		1	LS	$53,658.98	10%	$5,365.90	$59,024.88
		Electrical							
	60	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$34,800.00	10%	$3,480.00	$38,280.00
	61	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	62	Electrical Conduit replacement		1	LS	$18,165.58	10%	$1,816.56	$19,982.13
	63	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$585.00	$18,135.00
	64	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	65	Diesel Power Generator Set : 60 Hz-1,330 kVA, includes enclosure, switch, battery, charger, muffler, complete in place		2	EA	$353,968.36	10%	$35,396.84	$743,333.56
		Process Intigration							
	66	SCADA and Telemetry System		1	LS	$435,651.40	10%	$43,565.14	$479,216.54
		PB1B							
	67	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	68	Multi-Rake Bar Screen (Fine)		2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	69	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		6	EA	$360,000.00	10%	$216,000.00	$2,376,000.00
	70	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	71	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	72	24" Check valve		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	73	24" Globe Valve		6	EA	$45,900.00	10%	$27,540.00	$302,940.00
	74	24" Ductile Iron Piping: lining for WW, furnish and install		1,600	LF	$285.00	10%	$45,600.00	$501,600.00
	75	Demolish pumps (4)		1	EA	$65,550.00	10%	$6,555.00	$72,105.00
		Earthwork							
	76	Trench cut, fill, compaction, and haul away excess		7,000	CY	$12.56	10%	$8,792.00	$96,712.00
		Influent Channel							
	77	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	78	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	79	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Building							
	80	Demolish and replace with new structure		1,600	CY	$170.00	10%	$27,200.00	$418,880.00
		Trolley Hoist							
	81	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$12.50	$7,512.50
	82	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$9.00	$18,009.00
	83	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$23.90	10%	$2.39	$5,738.39
	84	5 Ton Hoist		1	EA	$0.00	10%	$0.00	$0.00
	85	Trench cut, fill, compaction, and haul away excess		6,000	CY	$18.00	10%	$1.80	$108,001.80
		Electrical							
	86	New Transformer, liquid filled Pad mounted, 500 KVA		3	EA	$34,800.00	10%	$3,480.00	$107,880.00
	87	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	88	Isolating Transformer, 300 kVA		2	EA	$31,800.00	10%	$3,180.00	$66,780.00
	89	Electrical Conduit replacement		1	LS	$18,987.50	10%	$1,898.75	$20,886.25
	90	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$585.00	$18,135.00
	91	Diesel Power Generator Set : 60 Hz-1,330 kVA, includes enclosure, switch, battery, charger, muffler, complete in place		2	EA	$353,968.36	10%	$35,396.84	$743,333.56
		Process Intigration							
	92	SCADA and Telemetry System		1		$475,583.73	10%	$47,558.37	$523,142.10
		Parallel System Pipelines (Tijuana Portion)							
	93	Trench cut, fill, compaction, and haul away excess		450,000	CY	$12.56	10%	$565,200.00	$6,217,200.00
	94	48 in DI: lining for WW, furnish and install, does not include cut, backfill, or compaction		26,500	LF	$876.48	10%	$2,322,671.17	$25,549,382.89
	95	48 in HDPE: lining for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		26,500	LF	$362.50	10%	$960,625.00	$10,566,875.00
	96	Concrete, ready mix delivered, 4,500 to 6,000 psi		11,778	CY	$100.00	10%	$117,777.78	$1,295,555.56
	97	Hydrostatic Leak Testing		45	EA	$68,000.00	10%	$306,000.00	$3,366,000.00
		Tie-in to SAB LS and WWTP							
	98	Concrete Channel Tie-in		1	EA	$523,774.47	10%	$52,377.45	$576,151.92

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		ROUNDED SUBTOTAL THIS SHEET							**$72,276,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				3.00%			$2,200,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				4.00%			$2,900,000.00
		Construction Phase Services				5.00%			$3,700,000.00
		Construction Contingecy				30.00%			$21,700,000.00
		General Contractor OH&P				8.00%			$6,300,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$110,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 3a. Diversion capacity expansion: Diversion system expansion in Mexico up to 2,600 lps (60 mgd)

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
PBCILA						
	Personnel Labor	LS	1	$ 89,656.00		$ 89,656
	Intake Maintenance	LS	1	$ 38,084.65		$ 38,085
	Vehicles usage and Maintenance	LS	1	$ 228,636.00		$ 228,636
	SCADA & Equipment Maintenance	LS	1	$ 114,318.00		$ 114,318
	Electrical System & Equipment Maintenance	LS	1	$ 609,696.00		$ 609,696
	Pump Equipment Maintenance	LS	6	$ 22,607.66		$ 135,646
	Piping and Valve Maintenance	LS	6	$ 10,047.85		$ 60,287
	Miscellaneous	LS	1	$ 72,348.00		$ 72,348
						$ 1,348,700
PB1A						
	Personnel Labor	LS	1	$ 177,450.00		$ 177,450
	Vehicles usage and Maintenance	LS	1	$ 266,742.00		$ 266,742
	SCADA & Equipment Maintenance	LS	1	$ 228,636.00		$ 228,636
	Electrical System & Equipment Maintenance	LS	1	$ 762,120.00		$ 762,120
	Pump Equipment Maintenance	LS	4	$ 53,827.75		$ 215,311
	Piping and Valve Maintenance	LS	4	$ 14,354.07		$ 57,416
	Structures Maintenance	LS	1	$ 60,125.19		$ 60,125
	Miscellaneous	LS	1	$ 101,611.58		$ 101,612
						$ 1,869,412
PB1B						
	Personnel Labor	LS	1	$ 177,450.00		$ 177,450
	Vehicles usage and Maintenance	LS	1	$ 266,742.00		$ 266,742
	SCADA & Equipment Maintenance	LS	1	$ 228,636.00		$ 228,636
	Electrical System & Equipment Maintenance	LS	1	$ 685,908.00		$ 685,908
	Pump Equipment Maintenance	LS	4	$ 62,799.04		$ 251,196
	Piping and Valve Maintenance	LS	4	$ 14,354.07		$ 57,416
	Structures Maintenance	LS	1	$ 57,435.56		$ 57,436
	Miscellaneous	LS	1	$ 97,066.10		$ 97,066
						$ 1,821,850
GRAND TOTAL ANNUAL O&M COSTS						**$ 5,039,962**
				ROUNDED TOTAL CONSTRUCTION COST		**$110,000,000.00**
				PRESENT WORTH OF O&M		**$ 84,173,000**
				TOTAL PRESENT WORTH		**$ 194,173,000**
				ANNUALIZED O&M COST		**$ 6,590,000**

Alternative 3a. Diversion capacity expansion: Diversion system expansion in Mexico up to 2,600 lps (60 mgd)

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 3a. Diversion capacity expansion: Diversion system expansion in Mexico up to 2,600 lps (60 mgd)	1		$110,000,000.00	$110,000,000	
	Total Anticipated Capital Costs:			$110,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$13,808	$5,039,962	
	Total Anticipated O&M Costs:			$5,039,962	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$194,173,000**
O&M Present/Future Worth:	**$84,173,000**
Per Year O&M:	$6,590,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$5,216,361	$9,590,301	$0	$13,968,549
2	0.889996	$5,398,933	$9,590,301	$0	$13,340,366
3	0.839619	$5,587,896	$9,590,301	$0	$12,743,907
4	0.792094	$5,783,472	$9,590,301	$0	$12,177,469
5	0.747258	$5,985,894	$9,590,301	$1,463,321	$12,732,918
6	0.704961	$6,195,400	$9,590,301	$0	$11,128,297
7	0.665057	$6,412,239	$9,590,301	$0	$10,642,603
8	0.627412	$6,636,668	$9,590,301	$0	$10,181,001
9	0.591898	$6,868,951	$9,590,301	$0	$9,742,206
10	0.558395	$7,109,364	$9,590,301	$5,853,283	$12,593,448
11	0.526788	$7,358,192	$9,590,301	$0	$8,928,255
12	0.496969	$7,615,729	$9,590,301	$0	$8,550,870
13	0.468839	$7,882,279	$9,590,301	$0	$8,191,828
14	0.442301	$8,158,159	$9,590,301	$0	$7,850,161
15	0.417265	$8,443,695	$9,590,301	$1,463,321	$8,135,549
16	0.393646	$8,739,224	$9,590,301	$0	$7,215,350
17	0.371364	$9,045,097	$9,590,301	$0	$6,920,524
18	0.350344	$9,361,675	$9,590,301	$0	$6,639,707
19	0.330513	$9,689,334	$9,590,301	$0	$6,372,170
20	0.311805	$10,028,461	$9,590,301	$0	$6,117,223
					$194,172,400

A/P for 20 years:
0.078226718

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST

NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Alternative 4a - New U.S. diversion infrastructure: New lift station to discharge directly to SBOO without treatment

PROJECT: **Tijuana River Diversion**

Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**

UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 4a

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$10,000.00	30%	$6,000.00	$26,000.00
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		River Cross Sectional Weir							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$148.00	30%	$6,660.00	$28,860.00
	5	Steel rebar # 4		3,000	LB	$1.25	30%	$1,125.00	$4,875.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	30%	$15,000.00	$65,000.00
		New Concrete Riser							
	7	Concrete, ready mix delivered, 4,500 to 6,000 psi		35	CY	$185.00	30%	$1,942.50	$8,417.50
	8	Steel rebar # 4		1,000	LB	$1.25	30%	$375.00	$1,625.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	30%	$13,500.00	$58,500.00
		Wastewater Pipelines							
	10	Trench cut, fill, compaction, and haul away excess		13,600	CY	$35.00	30%	$142,800.00	$618,800.00
	11	36" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		500	LF	$652.50	30%	$97,875.00	$424,125.00
	12	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		4,600	LF	$855.00	30%	$1,179,900.00	$5,112,900.00
	13	36" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$137,700.00	30%	$82,620.00	$1,455,300.00
	14	36" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$114,000.00	30%	$68,400.00	$310,620.00
	15	42" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$240,975.00	30%	$144,585.00	$550,350.00
	16	42" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$199,500.00	30%	$119,700.00	$543,585.00
	17	Tie-in 42" to SBOO, including all accessories, complete in place		2	EA	$65,000.00	30%	$39,000.00	$249,700.00
	18	Hydrostatic Leak Testing		3	EA	$80,000.00	30%	$72,000.00	$279,000.00
		Lift Station							
	19	Screen Metal		400	SF	$42.49	30%	$5,098.50	$22,093.50
	20	Natural gas generator: 60 Hz-350 KVA, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$202,267.63	30%	$60,680.29	$262,947.93
	21	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		3	EA	$225,500.00	30%	$202,950.00	$879,450.00
	22	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	30%	$170,663.32	$739,541.04
	23	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	30%	$7,500.00	$32,500.00
	24	Pump Station Wet well, cast in place, complete in place		1	EA.	$510,000.00	30%	$153,000.00	$663,000.00
	25	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA.	$3,062.50	30%	$5,512.50	$23,887.50
	26	24" Check Valve: Includes stem, accessories, complete in place		3	EA.	$57,000.00	30%	$51,300.00	$222,300.00
	28	Sumergible pump (734 gpm, 30 HP)		3	EA.	$45,000.00	30%	$40,500.00	$175,500.00
	29	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$185.00	30%	$19,425.00	$84,175.00
	30	Startup and Testing of Lift Station		1	EA.	$164,730.17	30%	$49,419.05	$214,149.22
		Master Control Shelter							
	31	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		1,000	LF	$8.25	30%	$2,475.00	$10,725.00
	32	Scructural Brick, Standard unit		800	SF	$16.45	30%	$3,948.00	$17,108.00
	33	Placing concrete footing, including labor and equipment to place, level and consolidate		1,200	CY	$35.50	30%	$12,780.00	$55,380.00
	34	Finishing contret floors, high tolerance, bull float and manual steel trowel		100	SF	$1.34	30%	$40.20	$174.20
	35	Cast Roof Deck cementittious/wood fiber planks		1,400	SF	$4.72	30%	$1,982.40	$8,590.40
	36	Solid wood roof decking western white srpuce		1,400	SF	$8.80	30%	$3,696.00	$16,016.00
	37	Plywood, prefinished, 3/4" thick 4'x8'		1,500	SF	$11.15	30%	$5,017.50	$21,742.50
	38	Asphalt roof shingles, pneumatic nailed		500	SQ	$178.00	30%	$26,700.00	$115,700.00
		Electrical							
	39	Drive for new motor		3	EA.	$ 66,344.94	30%	$59,710.45	$258,745.27
	40	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA.	$34,800.00	30%	$10,440.00	$45,240.00
	41	Transformer handling		1	EA.	$3,500.00	30%	$1,050.00	$4,550.00
	42	Isolating Transformer, 300 kVA		1	EA.	$31,800.00	30%	$9,540.00	$41,340.00
	43	Incoming Switchboards, 600 amp		3	EA.	$5,850.00	30%	$5,265.00	$22,815.00
		Trolley Hoist							
	44	W12 x 72 steel beam. Material only		60	LF	$125.00	30%	$2,250.00	$9,750.00
	45	W10 x 49 steel beam. Material only		200	LF	$90.00	30%	$5,400.00	$23,400.00
	46	Weld steel structure to extend existing hoist. Includes labor and welding material.		80	LH	$322.00	30%	$7,728.00	$33,488.00
	47	Trench cut, fill, compaction, and haul away excess		100	CY	$20.00	30%	$600.00	$2,600.00
		Tie-in to SBOO							
	48	SBOO tie-in		1	EA	$860,486.63	30%	$258,145.99	$1,118,632.62
		ROUNDED SUBTOTAL THIS SHEET							**$15,231,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$800,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$1,830,000.00
		Construction Phase Services				10.00%			$1,530,000.00
		Construction Contingecy				30.00%			$5,700,000.00
		General Contractor OH&P				15.00%			$2,400,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$27,500,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 4a. New U.S. diversion infrastructure: New lift station to discharge directly to SBOO without treatment

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
U.S. 35 MGD LS						
	Personnel Labor	LS	1	$ 405,600.00		$ 405,600
	Intake Maintenance	LS	1	$ 51,026.12		$ 51,026
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 531,765.00		$ 531,765
	Piping and Valve Maintenance	LS	1	$ 400,850.00		$ 400,850
	Miscellaneous	LS	1	$ 135,712.26		$ 135,712
						$ 2,060,500
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 2,060,500**
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,020,467**

ROUNDED TOTAL CONSTRUCTION COST	**$ 27,500,000**
PRESENT WORTH OF O&M	**$ 63,000,000**
TOTAL PRESENT WORTH	**$ 90,500,000**
ANNUALIZED O&M COST	**$ 5,500,000**

Alternative 4a. New U.S. diversion infrastructure: New lift station to discharge directly to SBOO without treatment

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 4a. New U.S. diversion infrastructure: New lift station to discharge directly to SBOO without treatment	1		$27,500,000.00	$27,500,000	
	Total Anticipated Capital Costs:			$27,500,000	
Annual O&M Costs					
Total Operating Cost ($/day)	140	Daily	$5,645	$790,329	
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
	Total Anticipated O&M Costs:			$3,810,795	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$90,500,000**
O&M Present/Future Worth:	**$63,000,000**
Per Year O&M:	$5,500,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$3,944,173	$2,397,575	$0	$5,982,782
2	0.889996	$4,082,219	$2,397,575	$0	$5,766,994
3	0.839619	$4,225,097	$2,397,575	$0	$5,560,523
4	0.792094	$4,372,975	$2,397,575	$0	$5,362,910
5	0.747258	$4,526,029	$2,397,575	$914,575	$5,857,144
6	0.704961	$4,684,440	$2,397,575	$0	$4,992,542
7	0.665057	$4,848,396	$2,397,575	$0	$4,818,985
8	0.627412	$5,018,090	$2,397,575	$0	$4,652,680
9	0.591898	$5,193,723	$2,397,575	$0	$4,493,278
10	0.558395	$5,375,503	$2,397,575	$3,658,302	$6,383,223
11	0.526788	$5,563,646	$2,397,575	$0	$4,193,872
12	0.496969	$5,758,373	$2,397,575	$0	$4,053,257
13	0.468839	$5,959,916	$2,397,575	$0	$3,918,318
14	0.442301	$6,168,514	$2,397,575	$0	$3,788,789
15	0.417265	$6,384,412	$2,397,575	$914,575	$4,046,037
16	0.393646	$6,607,866	$2,397,575	$0	$3,544,958
17	0.371364	$6,839,141	$2,397,575	$0	$3,430,188
18	0.350344	$7,078,511	$2,397,575	$0	$3,319,888
19	0.330513	$7,326,259	$2,397,575	$0	$3,213,854
20	0.311805	$7,582,678	$2,397,575	$0	$3,111,890
					$90,492,112

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Alternative 4b - New U.S. Diversion Infrastructure: New lift station to discharge at SBIWTP for primary treatment only

PROJECT: **Tijuana River Diversion**
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**
UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 4e

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$10,000.00	30%	$6,000.00	$26,000.00
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		River Cross Sectional Weir							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$148.00	30%	$6,660.00	$28,860.00
	5	Steel rebar # 4		3,000	LB	$1.25	30%	$1,125.00	$4,875.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	30%	$15,000.00	$65,000.00
		New Concrete Riser							
	7	Concrete, ready mix delivered, 4,500 to 6,000 psi		35	CY	$185.00	30%	$1,942.50	$8,417.50
	8	Steel rebar # 4		1,000	LB	$1.25	30%	$375.00	$1,625.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	30%	$13,500.00	$58,500.00
		River Intake Box							
	10	Concrete Cast in place 8'x8', 6' deep		2	EA	$2,392.62	30%	$1,435.57	$6,220.80
	11	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	12	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		Wastewater Pipelines							
	13	Trench cut, fill, compaction, and haul away excess		9,333	CY	$30.00	30%	$84,000.00	$364,000.00
	14	36" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		500	LF	$652.50	30%	$97,875.00	$424,125.00
	15	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		3,000	LF	$855.00	30%	$769,500.00	$3,334,500.00
	16	36" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$137,700.00	30%	$82,620.00	$358,020.00
	17	36" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$114,000.00	30%	$68,400.00	$296,400.00
	18	42" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$240,975.00	30%	$144,585.00	$626,535.00
	19	42" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$199,500.00	30%	$119,700.00	$518,700.00
	20	Tie-in 42" to Headworks, including all accessories, complete in place		2	EA	$65,000.00	30%	$39,000.00	$169,000.00
	21	Hydrostatic Leak Testing		3	EA	$80,000.00	30%	$72,000.00	$312,000.00
		Lift Station							
	22	Screen Metal		400	SF	$42.49	30%	$5,098.50	$22,093.50
	23	Natural gas generator: 60 Hz-250 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$232,607.78	30%	$69,782.33	$302,390.11
	24	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		3	EA	$225,500.00	30%	$202,950.00	$879,450.00
	25	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	30%	$170,663.32	$739,541.04
	26	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	30%	$7,500.00	$32,500.00
	27	Pump Station Wet well, cast in place, complete in place		1	EA.	$510,000.00	30%	$153,000.00	$663,000.00
	28	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA.	$3,062.50	30%	$5,512.50	$23,887.50
	29	24" Check Valve: Includes stem, accessories, complete in place		3	EA.	$57,000.00	30%	$51,300.00	$222,300.00
	30	24" Gate Valve: Includes valve box, stem, accessories, complete in place		6	EA.	$45,900.00	30%	$82,620.00	$358,020.00
	31	Sumergible pump (734 gpm, 30 HP)		3	EA.	$45,000.00	30%	$40,500.00	$175,500.00
	32	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$185.00	30%	$19,425.00	$84,175.00
	33	Startup and Testing of Lift Station		1	EA	$166,702.28	30%	$50,010.68	$216,712.96
		MCC (Master Control Shelter)							
	34	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		1,000	LF	$8.25	30%	$2,475.00	$10,725.00
	35	Scructural Brick, Standard unit		800	SF	$16.45	30%	$3,948.00	$17,108.00
	36	Placing concrete footing, including labor and equipment to place, level and consolidate		1,200	CY	$35.50	30%	$12,780.00	$55,380.00
	37	Finishing contret floors, high tolerance, bull float and manual steel trowel		100	SF	$1.34	30%	$40.20	$174.20
	38	Cast Roof Deck cementittious/wood fiber planks		1,400	SF	$4.72	30%	$1,982.40	$8,590.40
	39	Solid wood roof decking western white srpuce		1,400	SF	$8.80	30%	$3,696.00	$16,016.00
	40	Plywood, prefinished, 3/4" thick 4'x8'		1,500	SF	$11.15	30%	$5,017.50	$21,742.50
	41	Asphalt roof shingles, pneumatic nailed		500	SQ	$178.00	30%	$26,700.00	$115,700.00
		Electrical							
	42	Drive for new motor		3	EA.	$66,344.94	30%	$59,710.45	$258,745.27
	43	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA.	$34,800.00	30%	$10,440.00	$45,240.00
	44	Transformer handling		1	EA.	$3,500.00	30%	$1,050.00	$4,550.00
	45	Isolating Transformer, 300 kVA		1	EA.	$31,800.00	30%	$9,540.00	$41,340.00
	46	Incoming Switchboards, 600 amp		3	EA.	$5,850.00	30%	$5,265.00	$22,815.00
		Trolley Hoist							

	47	W12 x 72 steel beam. Material only		60	LF	$125.00	30%	$2,250.00	$9,750.00
	48	W10 x 49 steel beam. Material only		200	LF	$90.00	30%	$5,400.00	$23,400.00
	49	Weld steel structure to extend existing hoist. Includes labor and welding material.		80	LH	$322.00	30%	$7,728.00	$33,488.00
	50	Trench cut, fill, compaction, and haul away excess		100	CY	$20.00	30%	$600.00	$2,600.00
		SBIWTP Headworks Modification Improvements							
	51	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		12	EA	$225,500.00	30%	$811,800.00	$3,517,800.00
	52	Drive for new motor		12	EA	$82,500.00	30%	$297,000.00	$1,287,000.00
		SBIWTP Primary Treatment Basins Improvements							
	53	Miscellaneous Repairs		1	EA.	$5,000,000.00	30%	$1,500,000.00	$6,500,000.00
	54	Chemical injection system and chemical purchase		1	EA	$2,012,500.00	30%	$603,750.00	$2,616,250.00
	55	SBOO tie-in		1	EA	$1,122,373.86	30%	$336,712.16	$1,459,086.02
		ROUNDED SUBTOTAL THIS SHEET							**$26,410,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$1,400,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$3,200,000.00
		Construction Phase Services				10.00%			$2,650,000.00
		Construction Contingecy				30.00%			$10,000,000.00
		General Contractor OH&P				15.00%			$4,500,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$48,000,000.00**

QUANTITIES		**PRICES**	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 4b. New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for primary treatment only

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	Item Description	Unit	Quantity	Unit Cost		TOTAL COST
U.S. 35 MGD LS						
	Personnel Labor	LS	1	$ 405,600.00		$ 405,600
	Intake Maintenance	LS	1	$ 51,026.12		$ 51,026
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 531,765.00		$ 531,765
	Piping and Valve Maintenance	LS	1	$ 400,850.00		$ 400,850
	Miscellaneous	LS	1	$ 135,712.26		$ 135,712
						$ 2,060,500
SBIWTP						
	Personnel Labor	LS	1	$ 639,600.00		$ 639,600
	Intake Maintenance	LS	1	$ 55,867.43		$ 55,867
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 164,843.50		$ 164,844
	Pump Equipment Maintenance	LS	1	$ 709,020.00		$ 709,020
	Piping and Valve Maintenance	LS	1	$ 200,425.00		$ 200,425
	Chemical usage (Ferric Chloride & Anionic Polymer)	LS	1	$ 4,221,793.55		$ 4,221,794
	Miscellaneous	LS	1	$ 309,875.43		$ 309,875
						$ 6,622,600
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 8,683,100**
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,020,467**

ROUNDED TOTAL CONSTRUCTION COST	**$ 48,000,000**
PRESENT WORTH OF O&M	**$ 102,910,000**
TOTAL PRESENT WORTH	**$ 150,910,000**
ANNUALIZED O&M COST	**$ 8,900,000**

Alternative 4b. New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for primary treatment only

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 4b. New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for primary treatment only	1		$3,020,466.58	$3,020,467	
		Total Anticipated Capital Costs:		$3,020,467	
Annual O&M Costs					
Total Operating Cost ($/day)	140	Daily	$23,789	$3,330,504	
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
		Total Anticipated O&M Costs:		$6,350,971	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$105,930,000**
O&M Present/Future Worth:	**$102,910,000**
Per Year O&M:	$8,900,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$6,573,255	$263,338	$0	$6,449,616
2	0.889996	$6,803,319	$263,338	$0	$6,289,299
3	0.839619	$7,041,435	$263,338	$0	$6,133,228
4	0.792094	$7,287,885	$263,338	$0	$5,981,276
5	0.747258	$7,542,961	$263,338	$914,575	$6,516,745
6	0.704961	$7,806,965	$263,338	$0	$5,689,245
7	0.665057	$8,080,208	$263,338	$0	$5,548,935
8	0.627412	$8,363,016	$263,338	$0	$5,412,281
9	0.591898	$8,655,721	$263,338	$0	$5,279,177
10	0.558395	$8,958,671	$263,338	$3,658,302	$7,192,298
11	0.526788	$9,272,225	$263,338	$0	$5,023,216
12	0.496969	$9,596,753	$263,338	$0	$4,900,163
13	0.468839	$9,932,639	$263,338	$0	$4,780,272
14	0.442301	$10,280,281	$263,338	$0	$4,663,453
15	0.417265	$10,640,091	$263,338	$914,575	$4,931,240
16	0.393646	$11,012,495	$263,338	$0	$4,438,690
17	0.371364	$11,397,932	$263,338	$0	$4,330,581
18	0.350344	$11,796,859	$263,338	$0	$4,225,215
19	0.330513	$12,209,750	$263,338	$0	$4,122,518
20	0.311805	$12,637,091	$263,338	$0	$4,022,415
					$105,929,862

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Alternative 4c - New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for full treatment

PROJECT: Tijuana River Diversion
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**
UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 4e

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$10,000.00	30%	$6,000.00	$26,000.00
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		River Cross Sectional Weir							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$148.00	30%	$6,660.00	$28,860.00
	5	Steel rebar # 4		3,000	LB	$1.25	30%	$1,125.00	$4,875.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	30%	$15,000.00	$65,000.00
		New Concrete Riser							
	7	Concrete, ready mix delivered, 4,500 to 6,000 psi		35	CY	$185.00	30%	$1,942.50	$8,417.50
	8	Steel rebar # 4		1,000	LB	$1.25	30%	$375.00	$1,625.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	30%	$13,500.00	$58,500.00
		River Intake Box							
	10	Concrete Cast in place 8'x8', 6' deep		2	EA	$2,392.62	30%	$1,435.57	$6,220.80
	11	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	12	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		Wastewater Pipelines							
	13	Trench cut, fill, compaction, and haul away excess		9,333	CY	$30.00	30%	$84,000.00	$364,000.00
	14	36" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		500	LF	$652.50	30%	$97,875.00	$424,125.00
	15	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		3,000	LF	$855.00	30%	$769,500.00	$3,334,500.00
	16	36" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$137,700.00	30%	$82,620.00	$358,020.00
	17	36" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$114,000.00	30%	$68,400.00	$296,400.00
	18	42" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$240,975.00	30%	$144,585.00	$626,535.00
	19	42" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$199,500.00	30%	$119,700.00	$518,700.00
	20	Tie-in 42" to Headworks, including all accessories, complete in place		2	EA	$65,000.00	30%	$39,000.00	$169,000.00
	21	Hydrostatic Leak Testing		3	EA	$80,000.00	30%	$72,000.00	$312,000.00
		Lift Station							
	22	Screen Metal		400	SF	$42.49	30%	$5,098.50	$22,093.50
	23	Natural gas generator: 60 Hz-250 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$232,607.78	30%	$69,782.33	$302,390.11
	24	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		3	EA	$225,500.00	30%	$202,950.00	$879,450.00
	25	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	30%	$170,663.32	$739,541.04
	26	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	30%	$7,500.00	$32,500.00
	27	Pump Station Wet well, cast in place, complete in place		1	EA.	$510,000.00	30%	$153,000.00	$663,000.00
	28	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA.	$3,062.50	30%	$5,512.50	$23,887.50
	29	24" Check Valve: Includes stem, accessories, complete in place		3	EA.	$57,000.00	30%	$51,300.00	$222,300.00
	30	24" Gate Valve: Includes valve box, stem, accessories, complete in place		6	EA.	$45,900.00	30%	$82,620.00	$358,020.00
	31	Sumergible pump (734 gpm, 30 HP)		3	EA.	$45,000.00	30%	$40,500.00	$175,500.00
	32	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$185.00	30%	$19,425.00	$84,175.00
	33	Startup and Testing of Lift Station		1	EA	$166,702.28	30%	$50,010.68	$216,712.96
		MCC (Master Control Shelter)							
	34	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		1,000	LF	$8.25	30%	$2,475.00	$10,725.00
	35	Scructural Brick, Standard unit		800	SF	$16.45	30%	$3,948.00	$17,108.00
	36	Placing concrete footing, including labor and equipment to place, level and consolidate		1,200	CY	$35.50	30%	$12,780.00	$55,380.00
	37	Finishing contret floors, high tolerance, bull float and manual steel trowel		100	SF	$1.34	30%	$40.20	$174.20
	38	Cast Roof Deck cementittious/wood fiber planks		1,400	SF	$4.72	30%	$1,982.40	$8,590.40
	39	Solid wood roof decking western white srpuce		1,400	SF	$8.80	30%	$3,696.00	$16,016.00
	40	Plywood, prefinished, 3/4" thick 4'x8'		1,500	SF	$11.15	30%	$5,017.50	$21,742.50
	41	Asphalt roof shingles, pneumatic nailed		500	SQ	$178.00	30%	$26,700.00	$115,700.00
		Electrical							
	42	Drive for new motor		3	EA.	$66,344.94	30%	$59,710.45	$258,745.27
	43	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA.	$34,800.00	30%	$10,440.00	$45,240.00
	44	Transformer handling		1	EA.	$3,500.00	30%	$1,050.00	$4,550.00
	45	Isolating Transformer, 300 kVA		1	EA.	$31,800.00	30%	$9,540.00	$41,340.00
	46	Incoming Switchboards, 600 amp		3	EA.	$5,850.00	30%	$5,265.00	$22,815.00
		Trolley Hoist							
	47	W12 x 72 steel beam. Material only		60	LF	$125.00	30%	$2,250.00	$9,750.00
	48	W10 x 49 steel beam. Material only		200	LF	$90.00	30%	$5,400.00	$23,400.00

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	49	Weld steel structure to extend existing hoist. Includes labor and welding material.		80	LH	$322.00	30%	$7,728.00	$33,488.00
	50	Trench cut, fill, compaction, and haul away excess		100	CY	$20.00	30%	$600.00	$2,600.00
		New Junction box							
	51	Concrete Cast in place 8'x8', 6' deep		2	EA	$1,196.31	30%	$717.78	$3,110.40
	39	Frames and covers 30" to 36" wide frame		2	EA	$435.00	30%	$261.00	$1,131.00
		SBIWTP Headworks Modification Improvements							
	40	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		12	EA	$225,500.00	30%	$811,800.00	$3,517,800.00
	41	Drive for new motor		12	EA	$82,500.00	30%	$297,000.00	$1,287,000.00
		SBIWTP Primary Treatment Basins Improvements							
	42	Miscellaneous Modifications		1	EA.	$7,500,000.00	30%	$2,250,000.00	$9,750,000.00
		SBIWTP Activated Sludge & 2ry SS Basins Improvements							
	43	Equalization tanks		3	EA.	$8,400,000.00	30%	$7,560,000.00	$32,760,000.00
	44	Pump Station wet well		2	LS	$900,000.00	30%	$540,000.00	$2,340,000.00
	45	Secondary Sedimentation Tanks, complete in place		4	LS	$9,000,000.00	30%	$10,800,000.00	$46,800,000.00
	46	yard piping		4	LS	$600,000.00	30%	$720,000.00	$3,120,000.00
	47	Miscellaneous Modifications		5	LS	$2,750,000.00	30%	$4,125,000.00	$17,875,000.00
	48	SBOO tie-in		1	LS	$823,074.16	30%	$246,922.25	$1,069,996.41
		ROUNDED SUBTOTAL THIS SHEET							**$129,550,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$6,480,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$15,600,000.00
		Construction Phase Services				10.00%			$13,000,000.00
		Construction Contingecy				30.00%			$49,300,000.00
		General Contractor OH&P				15.00%			$22,300,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$236,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 4c. New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for full treatment

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
U.S. 35 MGD LS						
	Personnel Labor	LS	1	$ 405,600.00		$ 405,600
	Intake Maintenance	LS	1	$ 51,026.12		$ 51,026
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 531,765.00		$ 531,765
	Piping and Valve Maintenance	LS	1	$ 400,850.00		$ 400,850
	Miscellaneous	LS	1	$ 135,712.26		$ 135,712
						$ 2,060,500
SBIWTP						
	Personnel Labor	LS	1	$ 639,600.00		$ 639,600
	Intake Maintenance	LS	1	$ 86,024.57		$ 86,025
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 1,063,530.00		$ 1,063,530
	Piping and Valve Maintenance	LS	1	$ 801,700.00		$ 801,700
	Chemical usage	LS	1	$ 3,462,776.81		$ 3,462,777
	Miscellaneous	LS	1	$ 485,541.53		$ 485,542
						$ 7,074,700
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 9,135,200**
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,020,467**

ROUNDED TOTAL CONSTRUCTION COST	**$ 236,000,000**
PRESENT WORTH OF O&M	**$ 108,743,000**
TOTAL PRESENT WORTH	**$ 344,743,000**
ANNUALIZED O&M COST	**$ 9,500,000**

Alternative 4c. New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for full treatment

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 4c. New U.S. diversion infrastructure: New lift station to discharge at SBIWTP for full treatment	1		$3,020,466.58	$3,020,467	
			Total Anticipated Capital Costs:	$3,020,467	
Annual O&M Costs					
Total Operating Cost ($/day)	140	Daily	$25,028	$3,503,912	
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
			Total Anticipated O&M Costs:	$6,524,379	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
			Total Anticipated Costs:	$0	

Net Present Value Total:	**$111,763,000**
O&M Present/Future Worth:	**$108,743,000**
Per Year O&M:	$9,500,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$6,752,732	$263,338	$0	$6,618,934
2	0.889996	$6,989,078	$263,338	$0	$6,454,624
3	0.839619	$7,233,696	$263,338	$0	$6,294,654
4	0.792094	$7,486,875	$263,338	$0	$6,138,895
5	0.747258	$7,748,915	$263,338	$1,829,151	$7,354,070
6	0.704961	$8,020,128	$263,338	$0	$5,839,516
7	0.665057	$8,300,832	$263,338	$0	$5,695,662
8	0.627412	$8,591,361	$263,338	$0	$5,555,548
9	0.591898	$8,892,059	$263,338	$0	$5,419,065
10	0.558395	$9,203,281	$263,338	$7,316,603	$9,371,664
11	0.526788	$9,525,396	$263,338	$0	$5,156,583
12	0.496969	$9,858,784	$263,338	$0	$5,030,385
13	0.468839	$10,203,842	$263,338	$0	$4,907,422
14	0.442301	$10,560,976	$263,338	$0	$4,787,605
15	0.417265	$10,930,611	$263,338	$1,829,151	$5,434,084
16	0.393646	$11,313,182	$263,338	$0	$4,557,054
17	0.371364	$11,709,143	$263,338	$0	$4,446,154
18	0.350344	$12,118,963	$263,338	$0	$4,338,062
19	0.330513	$12,543,127	$263,338	$0	$4,232,703
20	0.311805	$12,982,136	$263,338	$0	$4,130,002
					$111,762,686

A/P for 25 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE: PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK** **SOLTA-C-18-001**	**PROJECT:** **Tijuana River Diversion** **Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
	REGION: **R9** — **ESTIMATE LEVEL:** **PLANNING** — **UNIT PRICE LEVEL:** **April 2019**
Alternative 4d - New U.S. diversion infrastructure: New lift station to discharge to Point Loma WWTP	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 4e

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$10,000.00	30%	$6,000.00	$26,000.00
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		River Cross Sectional Weir							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$148.00	30%	$6,660.00	$28,860.00
	5	Steel rebar # 4		3,000	LB	$1.25	30%	$1,125.00	$4,875.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	30%	$15,000.00	$65,000.00
		New Concrete Riser							
	7	Concrete, ready mix delivered, 4,500 to 6,000 psi		35	CY	$185.00	30%	$1,942.50	$8,417.50
	8	Steel rebar # 4		1,000	LB	$1.25	30%	$375.00	$1,625.00
		Earthwork							
	9	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	30%	$13,500.00	$58,500.00
		River Intake Box							
	10	Concrete Cast in place 8'x8', 6' deep		2	EA	$2,392.62	30%	$1,435.57	$6,220.80
	11	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	12	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		Wastewater Pipelines							
	13	Trench cut, fill, compaction, and haul away excess		3,067	CY	$30.00	30%	$27,600.00	$119,600.00
	14	36" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		650	LF	$652.50	30%	$127,237.50	$551,362.50
	15	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		500	LF	$855.00	30%	$128,250.00	$555,750.00
	16	36" Gate Valve: Includes valve box, stem, accessories, complete in place		1	EA	$137,700.00	30%	$41,310.00	$179,010.00
	17	36" Check Valve: Includes valve box, stem, accessories, complete in place		1	EA	$114,000.00	30%	$34,200.00	$148,200.00
	18	42" Gate Valve: Includes valve box, stem, accessories, complete in place		1	EA	$240,975.00	30%	$72,292.50	$313,267.50
	19	42" Check Valve: Includes valve box, stem, accessories, complete in place		1	EA	$199,500.00	30%	$59,850.00	$259,350.00
		Wastewater Pipeline Replacement							
	20	Trench cut, fill, compaction, and haul away excess		93,833	CY	$35.00	30%	$985,250.00	$4,269,416.67
	21	30 in RCP replacement		5,630	LF	$1,584.00	30%	$2,675,376.00	$11,593,296.00
	22	Hydrostatic Leak Testing		1	EA	$80,000.00	30%	$24,000.00	$104,000.00
		Lift Station							
	23	Screen Metal		400	SF	$42.49	30%	$5,098.50	$22,093.50
	24	Natural gas generator: 60 Hz-250 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$232,607.78	30%	$69,782.33	$302,390.11
	25	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		3	EA	$256,250.00	30%	$230,625.00	$999,375.00
	26	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	30%	$170,663.32	$739,541.04
	27	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	30%	$7,500.00	$32,500.00
	29	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA.	$3,062.50	30%	$5,512.50	$23,887.50
	30	24" Check Valve: Includes stem, accessories, complete in place		3	EA.	$57,000.00	30%	$51,300.00	$222,300.00
	31	24" Gate Valve: Includes valve box, stem, accessories, complete in place		6	EA.	$45,900.00	30%	$82,620.00	$358,020.00
	32	Sumergible pump (734 gpm, 30 HP)		3	EA.	$45,000.00	30%	$40,500.00	$175,500.00
	33	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$185.00	30%	$19,425.00	$84,175.00
	34	Startup and Testing of Lift Station		1	EA.	$172,016.03	30%	$51,604.81	$223,620.84
		Master Control Shelter							
	35	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		1,000	LF	$8.25	30%	$2,475.00	$10,725.00
	36	Scructural Brick, Standard unit		800	SF	$16.45	30%	$3,948.00	$17,108.00
	37	Placing concrete footing, including labor and equipment to place, level and consolidate		1,200	CY	$35.50	30%	$12,780.00	$55,380.00
	38	Finishing contret floors, high tolerance, bull float and manual steel trowel		100	SF	$1.34	30%	$40.20	$174.20
	39	Cast Roof Deck cementittious/wood fiber planks		1,400	SF	$4.72	30%	$1,982.40	$8,590.40
	40	Solid wood roof decking western white srpuce		1,400	SF	$8.80	30%	$3,696.00	$16,016.00
	41	Plywood, prefinished, 3/4" thick 4'x8'		1,500	SF	$11.15	30%	$5,017.50	$21,742.50
	42	Asphalt roof shingles, pneumatic nailed		500	SQ	$178.00	30%	$26,700.00	$115,700.00
		Electrical							
	43	Drive for new motor		3	EA.	$66,344.94	30%	$59,710.45	$258,745.27
	44	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA.	$34,800.00	30%	$10,440.00	$45,240.00
	45	Transformer handling		1	EA.	$3,500.00	30%	$1,050.00	$4,550.00
	46	Isolating Transformer, 300 kVA		1	EA.	$31,800.00	30%	$9,540.00	$41,340.00
	47	Incoming Switchboards, 600 amp		3	EA.	$5,850.00	30%	$5,265.00	$22,815.00
		Trolley Hoist							
	48	W12 x 72 steel beam. Material only		60	LF	$125.00	30%	$2,250.00	$9,750.00
	49	W10 x 49 steel beam. Material only		200	LF	$90.00	30%	$5,400.00	$23,400.00
	50	Weld steel structure to extend existing hoist. Includes labor and welding material.		80	LH	$322.00	30%	$7,728.00	$33,488.00

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	51	Trench cut, fill, compaction, and haul away excess		100	CY	$20.00	30%	$600.00	$2,600.00
		Tie-in to Abandon Pipeline							
	52	Pipeline Tie-in		1	EA	$748,249.24	30%	$224,474.77	$972,724.01
		ROUNDED SUBTOTAL THIS SHEET							**$23,800,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$1,190,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$2,900,000.00
		Construction Phase Services				10.00%			$2,400,000.00
		Construction Contingecy				30.00%			$9,000,000.00
		General Contractor OH&P				15.00%			$4,100,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$43,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 4d. New U.S. diversion infrastructure: New lift station to discharge to Point Loma WWTP

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
U.S. 35 MGD LS						
	Personnel Labor	LS	1	$ 405,600.00		$ 405,600
	Intake Maintenance	LS	1	$ 51,026.12		$ 51,026
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 531,765.00		$ 531,765
	Piping and Valve Maintenance	LS	1	$ 400,850.00		$ 400,850
	Miscellaneous	LS	1	$ 135,712.26		$ 135,712
						$ 2,060,500
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 2,060,500**
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,020,467**

ROUNDED TOTAL CONSTRUCTION COST	**$ 43,000,000**
PRESENT WORTH OF O&M	**$ 60,780,000**
TOTAL PRESENT WORTH	**$ 103,780,000**
ANNUALIZED O&M COST	**$ 5,200,000**

Alternative 4d. New U.S. diversion infrastructure: New lift station to discharge to Point Loma WWTP

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 4d. New U.S. diversion infrastructure: New lift station to discharge to Point Loma WWTP	1		$43,000,000.00	$43,000,000	
		Total Anticipated Capital Costs:		$43,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	140	Daily	$5,645	$790,329	
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
		Total Anticipated O&M Costs:		$3,810,795	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$103,780,000**
O&M Present/Future Worth:	**$60,780,000**
Per Year O&M:	$5,200,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$3,944,173	$3,748,936	$0	$7,257,650
2	0.889996	$4,082,219	$3,748,936	$0	$6,969,700
3	0.839619	$4,225,097	$3,748,936	$0	$6,695,152
4	0.792094	$4,372,975	$3,748,936	$0	$6,433,314
5	0.747258	$4,526,029	$3,748,936	$262,483	$6,379,678
6	0.704961	$4,684,440	$3,748,936	$0	$5,945,198
7	0.665057	$4,848,396	$3,748,936	$0	$5,717,717
8	0.627412	$5,018,090	$3,748,936	$0	$5,500,540
9	0.591898	$5,193,723	$3,748,936	$0	$5,293,146
10	0.558395	$5,375,503	$3,748,936	$1,049,933	$5,681,316
11	0.526788	$5,563,646	$3,748,936	$0	$4,905,752
12	0.496969	$5,758,373	$3,748,936	$0	$4,724,841
13	0.468839	$5,959,916	$3,748,936	$0	$4,551,889
14	0.442301	$6,168,514	$3,748,936	$0	$4,386,497
15	0.417265	$6,384,412	$3,748,936	$262,483	$4,337,817
16	0.393646	$6,607,866	$3,748,936	$0	$4,076,917
17	0.371364	$6,839,141	$3,748,936	$0	$3,932,035
18	0.350344	$7,078,511	$3,748,936	$0	$3,793,329
19	0.330513	$7,326,259	$3,748,936	$0	$3,660,496
20	0.311805	$7,582,678	$3,748,936	$0	$3,533,251
					$103,776,236

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Alternative 4e - New U.S. Diversion Infrastructure: Gravity flow to the SBOO

PROJECT: **Tijuana River Diversion**
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**
UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt 4e

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$5,000.00	30%	$3,000.00	$13,000.00
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	30%	$522.00	$2,262.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	30%	$1,800.00	$7,800.00
		Wastewater Pipelines							
	4	Trench cut, fill, compaction, and haul away excess		28,000	CY	$35.00	30%	$294,000.00	$1,274,000.00
	5	48" RCP: lining for WW, furnish and install, does not include cut, backfill, or compaction		4,200	LF	$625.00	30%	$787,500.00	$3,412,500.00
	6	48" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$349,125.00	30%	$209,475.00	$907,725.00
	7	48" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$421,706.25	30%	$253,023.75	$1,096,436.25
	8	Tie-in 48" to SBOO, including all accessories, complete in place		1	EA	$65,000.00	30%	$19,500.00	$84,500.00
	9	Hydrostatic Leak Testing		2	EA	$80,000.00	30%	$48,000.00	$208,000.00
		Concrete Junction Box							
	10	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	30%	$54,000.00	$234,000.00
	11	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	30%	$66,000.00	$286,000.00
	12	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	30%	$7,500.00	$32,500.00
	13	Junction Box, cast in place, complete in place		1	EA.	$ 255,000.00	30%	$76,500.00	$331,500.00
	14	Concrete, ready mix delivered, 4,500 to 6,000 psi		250	CY	$185.00	30%	$13,875.00	$60,125.00
	15	Startup and Testing of Lift Station		1	EA.	$112,512.03	30%	$33,753.61	$146,265.63
		Master Control Shelter							
	22	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		800	LF	$8.25	30%	$1,980.00	$8,580.00
	23	Scructural Brick, Standard unit		600	SF	$16.45	30%	$2,961.00	$12,831.00
	24	Placing concrete footing, including labor and equipment to place, level and consolidate		800	CY	$35.50	30%	$8,520.00	$36,920.00
	25	Finishing contret floors, high tolerance, bull float and manual steel trowel		100	SF	$1.34	30%	$40.20	$174.20
	26	Cast Roof Deck cementittious/wood fiber planks		1,000	SF	$4.72	30%	$1,416.00	$6,136.00
	27	Solid wood roof decking western white srpuce		1,000	SF	$8.80	30%	$2,640.00	$11,440.00
	28	Plywood, prefinished, 3/4" thick 4'x8'		800	SF	$11.15	30%	$2,676.00	$11,596.00
	29	Asphalt roof shingles, pneumatic nailed		500	SQ	$178.00	30%	$26,700.00	$115,700.00
		Electrical for Multi-Rake							
	30	Drive for new motor		2	EA.	$66,344.94	30%	$39,806.97	$172,496.85
	31	New Transformer, liquid filled Pad mounted, 750 KVA		1	EA.	$34,800.00	30%	$10,440.00	$45,240.00
	32	Transformer handling		1	EA.	$3,500.00	30%	$1,050.00	$4,550.00
	33	Isolating Transformer, 300 kVA		1	EA.	$31,800.00	30%	$9,540.00	$41,340.00
	34	Incoming Switchboards, 600 amp		2	EA.	$5,850.00	30%	$3,510.00	$15,210.00
		Tie-in to SBOO							
	35	SBOO tie-in		1	EA	$897,899.09	30%	$269,369.73	$1,167,268.82
		ROUNDED SUBTOTAL THIS SHEET							**$9,800,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$490,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$1,200,000.00
		Construction Phase Services				10.00%			$1,000,000.00
		Construction Contingecy				30.00%			$3,800,000.00
		General Contractor OH&P				15.00%			$1,700,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$18,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 4e. New U.S. diversion infrastructure: Gravity flow to the SBOO

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
Gravity System to SBOO						
	Personnel Labor	LS	1	$ 147,300.00		$ 147,300
	Intake Maintenance	LS	1	$ 13,887.91		$ 13,888
	Vehicles usage and Maintenance	LS	1	$ 57,600.00		$ 57,600
	SCADA & Equipment Maintenance	LS	1	$ 49,453.05		$ 49,453
	Electrical System & Equipment Maintenance	LS	1	$ 65,937.40		$ 65,937
	Pump Equipment Maintenance	LS	1	$ 124,078.50		$ 124,079
	Piping and Valve Maintenance	LS	1	$ 76,161.50		$ 76,162
	Miscellaneous	LS	1	$ 40,081.38		$ 40,081
						$ 574,500
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 574,500**
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,020,467**
				ROUNDED TOTAL CONSTRUCTION COST		**$ 17,772,000**
				PRESENT WORTH OF O&M		**$ 51,047,000**
				TOTAL PRESENT WORTH		**$ 68,819,000**
				ANNUALIZED O&M COST		**$ 4,000,000**

Alternative 4e. New U.S. diversion infrastructure: Gravity flow to the SBOO

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 4e. New U.S. diversion infrastructure: Gravity flow to the SBOO	1		$17,772,000.00	$17,772,000	
	Total Anticipated Capital Costs:			$17,772,000	
Annual O&M Costs					
Total Operating Cost ($/day)	82	Daily	$1,574	$129,066	
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
	Total Anticipated O&M Costs:			$3,149,532	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$68,819,000**
O&M Present/Future Worth:	**$51,047,000**
Per Year O&M:	$4,000,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$3,259,766	$1,549,444	$0	$4,536,990
2	0.889996	$3,373,858	$1,549,444	$0	$4,381,721
3	0.839619	$3,491,943	$1,549,444	$0	$4,232,846
4	0.792094	$3,614,161	$1,549,444	$0	$4,090,059
5	0.747258	$3,740,656	$1,549,444	$457,288	$4,294,783
6	0.704961	$3,871,579	$1,549,444	$0	$3,821,608
7	0.665057	$4,007,085	$1,549,444	$0	$3,695,409
8	0.627412	$4,147,333	$1,549,444	$0	$3,574,228
9	0.591898	$4,292,489	$1,549,444	$0	$3,457,831
10	0.558395	$4,442,726	$1,549,444	$1,829,151	$4,367,385
11	0.526788	$4,598,222	$1,549,444	$0	$3,238,514
12	0.496969	$4,759,160	$1,549,444	$0	$3,135,183
13	0.468839	$4,925,730	$1,549,444	$0	$3,035,814
14	0.442301	$5,098,131	$1,549,444	$0	$2,940,229
15	0.417265	$5,276,565	$1,549,444	$457,288	$3,039,065
16	0.393646	$5,461,245	$1,549,444	$0	$2,759,732
17	0.371364	$5,652,389	$1,549,444	$0	$2,674,504
18	0.350344	$5,850,222	$1,549,444	$0	$2,592,427
19	0.330513	$6,054,980	$1,549,444	$0	$2,513,361
20	0.311805	$6,266,904	$1,549,444	$0	$2,437,174
					$68,818,862

A/P for 20 years:
0.078226718

ESTIMATE WORKSHEET

FEATURE:	PROJECT: Tijuana River Diversion
PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK** **SOLTA-C-18-001**	**Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
	REGION: R9 / **ESTIMATE LEVEL:** PLANNING / **UNIT PRICE LEVEL:** April 2019
Alternative 4f - New U.S. Diversion Infrastructure: Single inflatable dam or permanent weir on US-side of Tijuana River	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[TJ Diversion Tech Alts Table (100%).xlsx]top six Alts

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		Inflatable Dam							
	1	6' Inflatable Dam		1	EA	$250,000.00	30%	$75,000.00	$325,000.00
	2	Cam-lock fittings fill tubes (2 per dam)		2	EA	$55.00	30%	$33.00	$143.00
		Bypass Piping							
	3	Trench cut, fill, compaction, and haul away excess		569	CY	$20.00	30%	$3,413.33	$14,791.11
	4	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		160	LF	$290.00	30%	$13,920.00	$60,320.00
	5	42" MOV: Includes valve box, stem, accessories, complete in place		4	EA	$484,962.19	30%	$581,954.63	$2,521,803.38
	6	Trench cut, fill, compaction, and haul away excess		4	EA	$23,000.00	30%	$27,600.00	$119,600.00
	7	Tunneling. Includes labor, steel casing, carrier pipe, spacers, excatvation of pits, complete in place.		250	CY	$495.00	30%	$37,125.00	$160,875.00
	8	Concrete, ready mix delivered, slurry		80	CY	$130.00	20%	$2,080.00	$12,480.00
		Pipping to Discharge Option							
	9	Trench cut, fill, compaction, and haul away excess		711	CY	$20.00	30%	$4,266.67	$18,488.89
	10	12" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		800	LF	$63.50	30%	$15,240.00	$66,040.00
	11	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$11,500.00	30%	$3,450.00	$14,950.00
	12	Tunneling. Includes labor, steel casing, carrier pipe, spacers, excatvation of pits, complete in place.		250	CY	$495.00	30%	$37,125.00	$160,875.00
	13	Concrete, ready mix delivered, 4,500 to 6,000 psi		6	CY	$100.00	20%	$114.35	$686.08
		Electrical Control Room							
	14	Trench cut, fill, compaction, and haul away excess		1,000	CY	$20.00	30%	$6,000.00	$104,000.00
	15	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		1,000	LF	$8.25	30%	$2,475.00	$42,900.00
	16	Scructural Brick, Standard unit		1,100	SF	$16.45	30%	$5,428.50	$94,094.00
	17	Placing concrete footing, including labor and equipment to place, level and consolidate		1,000	CY	$35.50	30%	$10,650.00	$184,600.00
	18	Finishing contret floors, high tolerance, bull float and manual steel trowel		600	SF	$1.34	30%	$241.20	$4,180.80
	19	Cast Roof Deck cementittious/wood fiber planks		1,250	SF	$4.72	30%	$1,770.00	$30,680.00
	20	Solid wood roof decking western white srpuce		800	SF	$8.80	30%	$2,112.00	$36,608.00
	21	Plywood, prefinished, 3/4" thick 4'x8'		800	SF	$11.15	30%	$2,676.00	$46,384.00
	22	Asphalt roof shingles, pneumatic nailed		515	SQ	$178.00	30%	$27,501.00	$476,684.00
	23	Concrete, ready mix delivered, 4,500 to 6,000 psi		80	CY	$185.00	20%	$2,960.00	$17,760.00
		Miscellaneous							
	24	Freight		1	EA	$34,100.00	30%	$10,230.00	$44,330.00
	25	On-site inspection		2	EA	$18,000.00	30%	$10,800.00	$46,800.00
	26	Deployement and/or recovery of dams		1	EA	$5,700.00	30%	$1,710.00	$7,410.00
	27	One-day training		2	EA	$5,700.00	30%	$3,420.00	$14,820.00
						ROUNDED SUBTOTAL THIS SHEET			**$4,700,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$235,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$600,000.00
		Construction Phase Services				10.00%			$470,000.00
		Construction Contingecy				30.00%			$1,800,000.00
		General Contractor OH&P				15.00%			$810,000.00
						ROUNDED TOTAL CONSTRUCTION COST			**$8,600,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 4f. New U.S. diversion infrastructure: Single inflatable dam or permanent weir on US-side of the Tijuana River

Item No.	Item Description	Unit	Quantity	Unit Cost		TOTAL COST
	Study Level Opinion of Probable Annual Operation and Maintenance Costs					
Weir System						
	Personnel Labor	LS	1	$ 354,900.00		$ 354,900
	Intake Maintenance	LS	1	$ 117,373.51		$ 117,374
	Vehicles usage and Maintenance	LS	1	$ 57,600.00		$ 57,600
	Electrical System & Equipment Maintenance	LS	1	$ 49,453.05		$ 49,453
	Pump Equipment Maintenance	LS	1	$ 106,353.00		$ 106,353
	Piping and Valve Maintenance	LS	1	$ 76,161.50		$ 76,162
	Miscellaneous	LS	1	$ 38,092.05		$ 38,092
						$ 800,000
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 800,000**
GRAND TOTAL ANNUAL O&M COSTS						**$ 3,020,467**
	ROUNDED TOTAL CONSTRUCTION COST					**$ 8,600,000**
	PRESENT WORTH OF O&M					**$ 53,148,000**
	TOTAL PRESENT WORTH					**$ 61,748,000**
	ANNUALIZED O&M COST					**$ 4,000,000**

Alternative 4f. New U.S. diversion infrastructure: Single inflatable dam or permanent weir on US-side of the Tijuana River

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 4f. New U.S. diversion infrastructure: Single inflatable dam or permanent weir on US-side of the Tijuana River	1		$8,600,000.00	$8,600,000	
	Total Anticipated Capital Costs:			$8,600,000	
Annual O&M Costs					
Total Operating Cost ($/day)	140	Daily	$2,192	$306,849	
Total Operating Cost ($/day)	365	Daily	$8,275	$3,020,467	
	Total Anticipated O&M Costs:			$3,327,316	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$61,748,000**
O&M Present/Future Worth:	**$53,148,000**
Per Year O&M:	$4,000,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$3,443,772	$749,787	$0	$3,956,188
2	0.889996	$3,564,304	$749,787	$0	$3,839,526
3	0.839619	$3,689,055	$749,787	$0	$3,726,937
4	0.792094	$3,818,172	$749,787	$0	$3,618,251
5	0.747258	$3,951,808	$749,787	$253,205	$3,702,514
6	0.704961	$4,090,121	$749,787	$0	$3,411,944
7	0.665057	$4,233,275	$749,787	$0	$3,314,021
8	0.627412	$4,381,440	$749,787	$0	$3,219,395
9	0.591898	$4,534,790	$749,787	$0	$3,127,933
10	0.558395	$4,693,508	$749,787	$1,012,819	$3,605,060
11	0.526788	$4,857,780	$749,787	$0	$2,953,997
12	0.496969	$5,027,803	$749,787	$0	$2,871,285
13	0.468839	$5,203,776	$749,787	$0	$2,791,263
14	0.442301	$5,385,908	$749,787	$0	$2,713,824
15	0.417265	$5,574,415	$749,787	$253,205	$2,744,522
16	0.393646	$5,769,519	$749,787	$0	$2,566,301
17	0.371364	$5,971,452	$749,787	$0	$2,496,029
18	0.350344	$6,180,453	$749,787	$0	$2,427,967
19	0.330513	$6,396,769	$749,787	$0	$2,362,030
20	0.311805	$6,620,656	$749,787	$0	$2,298,139
					$61,747,126

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET

FEATURE: PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK** **SOLTA-C-18-001**	**PROJECT: Tijuana River Diversion** **Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
	REGION: R9 / **ESTIMATE LEVEL: PLANNING** / **UNIT PRICE LEVEL: April 2019**
Alternative 5a - Gravity reclaimed water pipeline from Tijuana's WWTPs to SBOO	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt5d

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		1	EA	$4,785.23	10%	$478.52	$5,263.75
	2	Frames and covers 30" to 36" wide frame		1	EA	$870.00	10%	$87.00	$957.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		2	EA	$1,500.00	10%	$300.00	$3,300.00
		River Cross Sectional Weir - PBCILA Intake							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$100.00	10%	$1,500.00	$16,500.00
	5	Steel rebar # 4		3,000	LB	$1.25	10%	$375.00	$4,125.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Earthwork							
	7	Trench cut, fill, compaction, and haul away excess		2,000	CY	$12.56	10%	$2,512.00	$27,632.00
		PBCILA							
	8	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	10%	$18,000.00	$198,000.00
	9	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	10%	$22,000.00	$242,000.00
	10	Replace pumps 2,3,4 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		3	EA	$251,196.17	10%	$75,358.85	$828,947.37
	11	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	10%	$56,887.77	$625,765.49
	12	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
	13	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	14	24" Check Valve: Includes stem, accessories, complete in place		12	EA	$57,000.00	10%	$68,400.00	$752,400.00
	15	24" Globe Valve		6	EA.	$45,900.00	10%	$27,540.00	$302,940.00
	16	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$100.00	10%	$3,500.00	$38,500.00
	17	24" Ductile Iron Piping: lining for WW, furnish and install		1,000	LF	$107.37	10%	$10,736.66	$118,103.28
	18	Lift Station Startup and Testing		1	LS	$274,186.86	10%	$27,418.69	$301,605.55
		Wet Well Modifications							
	19	Pump Station Wet well, cast in place, complete in place		1	LS	$229,500.00	10%	$22,950.00	$252,450.00
		Trolley Hoist							
	20	W12 x 72 steel beam. Material only		180	LF	$125.00	10%	$2,250.00	$24,750.00
	21	W10 x 49 steel beam. Material only		600	LF	$90.00	10%	$5,400.00	$59,400.00
	23	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	24	Electrical Controls and Istrumentation		1	LS	$69,863.20	10%	$6,986.32	$76,849.52
		Electrical							
	25	New Transformer, liquid filled Pad mounted, 500 KVA		3	EA	$66,344.94	10%	$19,903.48	$218,938.31
	26	Transformer handling		1	EA	$1,749.00	10%	$174.90	$1,923.90
	27	Lift Station Startup and Testing		1	EA	$31,800.00	10%	$3,180.00	$34,980.00
	27	84 in RCP: for WW, furnish and install, does not include cut, backfill, or compaction		1	EA	$6,727.50	10%	$672.75	$7,400.25
	28	Electrical Conduit replacement		2	EA	$16,966.67	10%	$3,393.33	$37,326.67
	29	Screen Metal		1	LS	$36,599.49	10%	$3,659.95	$40,259.44
	30	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
	31	Natural gas generator: 60 Hz-350 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$130,000.00	10%	$13,000.00	$143,000.00
		Earthwork							
	31	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		Process Intigration							
	32	SCADA and Telemetry System		1	LS	$625,794.01	10%	$62,579.40	$688,373.41
		PB1A							
	33	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifugal single stage vertical pump		4	EA	$358,851.67	10%	$143,540.67	$1,578,947.37
	34	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	35	24" Check valve		2	EA	$57,000.00	10%	$11,400.00	$125,400.00
	36	24" Globe Valve		2	EA	$45,900.00	10%	$9,180.00	$100,980.00
	37	24" Ductile Iron Piping: lining for WW, furnish and install		2,000	LF	$85.89	10%	$17,178.66	$188,965.24
	38	Demolish pump 1,2,3,4		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	39	Lift Station Startup and Testing		1	LS	$239,799.26	10%	$23,979.93	$263,779.19
		Earthwork							
	39	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Concrete							
	40	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	41	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	42	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	43	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	44	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	45	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	47	Trench cut, fill, compaction, and haul away excess		2,500	CY	$12.56	10%	$3,140.00	$34,540.00
	48	Electrical Controls and Istrumentation		1	LS	$62,009.20	10%	$6,200.92	$68,210.12
		Electrical							

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	49	Drive for new motor		1	EA	$ 66,344.94	10%	$6,634.49	$72,979.44
	50	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$20,700.00	10%	$2,070.00	$22,770.00
	51	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	52	Electrical Conduit replacement		1	LS	$31,226.81	10%	$3,122.68	$34,349.49
	53	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	54	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	55	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	55	SCADA and Telemetry System		1	LS	$344,557.03	10%	$34,455.70	$379,012.73
		PB1B							
	56	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	57	Multi-Rake Bar Screen (Fine)		2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	58	24" Ductile Iron Piping: lining for WW, furnish and install		3,000	LF	$107.37	10%	$10.74	$322,110.58
	59	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifugal single stage vertical pump		4	EA	$358,851.67	10%	$35,885.17	$1,471,291.87
	60	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	61	Lift Station Startup and Testing		1	LS	$267,890.25	10%	$26,789.02	$294,679.27
		Earthwork							
	62	Trench cut, fill, compaction, and haul away excess		7,000	CY	$12.56	10%	$8,792.00	$96,712.00
		Concrete							
	63	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	64	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	65	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	66	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	67	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	69	5 Ton Hoist		1	EA	$6,750.00	10%	$675.00	$7,425.00
	70	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Electrical							
	71	Drive for new motor		4	EA	$ 66,344.94	10%	$26,537.98	$291,917.75
	72	New Transformer, liquid filled Pad mounted, 500 KVA		2	EA	$20,700.00	10%	$4,140.00	$45,540.00
	73	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	74	Isolating Transformer, 300 kVA		2	EA	$18,000.00	10%	$3,600.00	$39,600.00
	75	Electrical Conduit replacement		1	LS	$28,598.74	10%	$2,859.87	$31,458.61
	76	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	77	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	78	SCADA and Telemetry System		1		$157,712.92	10%	$15,771.29	$173,484.21
		Wastewater Pipelines (Tijuana Portion)							
	79	Trench cut, fill, compaction, and haul away excess		1,454,188	CY	$3.65	10%	$530,052.68	$5,830,579.46
	80	36-in PVC: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		11,037	LF	$135.00	10%	$149,002.20	$1,639,024.20
	81	48 in HDPE: lining for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		10,365	LF	$250.00	10%	$259,120.00	$2,850,320.00
	82	60 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		28,323	LF	$362.50	10%	$1,026,701.50	$11,293,716.50
	83	60 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		36,028	LF	$362.50	10%	$1,305,997.60	$14,365,973.60
	84	78 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		30,583	LF	$525.63	10%	$1,607,504.22	$17,682,546.42
	85	Concrete, ready mix delivered, 4,500 to 6,000 psi		33,931	CY	$85.89	10%	$291,444.99	$3,205,894.88
	86	Hydrostatic Leak Testing		75	EA	$80,000.00	10%	$600,000.00	$6,600,000.00
		Tie-in to SBOO							
	87	SBOO tie-in		1	EA	$897,899.09	30%	$269,369.73	$1,167,268.82
		Wastewater Pipeline Replacement (San Diego County)							
	88	Trench cut, fill, compaction, and haul away excess		30,000	CY	$35.00	30%	$315,000.00	$1,365,000.00
	89	78 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (SD)		1,800	LF	$1,821.60	30%	$983,664.00	$4,262,544.00
	90	Concrete, ready mix delivered, 4,500 to 6,000 psi		9,275	CY	$170.20	30%	$473,596.39	$2,052,251.03
	90	Hydrostatic Leak Testing		6	EA	$172,800.00	30%	$320,554.08	$1,389,067.68
		ROUNDED SUBTOTAL THIS SHEET							**$86,860,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$4,300,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$10,400,000.00
		Construction Phase Services				10.00%			$8,600,000.00
		Construction Contingency				30.00%			$33,000,000.00
		General Contractor OH&P				15.00%			$15,000,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$158,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 5a. Gravity reclaimed water pipeline from WWTPs to SBOO

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
Pipelines - Tijuana Portion						
	Personnel Labor	LS	1	$ 57,480.00		$ 57,480
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 68,590.80		$ 68,591
	Pump Equipment Maintenance	LS	4	$ 30,502.39		$ 122,010
	Piping and Valve Maintenance	LS	4	$ 14,354.07		$ 57,416
	Miscellaneous	LS	1	$ 19,978.16		$ 19,978
						$ 554,111
Pipelines - San Diego Portion						
	Personnel Labor	LS	1	$ 147,300.00		$ 147,300
	Intake Maintenance	LS	1	$ 13,887.91		$ 13,888
	Vehicles usage and Maintenance	LS	1	$ 57,600.00		$ 57,600
	SCADA & Equipment Maintenance	LS	1	$ 49,453.05		$ 49,453
	Electrical System & Equipment Maintenance	LS	1	$ 65,937.40		$ 65,937
	Pump Equipment Maintenance	LS	1	$ 124,078.50		$ 124,079
	Piping and Valve Maintenance	LS	1	$ 76,161.50		$ 76,162
	Miscellaneous	LS	1	$ 40,081.38		$ 40,081
						$ 574,500
GRAND TOTAL ANNUAL O&M COSTS						**$ 4,149,077**
		ROUNDED TOTAL CONSTRUCTION COST				**$ 158,000,000**
		PRESENT WORTH OF O&M				**$ 98,522,000**
		TOTAL PRESENT WORTH				**$ 256,522,000**
		ANNUALIZED O&M COST				**$ 5,400,000**

Alternative 5a. Gravity reclaimed water pipeline from WWTPs to SBOO

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 5a. Gravity reclaimed water pipeline from WWTPs to SBOO	1		$158,000,000.00	$158,000,000	
	Total Anticipated Capital Costs:			$158,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$11,367	$4,149,077	
	Total Anticipated O&M Costs:			$4,149,077	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$227,092,884**
O&M Present/Future Worth:	**$69,092,884**
Per Year O&M:	$5,400,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	Present /Future Worth (p/f)	Annual O&M Costs	Debt Service Payment on Capital Investment	Repair/ Replacement Costs	Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs
0	1.000000	$0		$0	$0
1	0.943396	$4,294,295	$13,775,160	$0	$17,046,655
2	0.889996	$4,444,595	$13,775,160	$0	$16,215,517
3	0.839619	$4,600,156	$13,775,160	$0	$15,428,270
4	0.792094	$4,761,161	$13,775,160	$0	$14,682,503
5	0.747258	$4,927,802	$13,775,160	$1,280,406	$14,932,735
6	0.704961	$5,100,275	$13,775,160	$0	$13,306,437
7	0.665057	$5,278,785	$13,775,160	$0	$12,671,962
8	0.627412	$5,463,542	$13,775,160	$0	$12,070,600
9	0.591898	$5,654,766	$13,775,160	$0	$11,500,543
10	0.558395	$5,852,683	$13,775,160	$3,658,302	$13,002,862
11	0.526788	$6,057,527	$13,775,160	$0	$10,447,612
12	0.496969	$6,269,540	$13,775,160	$0	$9,961,602
13	0.468839	$6,488,974	$13,775,160	$0	$9,500,617
14	0.442301	$6,716,088	$13,775,160	$0	$9,063,299
15	0.417265	$6,951,152	$13,775,160	$1,280,406	$9,182,634
16	0.393646	$7,194,442	$13,775,160	$0	$8,254,606
17	0.371364	$7,446,247	$13,775,160	$0	$7,880,876
18	0.350344	$7,706,866	$13,775,160	$1,024,324	$7,884,960
19	0.330513	$7,976,606	$13,775,160	$0	$7,189,242
					$227,092,884

A/P for 25 years:
0.078226718

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST

NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Alternative 5b - Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP

PROJECT: **Tijuana River Diversion**

Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**

UNIT PRICE LEVEL: **April 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt5d

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		1	EA	$10,000.00	10%	$1,000.00	$11,000.00
	2	Frames and covers 30" to 36" wide frame		1	EA	$870.00	10%	$87.00	$957.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		2	EA	$1,500.00	10%	$300.00	$3,300.00
		River Cross Sectional Weir - PBCILA Intake							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$100.00	10%	$1,500.00	$16,500.00
	5	Steel rebar # 4		3,000	LB	$1.25	10%	$375.00	$4,125.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Earthwork							
	4	Trench cut, fill, compaction, and haul away excess		2,000	CY	$12.56	10%	$2,512.00	$27,632.00
		PBCILA							
	5	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	10%	$18,000.00	$198,000.00
	6	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	10%	$22,000.00	$242,000.00
	7	Replace pumps 2,3,4 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		3	EA	$251,196.17	10%	$75,358.85	$828,947.37
	8	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	10%	$56,887.77	$625,765.49
	9	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
	10	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	11	24" Check Valve: Includes stem, accessories, complete in place		12	EA	$57,000.00	10%	$68,400.00	$752,400.00
	12	24" Globe Valve		6	EA.	$45,900.00	10%	$27,540.00	$302,940.00
	13	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$100.00	10%	$3,500.00	$38,500.00
	14	24" Ductile Iron Piping: lining for WW, furnish and install		1,000	LF	$107.37	10%	$10,736.66	$118,103.28
	15	Lift Station Startup and Testing		1	LS	$274,186.86	10%	$27,418.69	$301,605.55
		Wet Well Modifications							
	16	Pump Station Wet well, cast in place, complete in place		1	LS	$229,500.00	10%	$22,950.00	$252,450.00
		Trolley Hoist							
	17	W12 x 72 steel beam. Material only		180	LF	$125.00	10%	$2,250.00	$24,750.00
	18	W10 x 49 steel beam. Material only		600	LF	$90.00	10%	$5,400.00	$59,400.00
	20	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	21	Electrical Controls and Istrumentation		1	LS	$69,863.20	10%	$6,986.32	$76,849.52
		Electrical							
	22	New Transformer, liquid filled Pad mounted, 500 KVA		3	EA	$ 66,344.94	10%	$19,903.48	$218,938.31
	23	Transformer handling		1	EA	$1,749.00	10%	$174.90	$1,923.90
	24	Lift Station Startup and Testing		1	EA	$31,800.00	10%	$3,180.00	$34,980.00
	24	Loop-Feed Switch		1	EA	$6,727.50	10%	$672.75	$7,400.25
	25	Electrical Conduit replacement		2	EA	$16,966.67	10%	$3,393.33	$37,326.67
	26	Screen Metal		1	LS	$36,599.49	10%	$3,659.95	$40,259.44
	27	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
	28	Natural gas generator: 60 Hz-350 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$130,000.00	10%	$13,000.00	$143,000.00
		Earthwork							
	28	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		Process Intigration							
	29	SCADA and Telemetry System		1	LS	$483,145.23	10%	$48,314.52	$531,459.75
		PB1A							
	30	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$358,851.67	10%	$143,540.67	$1,578,947.37
	31	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	32	24" Check valve		2	EA	$57,000.00	10%	$11,400.00	$125,400.00
	33	24" Globe Valve		2	EA	$45,900.00	10%	$9,180.00	$100,980.00
	34	24" Ductile Iron Piping: lining for WW, furnish and install		2,000	LF	$107.37	10%	$21,473.32	$236,206.55
	35	Demolish pump 1,2,3,4		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	36	Lift Station Startup and Testing		1	LS	$244,523.39	10%	$24,452.34	$268,975.73
		Earthwork							
	36	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Concrete							
	37	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	38	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	39	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	40	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	41	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	42	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	44	Trench cut, fill, compaction, and haul away excess		2,500	CY	$12.56	10%	$3,140.00	$34,540.00
	45	Electrical Controls and Istrumentation		1	LS	$62,009.20	10%	$6,200.92	$68,210.12
		Electrical							

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	46	Drive for new motor		1	EA	$ 66,344.94	10%	$6,634.49	$72,979.44
	47	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$34,800.00	10%	$3,480.00	$38,280.00
	48	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	49	Electrical Conduit replacement		1	LS	$34,751.81	10%	$3,475.18	$38,226.99
	50	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	51	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	52	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	52	SCADA and Telemetry System		1	LS	$351,939.33	10%	$35,193.93	$387,133.26
		PB1B							
	53	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	54	Multi-Rake Bar Screen (Fine)		2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	55	24" Ductile Iron Piping: lining for WW, furnish and install		3,000	LF	$285.00	10%	$28.50	$855,028.50
	56	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$358,851.67	10%	$35,885.17	$1,471,291.87
	57	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$25,000.00	10%	$2,500.00	$27,500.00
	58	Lift Station Startup and Testing		1	LS	$321,182.04	10%	$32,118.20	$353,300.24
		Earthwork							
	59	Trench cut, fill, compaction, and haul away excess		7,000	CY	$12.56	10%	$8,792.00	$96,712.00
		Concrete							
	60	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	61	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	62	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	63	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	64	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	66	5 Ton Hoist		1	EA	$6,750.00	10%	$675.00	$7,425.00
	67	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Electrical							
	68	Drive for new motor		4	EA	$ 66,344.94	10%	$26,537.98	$291,917.75
	69	New Transformer, liquid filled Pad mounted, 500 KVA		2	EA	$34,800.00	10%	$6,960.00	$76,560.00
	70	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	71	Isolating Transformer, 300 kVA		2	EA	$31,800.00	10%	$6,360.00	$69,960.00
	72	Electrical Conduit replacement		1	LS	$35,573.74	10%	$3,557.37	$39,131.11
	73	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	74	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	75	SCADA and Telemetry System		1		$186,807.96	10%	$18,680.80	$205,488.76
		Wastewater Pipelines (Tijuana Portion)							
	76	Trench cut, fill, compaction, and haul away excess		1,454,188	CY	$3.65	10%	$530,052.68	$5,830,579.46
	77	36-in PVC: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		11,037	LF	$135.00	10%	$149,002.20	$1,639,024.20
	78	48 in HDPE: lining for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		10,365	LF	$250.00	10%	$259,120.00	$2,850,320.00
	79	60 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		28,323	LF	$362.50	10%	$1,026,701.50	$11,293,716.50
	80	60 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		36,028	LF	$362.50	10%	$1,305,997.60	$14,365,973.60
	81	78 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		30,583	LF	$525.63	10%	$1,607,504.22	$17,682,546.42
	82	Concrete, ready mix delivered, 4,500 to 6,000 psi		33,931	CY	$100.00	10%	$339,310.53	$3,732,415.87
	83	Hydrostatic Leak Testing		75	EA	$80,000.00	10%	$600,000.00	$6,600,000.00
		Wastewater Pipeline Replacement (San Diego County)							
	84	Trench cut, fill, compaction, and haul away excess		93,833	CY	$35.00	30%	$985,250.00	$4,269,416.67
	85	30 in RCP replacement		5,630	LF	$1,584.00	30%	$2,675,376.00	$11,593,296.00
	86	Hydrostatic Leak Testing		4	EA	$80,000.00	30%	$90,080.00	$390,346.67
		Tie-in to Abandon Pipeline							
	87	Pipeline Tie-in		1	EA	$748,249.24	30%	$224,474.77	$972,724.01
		ROUNDED SUBTOTAL THIS SHEET							**$95,000,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$4,750,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$11,400,000.00
		Construction Phase Services				10.00%			$9,500,000.00
		Construction Contingency				30.00%			$36,195,000.00
		General Contractor OH&P				15.00%			$16,300,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$173,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 5b. Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
U.S. 35 MGD LS						
	Personnel Labor	LS	1	$ 405,600.00		$ 405,600
	Intake Maintenance	LS	1	$ 65,015.35		$ 65,015
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 797,647.50		$ 797,648
	Piping and Valve Maintenance	LS	1	$ 601,275.00		$ 601,275
	Miscellaneous	LS	1	$ 171,734.52		$ 171,735
						$ 2,576,800
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
Pipelines - Tijuana Portion						
	Personnel Labor	LS	1	$ 57,480.00		$ 57,480
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 68,590.80		$ 68,591
	Pump Equipment Maintenance	LS	4	$ 30,502.39		$ 122,010
	Piping and Valve Maintenance	LS	4	$ 14,354.07		$ 57,416
	Miscellaneous	LS	1	$ 19,978.16		$ 19,978
						$ 554,111
Pipelines - San Diego Portion						
	Personnel Labor	LS	1	$ 147,300.00		$ 147,300
	Intake Maintenance	LS	1	$ 13,887.91		$ 13,888
	Vehicles usage and Maintenance	LS	1	$ 57,600.00		$ 57,600
	SCADA & Equipment Maintenance	LS	1	$ 49,453.05		$ 49,453
	Electrical System & Equipment Maintenance	LS	1	$ 65,937.40		$ 65,937
	Pump Equipment Maintenance	LS	1	$ 124,078.50		$ 124,079
	Piping and Valve Maintenance	LS	1	$ 76,161.50		$ 76,162
	Miscellaneous	LS	1	$ 40,081.38		$ 40,081
						$ 574,500
GRAND TOTAL ANNUAL O&M COSTS						**$ 5,597,267**

ROUNDED TOTAL CONSTRUCTION COST	**$ 173,000,000**
PRESENT WORTH OF O&M	**$ 132,911,000**
TOTAL PRESENT WORTH	**$ 305,911,000**
ANNUALIZED O&M COST	**$ 6,900,000**

Alternative 5b. Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 5b. Gravity reclaimed water pipeline system from WWTPs to Point Loma WWTP	1		$173,000,000.00	$173,000,000	
	Total Anticipated Capital Costs:			$173,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$15,335	$5,597,267	
	Total Anticipated O&M Costs:			$5,597,267	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$260,957,581**
O&M Present/Future Worth:	**$87,957,581**
Per Year O&M:	$6,900,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$5,793,171	$15,082,928	$0	$19,694,433
2	0.889996	$5,995,932	$15,082,928	$0	$18,760,111
3	0.839619	$6,205,790	$15,082,928	$0	$17,874,418
4	0.792094	$6,422,992	$15,082,928	$0	$17,034,703
5	0.747258	$6,647,797	$15,082,928	$0	$16,238,462
6	0.704961	$6,880,470	$15,082,928	$0	$15,483,329
7	0.665057	$7,121,286	$15,082,928	$0	$14,767,071
8	0.627412	$7,370,531	$15,082,928	$0	$14,087,578
9	0.591898	$7,628,500	$15,082,928	$0	$13,442,859
10	0.558395	$7,895,497	$15,082,928	$0	$12,831,033
11	0.526788	$8,171,840	$15,082,928	$0	$12,250,322
12	0.496969	$8,457,854	$15,082,928	$0	$11,699,048
13	0.468839	$8,753,879	$15,082,928	$0	$11,175,625
14	0.442301	$9,060,265	$15,082,928	$0	$10,678,558
15	0.417265	$9,377,374	$15,082,928	$0	$10,206,430
16	0.393646	$9,705,582	$15,082,928	$0	$9,757,905
17	0.371364	$10,045,277	$15,082,928	$0	$9,331,722
18	0.350344	$10,396,862	$15,082,928	$0	$8,926,686
19	0.330513	$10,760,752	$15,082,928	$0	$8,541,673
20	0.311805	$11,137,379	$15,082,928	$0	$8,175,616
					$260,957,581

A/P for 25 years:
0.078226718

ESTIMATE WORKSHEET

FEATURE: PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK**	**PROJECT: Tijuana River Diversion** **Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
SOLTA-C-18-001	**REGION:** **R9** | **ESTIMATE LEVEL:** **PLANNING** | **UNIT PRICE LEVEL:** **April 2019**
Alternative 5c – Gravity reclaimed water pipeline system from WWTPs to Punta Bandera (ocean discharge)	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt5d

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box - PBCILA							
	1	Concrete Cast in place 8'x8', 6' deep		1	EA	$4,785.23	10%	$478.52	$5,263.75
	2	Frames and covers 30" to 36" wide frame		1	EA	$870.00	10%	$87.00	$957.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		2	EA	$1,500.00	10%	$300.00	$3,300.00
		River Cross Sectional Weir - PBCILA Intake							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$100.00	10%	$1,500.00	$16,500.00
	5	Steel rebar # 4		3,000	LB	$1.25	10%	$375.00	$4,125.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Earthwork							
	7	Trench cut, fill, compaction, and haul away excess		2,000	CY	$12.56	10%	$2,512.00	$27,632.00
		PBCILA							
	8	Multi-Rake Bar Screen (Coarse)		1	EA	$180,000.00	10%	$18,000.00	$198,000.00
	9	Multi-Rake Bar Screen (Fine)		1	EA	$220,000.00	10%	$22,000.00	$242,000.00
	10	Replace pumps 2,3,4 (Cornell pump Model: 16NHG22, 350 HP, 8500 gpm)		3	EA	$251,196.17	10%	$75,358.85	$828,947.37
	11	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	10%	$56,887.77	$625,765.49
	12	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		3	EA	$20,000.00	10%	$6,000.00	$66,000.00
	13	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA	$3,062.50	10%	$1,837.50	$20,212.50
	14	24" Check Valve: Includes stem, accessories, complete in place		12	EA	$57,000.00	10%	$68,400.00	$752,400.00
	15	24" Globe Valve		6	EA.	$45,900.00	10%	$27,540.00	$302,940.00
	16	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$100.00	10%	$3,500.00	$38,500.00
	17	24" Ductile Iron Piping: lining for WW, furnish and install		1,000	LF	$107.37	10%	$10,736.66	$118,103.28
	18	Lift Station Startup and Testing		1	LS	$275,286.86	10%	$27,528.69	$302,815.55
		Wet Well Modifications							
	19	Pump Station Wet well, cast in place, complete in place		1	LS	$229,500.00	10%	$22,950.00	$252,450.00
		Trolley Hoist							
	20	W12 x 72 steel beam. Material only		180	LF	$125.00	10%	$2,250.00	$24,750.00
	21	W10 x 49 steel beam. Material only		600	LF	$90.00	10%	$5,400.00	$59,400.00
	23	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	24	Electrical Controls and Istrumentation		1	LS	$69,863.20	10%	$6,986.32	$76,849.52
		Electrical							
	25	New Transformer, liquid filled Pad mounted, 500 KVA		3	EA	$ 66,344.94	10%	$19,903.48	$218,938.31
	26	Transformer handling		1	EA	$1,749.00	10%	$174.90	$1,923.90
	27	Lift Station Startup and Testing		1	EA	$31,800.00	10%	$3,180.00	$34,980.00
	27	84 in RCP: for WW, furnish and install, does not include cut, backfill, or compaction		1	EA	$6,727.50	10%	$672.75	$7,400.25
	28	Electrical Conduit replacement		2	EA	$16,966.67	10%	$3,393.33	$37,326.67
	29	Screen Metal		1	LS	$36,599.49	10%	$3,659.95	$40,259.44
	30	Electrical Improvements		1	EA	$22,809.85	10%	$2,280.98	$25,090.83
	31	Natural gas generator: 60 Hz-350 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$130,000.00	10%	$13,000.00	$143,000.00
		Earthwork							
	32	Trench cut, fill, compaction, and haul away excess		3,000	CY	$12.56	10%	$3,768.00	$41,448.00
		Process Intigration							
	33	SCADA and Telemetry System		1	LS	$624,507.01	10%	$62,450.70	$686,957.71
		PB1A							
	34	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$358,851.67	10%	$143,540.67	$1,578,947.37
	35	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$10,000.00	10%	$2,000.00	$22,000.00
	36	24" Check valve		2	EA	$57,000.00	10%	$11,400.00	$125,400.00
	37	24" Globe Valve		2	EA	$45,900.00	10%	$9,180.00	$100,980.00
	38	24" Ductile Iron Piping: lining for WW, furnish and install		2,000	LF	$285.00	10%	$57,000.00	$627,000.00
	39	Demolish pump 1,2,3,4		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	40	Lift Station Startup and Testing		1	LS	$283,052.74	10%	$28,305.27	$311,358.01
		Earthwork							
	41	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Concrete							
	42	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	43	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	44	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	45	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	46	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	47	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	49	Trench cut, fill, compaction, and haul away excess		2,500	CY	$12.56	10%	$3,140.00	$34,540.00
	50	Electrical Controls and Istrumentation		1	LS	$62,009.20	10%	$6,200.92	$68,210.12
		Electrical							

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	51	Drive for new motor		1	EA	$ 66,344.94	10%	$6,634.49	$72,979.44
	52	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$20,700.00	10%	$2,070.00	$22,770.00
	53	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	54	Electrical Conduit replacement		1	LS	$31,226.81	10%	$3,122.68	$34,349.49
	55	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	56	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	57	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	58	SCADA and Telemetry System		1	LS	$353,946.38	10%	$35,394.64	$389,341.02
		PB1B							
	59	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	60	Multi-Rake Bar Screen (Fine)		2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	61	24" Ductile Iron Piping: lining for WW, furnish and install		3,000	LF	$107.37	10%	$10.74	$322,110.58
	62	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifugal single stage vertical pump		4	EA	$358,851.67	10%	$35,885.17	$1,471,291.87
	63	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$10,000.00	10%	$1,000.00	$11,000.00
	64	Lift Station Startup and Testing		1	LS	$266,240.25	10%	$26,624.02	$292,864.27
		Earthwork							
	65	Trench cut, fill, compaction, and haul away excess		7,000	CY	$12.56	10%	$8,792.00	$96,712.00
		Concrete							
	66	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	67	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	68	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	69	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	70	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	72	5 Ton Hoist		1	EA	$6,750.00	10%	$675.00	$7,425.00
	73	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Electrical							
	74	Drive for new motor		4	EA	$ 66,344.94	10%	$26,537.98	$291,917.75
	75	New Transformer, liquid filled Pad mounted, 500 KVA		2	EA	$20,700.00	10%	$4,140.00	$45,540.00
	76	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	77	Isolating Transformer, 300 kVA		2	EA	$18,000.00	10%	$3,600.00	$39,600.00
	78	Electrical Conduit replacement		1	LS	$28,598.74	10%	$2,859.87	$31,458.61
	79	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	80	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	81	SCADA and Telemetry System		1		$152,218.42	10%	$15,221.84	$167,440.26
		Wastewater Pipelines (Tijuana Portion)							
	82	Trench cut, fill, compaction, and haul away excess		2,175,911	CY	$3.65	10%	$793,121.28	$8,724,334.12
	83	36-in PVC: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		11,037	LF	$135.00	10%	$149,002.20	$1,639,024.20
	84	48 in HDPE: lining for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		21,766	LF	$250.00	10%	$544,152.00	$5,985,672.00
	85	60 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		56,646	LF	$362.50	10%	$2,053,403.00	$22,587,433.00
	86	60 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		54,041	LF	$362.50	10%	$1,958,996.40	$21,548,960.40
	87	78 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		30,583	LF	$525.63	10%	$1,607,504.22	$17,682,546.42
	88	Concrete, ready mix delivered, 4,500 to 6,000 psi		50,771	CY	$100.00	10%	$507,712.57	$5,584,838.23
	89	Hydrostatic Leak Testing		105	EA	$80,000.00	10%	$840,000.00	$9,240,000.00
		Tie-in to SBOO							
	90	SBOO tie-in		1	EA	$897,899.09	30%	$269,369.73	$1,167,268.82
		Wastewater Pipeline Replacement (San Diego County)							
	91	Trench cut, fill, compaction, and haul away excess		30,000	CY	$35.00	30%	$315,000.00	$1,365,000.00
	92	78 in HDPE: for WW, furnish and install, does not include cut, backfill, or compaction (SD)		1,800	LF	$1,821.60	30%	$983,664.00	$4,262,544.00
	93	Concrete, ready mix delivered, 4,500 to 6,000 psi		9,275	CY	$170.20	30%	$473,596.39	$2,052,251.03
	93	Hydrostatic Leak Testing		6	EA	$172,800.00	30%	$320,554.08	$1,389,067.68
		ROUNDED SUBTOTAL THIS SHEET							**$116,870,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$5,850,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$14,100,000.00
		Construction Phase Services				10.00%			$11,700,000.00
		Construction Contingency				30.00%			$44,500,000.00
		General Contractor OH&P				15.00%			$20,100,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$213,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
03/30/19	04/08/19	03/30/19	04/08/19

Alternative 5c. Gravity reclaimed water pipeline system from WWTPs to Punta Bandera (ocean discharge)

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
Pipelines - Tijuana Portion						
	Personnel Labor	LS	1	$ 57,480.00		$ 57,480
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 68,590.80		$ 68,591
	Pump Equipment Maintenance	LS	4	$ 30,502.39		$ 122,010
	Piping and Valve Maintenance	LS	4	$ 14,354.07		$ 57,416
	Miscellaneous	LS	1	$ 19,978.16		$ 19,978
						$ 554,111
Pipelines - San Diego Portion						
	Personnel Labor	LS	1	$ 147,300.00		$ 147,300
	Intake Maintenance	LS	1	$ 13,887.91		$ 13,888
	Vehicles usage and Maintenance	LS	1	$ 57,600.00		$ 57,600
	SCADA & Equipment Maintenance	LS	1	$ 49,453.05		$ 49,453
	Electrical System & Equipment Maintenance	LS	1	$ 65,937.40		$ 65,937
	Pump Equipment Maintenance	LS	1	$ 124,078.50		$ 124,079
	Piping and Valve Maintenance	LS	1	$ 76,161.50		$ 76,162
	Miscellaneous	LS	1	$ 40,081.38		$ 40,081
						$ 574,500
GRAND TOTAL ANNUAL O&M COSTS						**$ 4,149,077**

ROUNDED TOTAL CONSTRUCTION COST	**$ 213,000,000**
PRESENT WORTH OF O&M	**$ 98,522,000**
TOTAL PRESENT WORTH	**$ 311,522,000**
ANNUALIZED O&M COST	**$ 5,400,000**

Alternative 5c. Gravity reclaimed water pipeline system from WWTPs to Punta Bandera (ocean discharge)

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 5c. Gravity reclaimed water pipeline system from WWTPs to Punta Bandera (ocean discharge)	1		$213,000,000.00	$213,000,000	
	Total Anticipated Capital Costs:			$213,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$11,367	$4,149,077	
	Total Anticipated O&M Costs:			$4,149,077	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$282,092,884**
O&M Present/Future Worth:	**$69,092,884**
Per Year O&M:	$5,400,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	**Present /Future Worth (p/f)**	**Annual O&M Costs**	**Debt Service Payment on Capital Investment**	**Repair/ Replacement Costs**	**Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs**
0	1.000000	$0		$0	$0
1	0.943396	$4,294,295	$18,570,311	$0	$21,570,383
2	0.889996	$4,444,595	$18,570,311	$0	$20,483,184
3	0.839619	$4,600,156	$18,570,311	$0	$19,454,371
4	0.792094	$4,761,161	$18,570,311	$0	$18,480,711
5	0.747258	$4,927,802	$18,570,311	$1,280,406	$18,515,950
6	0.704961	$5,100,275	$18,570,311	$0	$16,686,829
7	0.665057	$5,278,785	$18,570,311	$0	$15,861,011
8	0.627412	$5,463,542	$18,570,311	$0	$15,079,137
9	0.591898	$5,654,766	$18,570,311	$0	$14,338,786
10	0.558395	$5,852,683	$18,570,311	$3,658,302	$15,680,449
11	0.526788	$6,057,527	$18,570,311	$0	$12,973,638
12	0.496969	$6,269,540	$18,570,311	$0	$12,344,645
13	0.468839	$6,488,974	$18,570,311	$0	$11,748,771
14	0.442301	$6,716,088	$18,570,311	$0	$11,184,199
15	0.417265	$6,951,152	$18,570,311	$1,280,406	$11,183,483
16	0.393646	$7,194,442	$18,570,311	$0	$10,142,199
17	0.371364	$7,446,247	$18,570,311	$0	$9,661,624
18	0.350344	$7,706,866	$18,570,311	$1,024,324	$9,564,911
19	0.330513	$7,976,606	$18,570,311	$0	$8,774,101
20	0.311805	$8,255,787	$18,570,311	$0	$8,364,504
					$282,092,884

A/P for 20 years:
0.078226718

ESTIMATE WORKSHEET

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST

NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Alternative 5d - New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP

PROJECT: Tijuana River Diversion

Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: R9

ESTIMATE LEVEL: PLANNING

UNIT PRICE LEVEL: April 2019

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Alt5d

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		River Intake Box							
	1	Concrete Cast in place 8'x8', 6' deep		2	EA	$2,392.62	20%	$957.05	$5,742.28
	2	Frames and covers 30" to 36" wide frame		2	EA	$870.00	20%	$348.00	$2,088.00
	3	Cast Iron Storm Sewer Grate 24" x 48"		4	EA	$1,500.00	20%	$1,200.00	$7,200.00
		River Cross Sectional Weir - PBCILA Intake							
	4	Concrete, ready mix delivered, 4,500 to 6,000 psi		150	CY	$148.00	10%	$2,220.00	$24,420.00
	5	Steel rebar # 4		3,000	LB	$1.25	10%	$375.00	$4,125.00
	6	Sliding Metal gate for V-notch Canal		2	EA	$25,000.00	10%	$5,000.00	$55,000.00
		Wastewater Pipelines							
	7	Trench cut, fill, compaction, and haul away excess		13,600	CY	$35.00	15%	$71,400.00	$547,400.00
	8	36" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		500	LF	$652.50	15%	$48,937.50	$375,187.50
	9	42" DIP: lining for WW, furnish and install, does not include cut, backfill, or compaction		4,600	LF	$855.00	15%	$589,950.00	$4,522,950.00
	10	36" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$137,700.00	15%	$41,310.00	$865,350.00
	11	36" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$114,000.00	15%	$34,200.00	$269,310.00
	12	42" Gate Valve: Includes valve box, stem, accessories, complete in place		2	EA	$240,975.00	15%	$72,292.50	$516,150.00
	13	42" Check Valve: Includes valve box, stem, accessories, complete in place		2	EA	$199,500.00	15%	$59,850.00	$471,292.50
	14	Tie-in 42" to SBOO, including all accessories, complete in place		2	EA	$65,000.00	15%	$19,500.00	$189,850.00
	15	Hydrostatic Leak Testing		3	EA	$80,000.00	15%	$36,000.00	$259,500.00
		Lift Station							
	16	Screen Metal		400	SF	$42.49	15%	$2,549.25	$19,544.25
	17	Natural gas generator: 60 Hz-250 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$232,607.78	15%	$34,891.17	$267,498.95
	18	Submersible Pumps (18,000 gpm, 150 HP), level sensors, ultrasonic level, valve vault,		3	EA	$225,500.00	20%	$135,300.00	$811,800.00
	19	Lift Station Control panel and instrumentation: controls, drivers, sensors, software and startup		3	EA	$189,625.91	15%	$85,331.66	$654,209.38
	20	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$10,000.00	15%	$3,000.00	$23,000.00
	21	Pump Station Wet well, cast in place, complete in place		1	EA.	$510,000.00	15%	$76,500.00	$586,500.00
	22	1" Combination Air / Vacuum Valve: includes gaskets, bolts, other parts. Complete in place		6	EA.	$3,062.50	15%	$2,756.25	$21,131.25
	23	24" Check Valve: Includes stem, accessories, complete in place		3	EA.	$57,000.00	15%	$25,650.00	$196,650.00
	24	24" Gate Valve: Includes valve box, stem, accessories, complete in place		6	EA.	$45,900.00	15%	$41,310.00	$316,710.00
	25	Sumergible pump (734 gpm, 30 HP)		3	EA.	$45,000.00	15%	$20,250.00	$155,250.00
	26	Concrete, ready mix delivered, 4,500 to 6,000 psi		350	CY	$185.00	15%	$9,712.50	$74,462.50
	27	Startup and Testing of Lift Station		1	EA.	$165,727.28	15%	$24,859.09	$190,586.37
		Master Control Shelter							
	28	Concrete Wall Cutting with Hydraulic Saw and rod reinforcing		1,000	LF	$8.25	15%	$1,237.50	$9,487.50
	29	Scructural Brick, Standard unit		800	SF	$16.45	15%	$1,974.00	$15,134.00
	30	Placing concrete footing, including labor and equipment to place, level and consolidate		1,200	CY	$35.50	15%	$6,390.00	$48,990.00
	31	Finishing contret floors, high tolerance, bull float and manual steel trowel		100	SF	$1.34	15%	$20.10	$154.10
	32	Cast Roof Deck cementittious/wood fiber planks		1,400	SF	$4.72	15%	$991.20	$7,599.20
	33	Solid wood roof decking western white srpuce		1,400	SF	$8.80	15%	$1,848.00	$14,168.00
	34	Plywood, prefinished, 3/4" thick 4'x8'		1,500	SF	$11.15	15%	$2,508.75	$19,233.75
	35	Asphalt roof shingles, pneumatic nailed		500	SQ	$178.00	15%	$13,350.00	$102,350.00
		Electrical							
	36	Drive for new motor		3	EA.	$ 66,344.94	15%	$29,855.22	$228,890.05
	37	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA.	$34,800.00	15%	$5,220.00	$40,020.00
	38	Transformer handling		1	EA.	$3,500.00	15%	$525.00	$4,025.00
	39	Isolating Transformer, 300 kVA		1	EA.	$31,800.00	15%	$4,770.00	$36,570.00
	40	Incoming Switchboards, 600 amp		3	EA.	$5,850.00	15%	$2,632.50	$20,182.50
		Trolley Hoist							
	41	W12 x 72 steel beam. Material only		60	LF	$125.00	15%	$1,125.00	$8,625.00
	42	W10 x 49 steel beam. Material only		200	LF	$90.00	15%	$2,700.00	$20,700.00
	43	Weld steel structure to extend existing hoist. Includes labor and welding material.		80	LH	$322.00	15%	$3,864.00	$29,624.00
	44	Trench cut, fill, compaction, and haul away excess		100	CY	$20.00	15%	$300.00	$2,300.00
		Tie-in to PERC							
	45	PERC tie-in		1	EA	$875,451.61	15%	$131,317.74	$1,006,769.35
		PB1A							
	46	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$358,851.67	10%	$143,540.67	$1,578,947.37
	47	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		2	EA	$10,000.00	10%	$2,000.00	$22,000.00
	48	24" Check valve		2	EA	$57,000.00	10%	$11,400.00	$125,400.00
	49	24" Globe Valve		2	EA	$45,900.00	10%	$9,180.00	$100,980.00
	50	24" Ductile Iron Piping: lining for WW, furnish and install		2,000	LF	$107.37	10%	$21,473.32	$236,206.55
	51	Demolish pump 1,2,3,4		6	EA	$57,000.00	10%	$34,200.00	$376,200.00
	52	Lift Station Startup and Testing		1	LS	$243,973.39	10%	$24,397.34	$268,370.73
		Earthwork							
	53	Trench cut, fill, compaction, and haul away excess		6,000	CY	$12.56	10%	$7,536.00	$82,896.00
		Concrete							

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
	54	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	55	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	56	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	57	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	58	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	59	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$322.00	10%	$7,728.00	$85,008.00
	60	5 Ton Hoist		1	EA	$6,750.00	10%	$675.00	$7,425.00
	61	Trench cut, fill, compaction, and haul away excess		2,500	CY	$12.56	10%	$3,140.00	$34,540.00
	62	Electrical Controls and Istrumentation		1	LS	$62,009.20	10%	$6,200.92	$68,210.12
		Electrical							
	63	Drive for new motor		1	EA	$ 66,344.94	10%	$6,634.49	$72,979.44
	64	New Transformer, liquid filled Pad mounted, 500 KVA		1	EA	$20,700.00	10%	$2,070.00	$22,770.00
	65	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	66	Electrical Conduit replacement		1	LS	$31,226.81	10%	$3,122.68	$34,349.49
	67	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	68	Electrical Improvements		1	LS	$28,512.31	10%	$2,851.23	$31,363.54
	69	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	70	SCADA and Telemetry System		1	LS	$390,491.58	10%	$39,049.16	$429,540.74
		PB1B							
	71	Multi-Rake Bar Screen (Coarse)		2	EA	$180,000.00	10%	$36,000.00	$396,000.00
	72	Multi-Rake Bar Screen (Fine)		2	EA	$220,000.00	10%	$22,000.00	$462,000.00
	73	24" Ductile Iron Piping: lining for WW, furnish and install		3,000	LF	$107.37	10%	$10.74	$322,110.58
	74	Cornell pump Model: 14NHG28, 1180 RPM, 700 HP, 14-in centrifigual single stage vertical pump		4	EA	$358,851.67	10%	$35,885.17	$1,471,291.87
	75	Magnetic Flow Meter. Includes mounting kit, wiring, other parts. Complete in place.		1	EA	$10,000.00	10%	$1,000.00	$11,000.00
	76	Lift Station Startup and Testing		1	LS	$266,240.25	10%	$26,624.02	$292,864.27
		Earthwork							
	77	Trench cut, fill, compaction, and haul away excess		7,000	CY	$12.56	10%	$8,792.00	$96,712.00
		Concrete							
	78	Dredge and clean sediment from all influent concrete channels		1	LS	$15,000.00	10%	$1,500.00	$16,500.00
	79	Scrubb and patch all concrete influent channel walls and invert		1	LS	$20,000.00	10%	$2,000.00	$22,000.00
	80	Misellaneous Concrete Repair Work		2,000	LF	$20.00	10%	$4,000.00	$44,000.00
		Trolley Hoist							
	81	W12 x 72 steel beam. Material only		60	LF	$125.00	10%	$750.00	$8,250.00
	82	W10 x 49 steel beam. Material only		200	LF	$90.00	10%	$1,800.00	$19,800.00
	83	Weld steel structure to extend existing hoist. Includes labor and welding material.		240	LH	$23.90	10%	$573.60	$6,309.60
	84	5 Ton Hoist		1	EA	$0.00	10%	$0.00	$0.00
	85	Trench cut, fill, compaction, and haul away excess		6,000	CY	$18.00	10%	$10,800.00	$118,800.00
		Electrical							
	86	Drive for new motor		4	EA	$ 66,344.94	10%	$26,537.98	$291,917.75
	87	New Transformer, liquid filled Pad mounted, 500 KVA		2	EA	$20,700.00	10%	$4,140.00	$45,540.00
	88	Transformer handling		1	EA	$3,500.00	10%	$350.00	$3,850.00
	89	Isolating Transformer, 300 kVA		2	EA	$18,000.00	10%	$3,600.00	$39,600.00
	90	Electrical Conduit replacement		1	LS	$28,598.74	10%	$2,859.87	$31,458.61
	91	Incoming Switchboards, 600 amp		3	EA	$5,850.00	10%	$1,755.00	$19,305.00
	92	Natural gas generator: 60 Hz-500 KW, includes enclosure, switch, battery, charger, muffler, complete in place		1	EA	$150,000.00	10%	$15,000.00	$165,000.00
		Process Intigration							
	93	SCADA and Telemetry System		1		$149,992.72	10%	$14,999.27	$164,991.99
		Parallel System Pipelines (Tijuana Portion)							
	94	Trench cut, fill, compaction, and haul away excess		424,000	CY	$12.56	5%	$266,272.00	$5,591,712.00
	95	48 in DI: lining for WW, furnish and install, does not include cut, backfill, or compaction		26,500	LF	$762.16	5%	$1,009,857.03	$21,206,997.66
	96	48 in HDPE: lining for WW, furnish and install, does not include cut, backfill, or compaction (TJ)		26,500	LF	$362.50	5%	$480,312.50	$10,086,562.50
	97	Concrete, ready mix delivered, 4,500 to 6,000 psi		11,778	CY	$100.00	5%	$58,888.89	$1,236,666.67
	98	Hydrostatic Leak Testing		20	EA	$68,000.00	5%	$68,000.00	$1,428,000.00
		Tie-in to SAB LS and WWTP							
	99	Concrete Channel Tie-in		1	EA	$523,774.47	5%	$26,188.72	$549,963.19
		ROUNDED SUBTOTAL THIS SHEET							**$61,073,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$1,100,000.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$7,300,000.00
		Construction Phase Services				10.00%			$6,000,000.00
		Construction Contingecy				30.00%			$22,000,000.00
		General Contractor OH&P				15.00%			$10,000,000.00
		ROUNDED TOTAL CONSTRUCTION COST							**$107,000,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS, JM	LCG	PS, JM	LCG
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
06/24/19	06/28/19	06/24/19	06/28/19

Alternative 5d. New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP

Study Level Opinion of Probable Annual Operation and Maintenance Costs						
Item No.	**Item Description**	**Unit**	**Quantity**	**Unit Cost**		**TOTAL COST**
U.S. 35 MGD LS						
	Personnel Labor	LS	1	$ 405,600.00		$ 405,600
	Intake Maintenance	LS	1	$ 51,026.12		$ 51,026
	Vehicles usage and Maintenance	LS	3	$ 57,600.00		$ 172,800
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 531,765.00		$ 531,765
	Piping and Valve Maintenance	LS	1	$ 400,850.00		$ 400,850
	Miscellaneous	LS	1	$ 135,712.26		$ 135,712
						$ 2,060,500
SAB WTP						
	Personnel Labor	LS	1	$ 639,600.00		$ 639,600
	Intake Maintenance	LS	1	$ 86,024.57		$ 86,025
	Vehicles usage and Maintenance	LS	1	$ 57,600.00		$ 57,600
	SCADA & Equipment Maintenance	LS	1	$ 148,359.15		$ 148,359
	Electrical System & Equipment Maintenance	LS	1	$ 214,296.55		$ 214,297
	Pump Equipment Maintenance	LS	1	$ 1,063,530.00		$ 1,063,530
	Piping and Valve Maintenance	LS	1	$ 801,700.00		$ 801,700
	Chemical usage	LS	1	$ 3,011,110.27		$ 3,011,110
	Miscellaneous	LS	1	$ 451,666.54		$ 451,667
						$ 6,473,900
PBCILA						
	Personnel Labor	LS	1	$ 64,100.00		$ 64,100
	Intake Maintenance	LS	1	$ 16,206.35		$ 16,206
	Vehicles usage and Maintenance	LS	1	$ 99,075.60		$ 99,076
	SCADA & Equipment Maintenance	LS	1	$ 76,212.00		$ 76,212
	Electrical System & Equipment Maintenance	LS	1	$ 381,060.00		$ 381,060
	Pump Equipment Maintenance	LS	6	$ 12,559.81		$ 75,359
	Piping and Valve Maintenance	LS	6	$ 6,279.90		$ 37,679
	Miscellaneous	LS	1	$ 32,774.68		$ 32,775
						$ 782,500
PB1A						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 167,666.40		$ 167,666
	SCADA & Equipment Maintenance	LS	1	$ 144,802.80		$ 144,803
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 47,067.38		$ 47,067
						$ 1,122,984
PB1B						
	Personnel Labor	LS	1	$ 126,750.00		$ 126,750
	Vehicles usage and Maintenance	LS	1	$ 152,424.00		$ 152,424
	SCADA & Equipment Maintenance	LS	1	$ 152,424.00		$ 152,424
	Electrical System & Equipment Maintenance	LS	1	$ 457,272.00		$ 457,272
	Pump Equipment Maintenance	LS	4	$ 35,885.17		$ 143,541
	Piping and Valve Maintenance	LS	4	$ 8,971.29		$ 35,885
	Miscellaneous	LS	1	$ 46,686.32		$ 46,686
						$ 1,114,982
GRAND TOTAL ANNUAL O&M COSTS						**$ 11,554,867**

ROUNDED TOTAL CONSTRUCTION COST	**$ 106,000,000**
PRESENT WORTH OF O&M	**$ 187,794,000**
TOTAL PRESENT WORTH	**$ 293,794,000**
ANNUALIZED O&M COST	**$ 16,300,000**

Alternative 5d. New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP

Net Present Value Analysis

Cost Summary					
Capital Costs					
Description	**QTY**	**Units**	**Unit Cost**	**Sub-Total**	**Comments**
Alternative 5d. New lift station and pipeline to divert transboundary flows to PERC and treatment at SAB WWTP	1		$106,000,000.00	$106,000,000	
	Total Anticipated Capital Costs:			$106,000,000	
Annual O&M Costs					
Total Operating Cost ($/day)	365	Daily	$31,657	$11,554,867	
	Total Anticipated O&M Costs:			$11,554,867	
Repair/Replacement Costs					
	0	EA	$0	$0	
	0	EA	$0	$0	
	0	EA	$0	$0	
		Total Anticipated Costs:		$0	

Net Present Value Total:	**$293,794,000**
O&M Present/Future Worth:	**$187,794,000**
Per Year O&M:	$16,300,000

Present Value Basis Calculations

Interest Rate:	6.0%
Cost Esclation Factor:	3.5%

Year, n	Present /Future Worth (p/f)	Annual O&M Costs	Debt Service Payment on Capital Investment	Repair/ Replacement Costs	Present Worth of Annual OM payment (p/f * annual OM Costs) + annual repair costs
0	1.000000	$0		$0	$0
1	0.943396	$11,959,287	$9,241,563	$0	$20,000,802
2	0.889996	$12,377,862	$9,241,563	$0	$19,241,211
3	0.839619	$12,811,087	$9,241,563	$0	$18,515,830
4	0.792094	$13,259,475	$9,241,563	$0	$17,822,930
5	0.747258	$13,723,557	$9,241,563	$1,829,151	$18,527,721
6	0.704961	$14,203,881	$9,241,563	$0	$16,528,113
7	0.665057	$14,701,017	$9,241,563	$0	$15,923,183
8	0.627412	$15,215,553	$9,241,563	$0	$15,344,697
9	0.591898	$15,748,097	$9,241,563	$0	$14,791,341
10	0.558395	$16,299,280	$9,241,563	$7,316,603	$18,347,427
11	0.526788	$16,869,755	$9,241,563	$0	$13,755,117
12	0.496969	$17,460,197	$9,241,563	$0	$13,269,957
13	0.468839	$18,071,304	$9,241,563	$0	$12,805,338
14	0.442301	$18,703,799	$9,241,563	$0	$12,360,261
15	0.417265	$19,358,432	$9,241,563	$1,829,151	$12,697,019
16	0.393646	$20,035,977	$9,241,563	$0	$11,524,995
17	0.371364	$20,737,237	$9,241,563	$0	$11,133,059
18	0.350344	$21,463,040	$9,241,563	$0	$10,757,167
19	0.330513	$22,214,246	$9,241,563	$0	$10,396,554
20	0.311805	$22,991,745	$9,241,563	$0	$10,050,498
					$293,793,221

A/P for 20 years:
0.087184557

ESTIMATE WORKSHEET SHEET 1 OF 1

FEATURE:

PLANNING LEVEL OPINION OF PROBABLE COST
NORTH AMERICAN DEVELOPMENT BANK

SOLTA-C-18-001

Capacity Increase at International Interceptor

PROJECT: **Tijuana River Diversion**
Flow Analysis, Infraestructure Diagnostics and Alternatives Development

REGION: **R9**

ESTIMATE LEVEL: **PLANNING**
UNIT PRICE LEVEL: **February 2019**

FILE: G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[All Alternatives Study Level Cost Estimates (100%).xlsx]Capacity Increase of Int.Interc

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		Capacity Increase at International Interceptor							
		International Interceptor							
	1	Trench cut, fill, compaction, and haul away excess		100,000	CY	$0.21	10%	$2,125.40	$23,379.35
	2	96" HOBAS line		8,200	LF	$850.00	10%	$697,000.00	$7,667,000.00
	3	Concrete Demolition and re-paving		140,000	SF	$4.65	10%	$65,065.44	$715,719.81
	4	Manhole Installation		30	EA	$2,000.00	10%	$6,000.00	$66,000.00
	5	Tie-in to SBIWTP JB and to PB1B, including all accessories, complete in place		1	EA	$65,000.00	10%	$6,500.00	$71,500.00
	6	Hydrostatic Leak Testing		2	EA	$80,000.00	10%	$16,000.00	$176,000.00
		Traffic Control							
	35	Traffic Control Plan and Execution		1	EA	$741,166.00	10%	$74,116.60	$815,282.60
		ROUNDED SUBTOTAL THIS SHEET							**$9,535,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$476,750.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$1,144,200.00
		Construction Phase Services				10.00%			$953,500.00
		Construction Contingecy				30.00%			$2,860,500.00
		General Contractor OH&P				15.00%			$1,644,787.50
		ROUNDED TOTAL CONSTRUCTION COST							**$16,615,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/30/19	02/08/19	01/30/19	02/08/19

ESTIMATE WORKSHEET SHEET 1 OF 1

FEATURE:	PROJECT: Tijuana River Diversion
PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK**	**Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
SOLTA-C-18-001	**REGION: R9** | **ESTIMATE LEVEL: PLANNING** | **UNIT PRICE LEVEL: February 2019**
Stewart's Drain Diversion Box Improvements (MX Based Solution)	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[TJ Diversion Tech Alts Table (100%).xlsx]top six Alts

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		Invert work at Culvert Barrrels							
	1	Trench cut, fill, compaction, and haul away excess		2,500	CY	$18.00	15%	$6,750.00	$51,750.00
	2	concrete work		20	CY	$181.00	15%	$543.00	$4,163.00
	3	18" check valves		1	EA	$35,000.00	10%	$3,500.00	$38,500.00
	4	Hatch doors (4'x4')		3	EA	$3,500.00	10%	$1,050.00	$11,550.00
	5	Metal precast grates		3	EA	$35,000.00	10%	$10,500.00	$115,500.00
	6	Submersible Sump Pumps 150-200 gpm, 5 HP		2	EA	$8,000.00	10%	$1,600.00	$17,600.00
	7	18" pipeline connecting drain to PB1B		100	LF	$285.00	10%	$2,850.00	$31,350.00
	8	PB1B Tie-in		1	EA	$85,000.00	10%	$8,500.00	$93,500.00
		ROUNDED SUBTOTAL THIS SHEET							**$364,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$18,200.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$43,680.00
		Construction Phase Services				10.00%			$36,400.00
		Construction Contingecy				30.00%			$109,200.00
		General Contractor OH&P				15.00%			$62,790.00
		ROUNDED TOTAL CONSTRUCTION COST							**$635,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
JP	JM	JP	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
07/12/19	07/13/19	07/13/19	07/13/19

ESTIMATE WORKSHEET

SHEET 1 OF 1

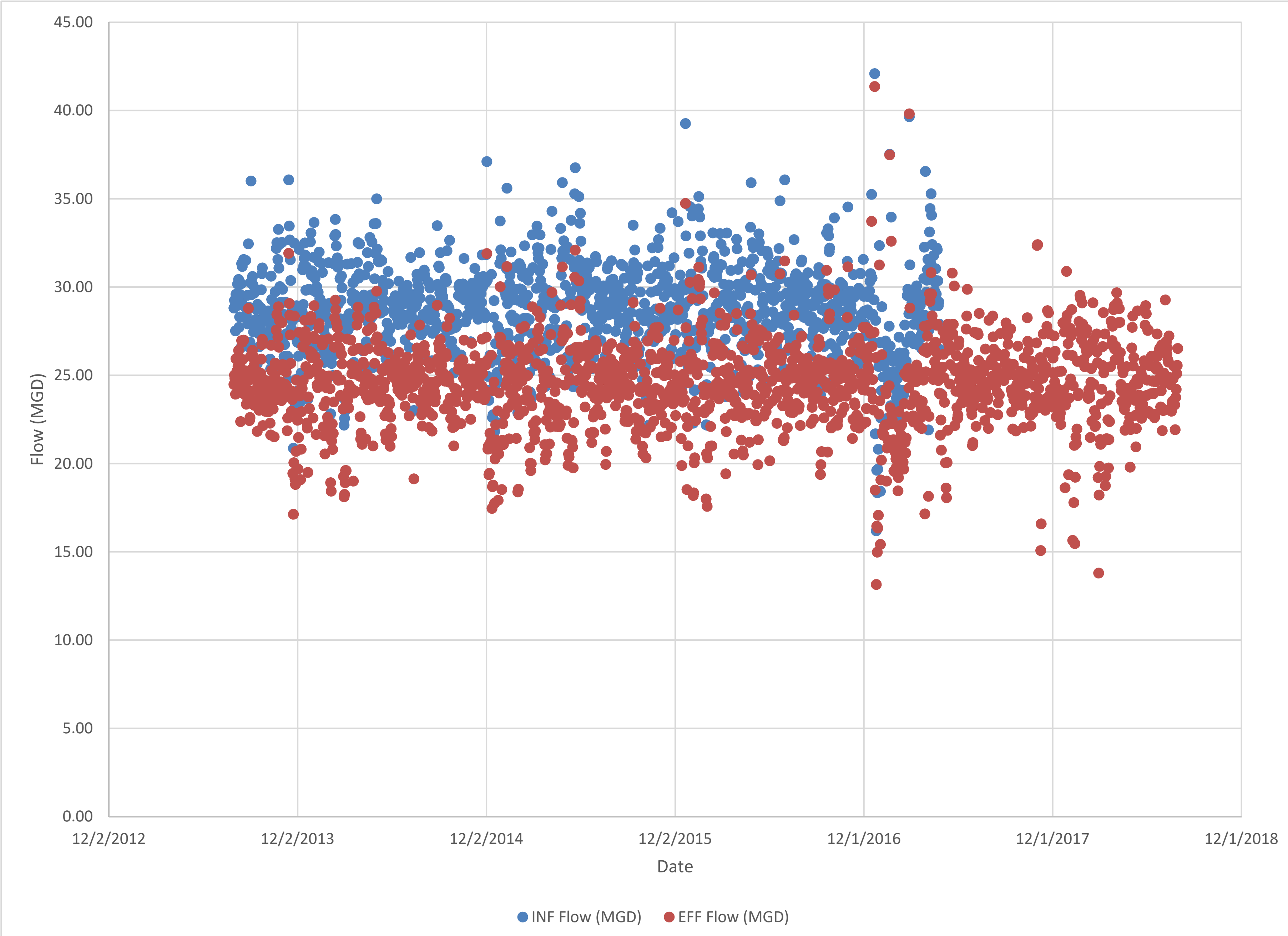
FEATURE: PLANNING LEVEL OPINION OF PROBABLE COST **NORTH AMERICAN DEVELOPMENT BANK** **SOLTA-C-18-001**	**PROJECT: Tijuana River Diversion Flow Analysis, Infraestructure Diagnostics and Alternatives Development**
	REGION: R9 — **ESTIMATE LEVEL: PLANNING** — **UNIT PRICE LEVEL: February 2019**
Stewart's Drain Diversion Box Improvements (U.S. Based Solution)	**FILE:** G:\Projects\27077004 - Tijuana River Diversion Study (STUDY)\J - Deliverables\J.19 100%\[TJ Diversion Tech Alts Table (100%).xlsx]top six Alts

PLANT ACCOUNT	PAY ITEM	DESCRIPTION	CODE	QUANTITY	UNIT	UNIT PRICE	INSTALLATION & LABOR PERCENTAGE	INSTALLATION & LABOR COST	AMOUNT
		Invert work at the flume							
	1	Trench cut, fill, compaction, and haul away excess		10,000	CY	$34.00	30%	$102,000.00	$442,000.00
	2	concrete work		230	CY	$181.00	30%	$12,489.00	$54,119.00
	3	18" check valves		2	EA	$35,000.00	30%	$21,000.00	$91,000.00
	4	Hacth doors (4'x4')		2	EA	$3,500.00	30%	$2,100.00	$9,100.00
	5	Metal precast grates		2	LS	$35,000.00	30%	$21,000.00	$91,000.00
	5	18" pipeline connecting drain to JB1		100	LF	$1,000.00	30%	$30,000.00	$130,000.00
	6	JB1 Tie-in		1	EA	$85,000.00	30%	$25,500.00	$110,500.00
		ROUNDED SUBTOTAL THIS SHEET							**$928,000.00**
		Mobilization, demobilization, insurance, bonds, and related expenses				5.00%			$46,400.00
		Engineer's Fee (W/geotechnical investigation and topographic survey)				12.00%			$111,360.00
		Construction Phase Services				10.00%			$92,800.00
		Construction Contingecy				30.00%			$278,400.00
		General Contractor OH&P				15.00%			$160,080.00
		ROUNDED TOTAL CONSTRUCTION COST							**$1,600,000.00**

QUANTITIES		PRICES	
BY	**CHECKED**	**BY**	**CHECKED**
PS	JM	PS	JM
DATE PREPARED	**PEER REVIEW / DATE**	**DATE PREPARED**	**PEER REVIEW / DATE**
01/30/19	02/08/19	01/30/19	02/08/19

APPENDIX J

SBIWTP average inflow chart (2013 to 2018)


45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Flow (MGD)
12/2/2012
12/2/2013
12/2/2014
12/2/2015
12/1/2016
12/1/2017
12/1/2018
Date
INF Flow (MGD)
EFF Flow (MGD)

APPENDIX K

City of San Diego Capacity Analysis for SBWRP

Tijuana River Flow Capture –

South Bay Water Reclamation Plant Capacity and Concerns

The South Bay Water Reclamation Plant (SBWRP) is located at 2411 Dairy Mart Rd, San Diego, CA 92154 and is owned and operated by the City of San Diego. While this facility has several other smaller customers, its primary recycled water customer is the Otay Water District which distributes the recycled water to its customers throughout their jurisdiction.

The SBWRP has a rated treatment capacity of 15 Million Gallons per Day (MGD) and records indicate that over the past 3 years the average daily flow rate was 7.95 MGD with a daily high of 12.52 MGD. This equates to an average available capacity of approximately 7.05 MGD with a low end available capacity level of about 2.48 MGD when the facility is processing flows at the higher end. Currently, the plant is operated in a cost-effective manner to maximize its efficiency and as a consequence, the number of operating units is limited to those that are needed to treat the incoming flows. In its current operational mode, two (out of five) primary clarifiers, five (out of eight) biological reactors and six (out of nine) secondary clarifiers are in service; the units that are not currently in operation remain idle to reduce the cost of operation. Systems and units not currently in operation would need to be placed back in service to effectively treat higher flows that would result from diversions of storm water or waste flows from the Tijuana River. It should be noted that the biological reactors at the SBWRP would need about two to four (2-4) weeks to allow the microbes to properly acclimate to the new conditions imposed by flows that may be subject to fluctuations. Proceeding too quickly without adequate time for the microbes to adapt to the fluctuating wastewater flows puts the facility potentially at risk to not meeting its permit compliance requirements.

Of additional concern is the proposal of adding unregulated storm water or wastewater to the existing flows currently being treated at the SBWRP. The SBWRP recycled water production process can be highly susceptible to upsets caused by a change in the characteristics of the wastewater that it currently receives. Staff carefully monitors the quality of the waste streams that enter the SBWRP and this monitoring protocol is continued throughout the treatment process. The monitoring process looks at nitrogen and phosphorus-based compounds, heavy metals, and other toxins that, left unmonitored, could potentially upset the reclamation process and hinder the SBWRP's ability to deliver Title 22 recycled water to its customers and meet the region's Basin Plan standards.

Other areas of concern, when contemplating adding unregulated storm water or other waste streams, is the ability of the SBWRP flows to effectively handle other unintended consequences, such as:

- loss of solids inventory in the activated sludge process
- high turbidity effluents, which impacts overall water quality and increases chlorine demand
- production of nitrites which also correlates to increased chlorine demands
- production of disinfection by-products
- potential for increasing the presence of heavy metals in the resulting activated sludge

APPENDIX L

Initial draft Tech Memo submitted to USEPA

TIJUANA DIVERSION TECH MEMO: U.S. BASED SOLUTIONS PRELIMINARY COST EVALUATION

To:

Químico Toribio Cueva

Project Manager

NADB

Copies:

Salvador Lopez, NADB Chief Environmental Officer

Renata Manning, NADB Director of Projects

Roberto Molina, NADB Regional Manager

Doug Eberhardt, USEPA-R9 Manager, Infrastructure Section

Hector Aguirre, USEPA-R9 San Diego Office Manager

Doug Liden, USEPA-R9 Environmental Engineer

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TX Engineering License # F-533

From:

Joel Mora, PE, Arcadis PM

Date:

July 23, 2018

Arcadis Project No.:

27077004.0000

Subject:

TIJUANA DIVERSION TECH MEMO: U.S. BASED SOLUTIONS PRELIMINARY COST EVALUATION

INTRODUCTION

The Baja California region including City of Tijuana, Playas de Tijuana and Playas de Rosarito has an estimated population of 1.76 million, up 35 percent from the estimated 1.4 million in 2013. The growth of the region has continued to put a burden on the operation, maintenance, and condition of public water/wastewater services and infrastructure. The State Commission of Public Services of Tijuana (Comisión Estatal de Servicios Públicos, CESPT) has assisted with improvements for potable water distribution, wastewater collection, and treatment with a recognized need to employ their master plan to address the increased need for public water services and infrastructure. However, similar to the municipalities and government agencies across the United States, the efforts from CESPT alone are not sufficient to address all of the wastewater and stormwater needs due to the many complexities within the region including topography, weather, aged infrastructure, lack of Operation and Maintenance (O&M) resources, and growth. Due to the natural impact of the region to the U.S., it being a shared River Basin, agencies such as USEPA-R9, USIBWC, and NADB have stepped in to provide technical assistance in developing a diagnostic study to identify an option that can eliminate or reduce the occurrence of transboundary flows containing raw sewage that ultimately make their way to the Pacific Ocean, resulting in beach closures along the coast and environmental concerns along the Tijuana River and its estuaries between the international boundary and the Pacific Ocean. Within the diagnostic, USEPA-R9 requested Arcadis fast track study of some U.S. Based alternatives to developed preliminary level opinions of probable costs for implementation of mitigation options. This technical memorandum (Tech Memo) briefly explores 7 U.S. based options through three main categories that will be incorporated into the diagnostics:

1. New Lift Station to Divert Flow (within the U.S.) from the Tijuana River Channel
   a. Discharge directly to South Bay Ocean Outfall (SBOO) without treatment
   b. Discharge at South Bay International Wastewater Treatment Plant (SBIWTP) for primary treatment only
   c. Discharge at SBIWTP for full plant treatment
   d. Discharge at Point Loma WWTP

2. Gravity reclaimed water pipeline System
   a. Pipeline from La Morita/Herrera Solis WWTPs to SBOO
   b. Pipeline from La Morita/Herrera Solis WWTPs to Point Loma WWTP

3. Inflatable dams at Tijuana River Channel in Tijuana

Some of the alternatives listed above are part of the Tijuana River Diversion Diagnostic's Scope of Work (SOW). For organizational reasons, numbering of alternatives in this Memorandum does not correspond to numbering of alternatives in the SOW. Table 1 displays the correspondence between Memo and SOW alternatives.

Table 1. Correspondence between Tech Memo and SOW alternative numbering

This Memo Alternative Sequence:	Study Diagnostics Alternative Sequence:
1a. LS to SBOO no treatment	4a. New infrastructure to convey transboundary flows to the SBOO without treatment
1b. LS to SBIWTP with advanced primary treatment	4b. New infrastructure to convey transboundary flows to the SBOO with primary level treatment at SBIWTP
1c. LS to SBIWTP with secondary treatment	4c. New infrastructure to convey transboundary flows to the SBOO with secondary level treatment at SBIWTP
1d. LS convey and treat at Point Loma WWTP 2b. Gravity reclaimed pipeline to Point Loma WWTP	4d. New infrastructure to convey transboundary flows for treatment at Point Loma WWTP

Preliminary analysis of USIBWC gage flow records just south of the international border shows that transboundary flows range from zero to 1,000 liters per second (lps) [approximately 25 MGD, or 39 cubic feet per second (cfs)] nearly 80 percent of the time since the PB CILA plant went into operation in 1991. Several short-duration transboundary flow events larger than 10,000 cfs (283,200 lps) have also occurred during this time. However, as shown in Figure 2 and Figure 3, monthly transboundary flow volume is not highly correlated with monthly precipitation, and consequently inadequate plant capacity does not appear to be the most significant cause of transboundary flows.

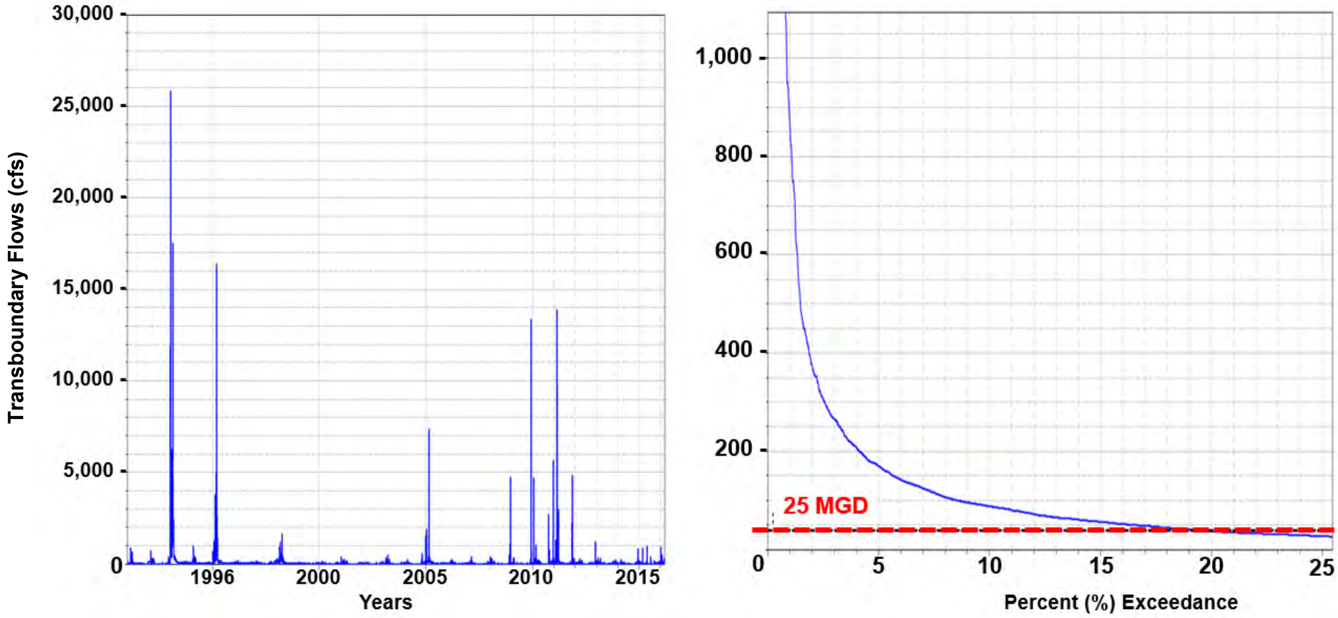


Figure 1. Tijuana River transboundary flow time-series and duration data, 1991 – 2016

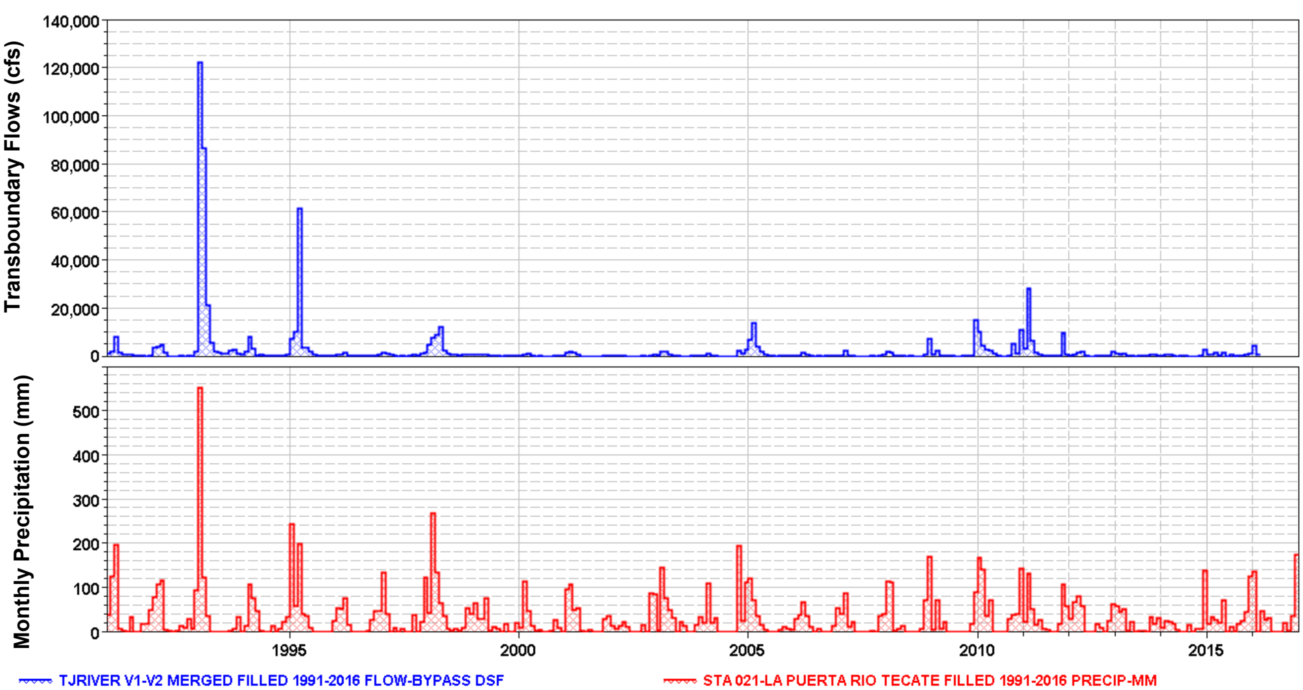


Figure 2. Tijuana River monthly transboundary flow and precipitation time-series, 1991 – 2016

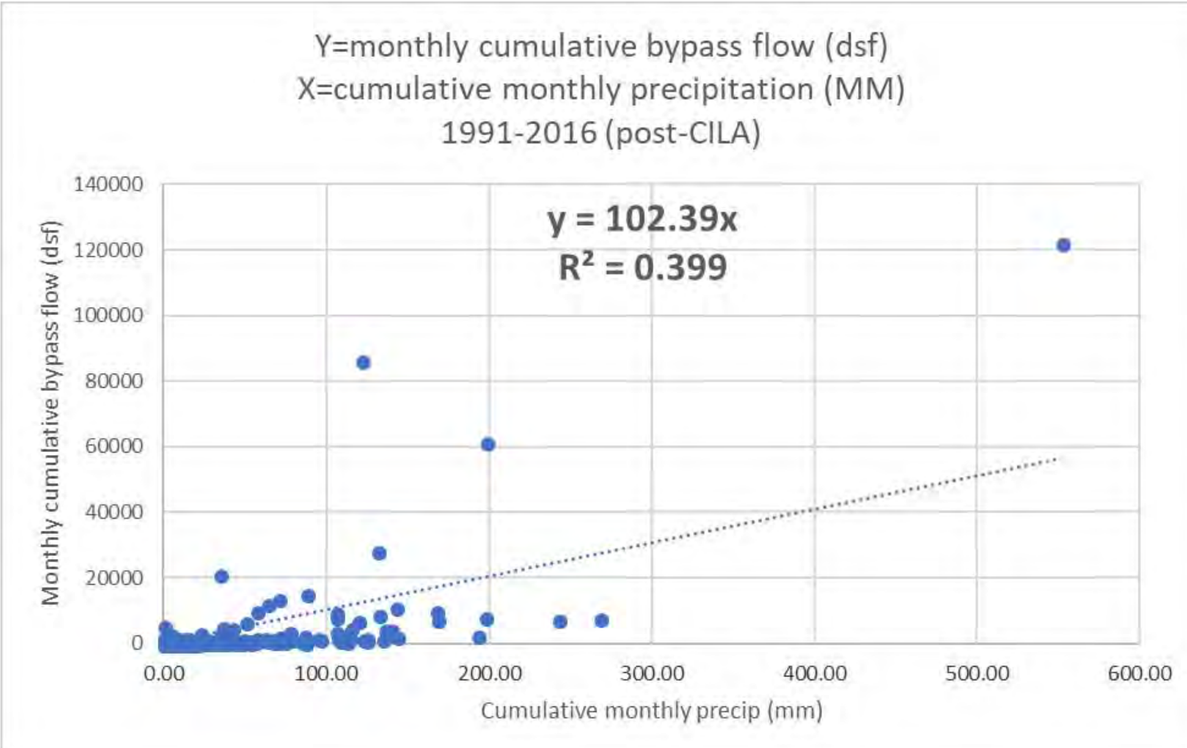


Figure 3. Tijuana River monthly transboundary flow – precipitation correlation, 1991 – 2016

ALTERNATIVE DESCRIPTIONS

Alternative 1

Given the relatively poor correlation of transboundary flows with precipitation and the frequency of transboundary flows less than 25 MGD, alternatives that divert transboundary flows of this magnitude can potentially mitigate a significant portion of transboundary flows assuming otherwise normal PBCILA operational capacity. Alternative 1 consists of a new lift station on the Tijuana River in the U.S., with an average design flow of 25 MGD and diversion capacity ranging from 10 to 35 MGD for operation during relatively small and frequent rainfall events, or during PBCILA operational failures irrespective of rainfall.

The new intake structure and lift station would be planned as a wet weather installation located just north of the international border (see Figures 4-7) adjacent to SBIWTP to intercept any transboundary flows averaging 25 MGDs before they reach the Pacific Ocean. From our recent site visits to the Tijuana river and wastewater infrastructure, our observations indicate that rainfall event transboundary flows may have a high hydraulic and low BOD/organic loading, possibly mixing as combined sewer overflows (CSO) at the time the flows reach the Tijuana River such that further detailed analysis may give a better suited CSO configuration with flocculation, filtration and disinfection independent from SBIWTP, wet weather treatment technologies such as ballasted flocculation systems, high rate filtration, or chemically enhanced treatment.

Under alternative 1, diverted flows may be directed in four ways, designated as Alternatives 1a, 1b, 1c, and 1d, described as follows:

Alternative 1a

Collected transboundary flows via a new intake and diversion lift station that will bypass treatment at the SBIWTP, discharging directly to the South Bay Ocean Outfall (SBOO) as shown in Figure 4 below. This Alternative will have no additional treatment and will require an agreement with the California Regional Water Quality Control Board (CRWQCB), San Diego Region, for emergency discharge as needed discharge and pertinent permit amendment for NPDES No. CA0108928.

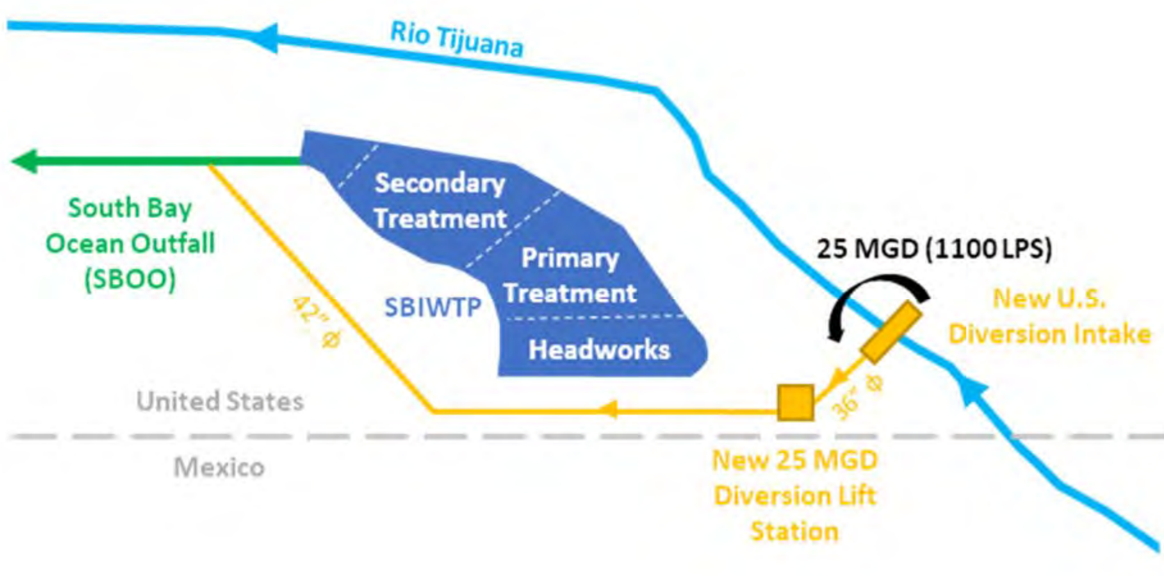


Figure 4. New 25 MGD Lift Station with connection to SBOO (Alternative 1a)

Alternative 1b

Alternative 1b will take diverted flows from the Tijuana River directly to headworks and primary treatment at the SBIWTP and then bypass any secondary treatment, this option showed in Figure 5 will tie into the SBOO after primary level treatment at the influent screens, grit chambers and primary sedimentation basins and disinfection; primary treated flows will blend with the full plant effluent then reach the SBOO. This alternative requires retrofitting headworks and the primary unit process to have wet weather high rate treatment capabilities during storm induced high flow events. Additional chemical coagulants along with equipment, instrumentation and controls replacement/upgrades throughout the primary treatment unit process. This Alternative will require agreements with the CRWQCB San Diego Region for an emergency discharge permit amendment for NPDES No. CA0108928 for the additional flows and the resulting water quality level after the blending and disinfection takes place.

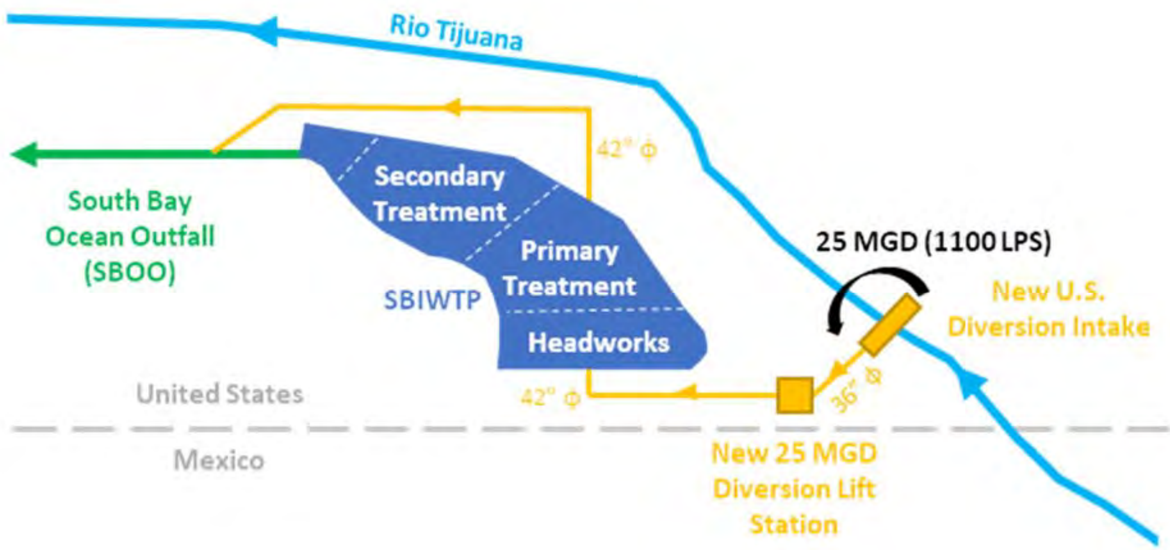


Figure 5. New lift station with diverted flow through advanced primary treatment at SBIWTP (Alternative 1b)

Alternative 1c

Alternative 1c (shown in Figure 6) aims at having the intercepted transboundary flows from the new diversion lift station to run through the entire treatment process at SBIWTP and discharge at the SBOO. This alternative requires retrofitting the primary treatment with equipment, instrumentation and control replacement and upgrades similar to Alternative 1b. Improvements at the secondary treatment will require modifications to the activated sludge basins, secondary sedimentation basins and the recently completed equalization basins, along with waste activated sludge and thickening facility/Sludge Storage Area/Dewatering Building to have the additional capability to handle the added 25 MGDs and hydraulic & process modeling along with a sampling plan will be required to understand exact modifications.

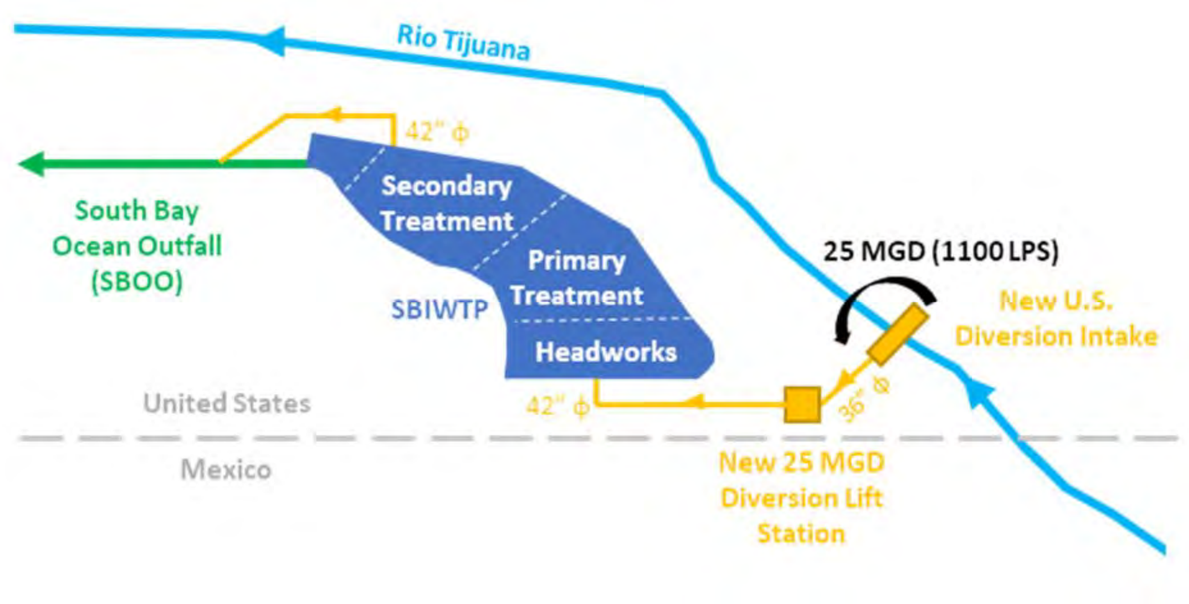


Figure 6. New 25 MGD lift station with diverted flow through secondary treatment at SBIWTP (alternative 1c)

Alternative 1d

With this Alternative, flows from the Tijuana River would be diverted at the proposed lift station to an existing collection system and wastewater pipeline that connects to Point Loma WWTP. Approximately 5,600 linear feet of the existing line has been abandoned, and consequently a replacement line with tie-in into the existing collection system is included under this Alternative. As shown in Figure 7, diverted flows will then be treated before reaching the ocean at the Point Loma WWTP. This Alternative requires an agreement with the CRWQCB San Diego Region for an emergency discharge permit amendment for NPDES No. CA0107409 for the additional flows and the resulting water quality level after the blending with the wastewater collection system occurs, it may be that availability to send flows to Point Loma will be dependent to phase 1 of the San Diego Pure Water Project in the central area taking place.

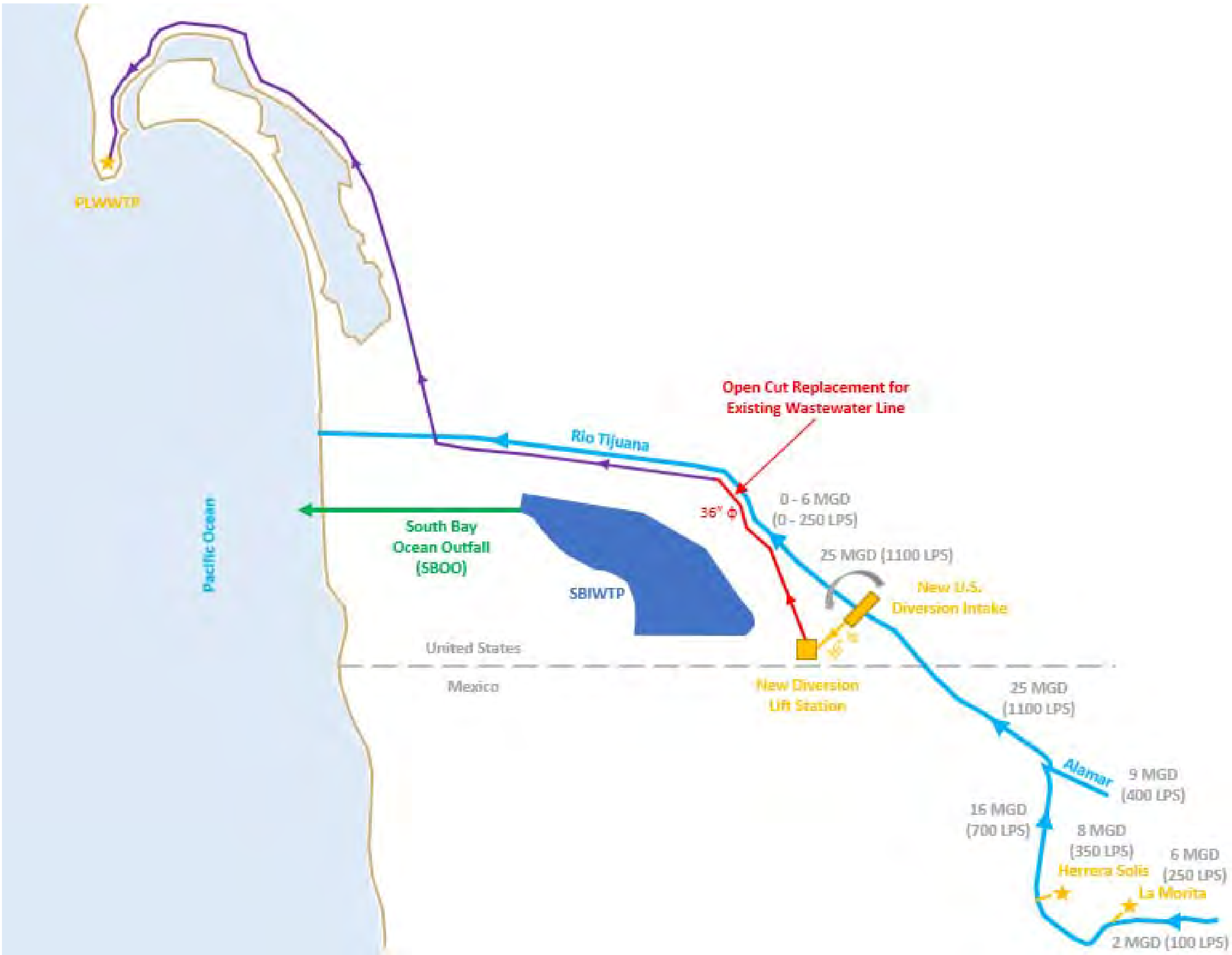


Figure 7. New 25 MGD lift station with tie-in to Point Loma WWTP (Alternative 1d)

Alternative 2

This Alternative utilizes a proposed reclaimed water pipeline system to carry discharges from La Morita and Herrera Solis WWTPs. The purposes of this alternative are to: (1) remove approximately 14 MGD of treated water currently discharging to the Tijuana Diversion system (PBCILA, PB1A and 1B and either San Antonio de los Buenos WWTP or SBIWTP), and; (2) preserve the reclaimed water quality gained at the treatment processes at both La Morita and Herrera Solis WWTPs, currently conveyed through open channel at the Tijuana River. Presently, both WWTPs discharge into the concrete-lined Tijuana river and mix with flows from other sources that likely impair water quality creating CSO conditions. For pipe diameter selection purposes, options considered under Alternative 2 account for future conditions with peak flows of approximately 20 MGD from each WWTP, totaling 40 MGD.

Alternative 2a

Approximately 14 MGD of reclaimed water flows would be conveyed besides the River for about 10 miles through Tijuana, will cross the U.S.- Mexico Border until it discharges at the South Bay Ocean Outfall in San Diego County. Pipe diameters will have capacity to carry 40 MGD at full buildout. Figure 8 illustrates the schematic of the proposed pipeline location.

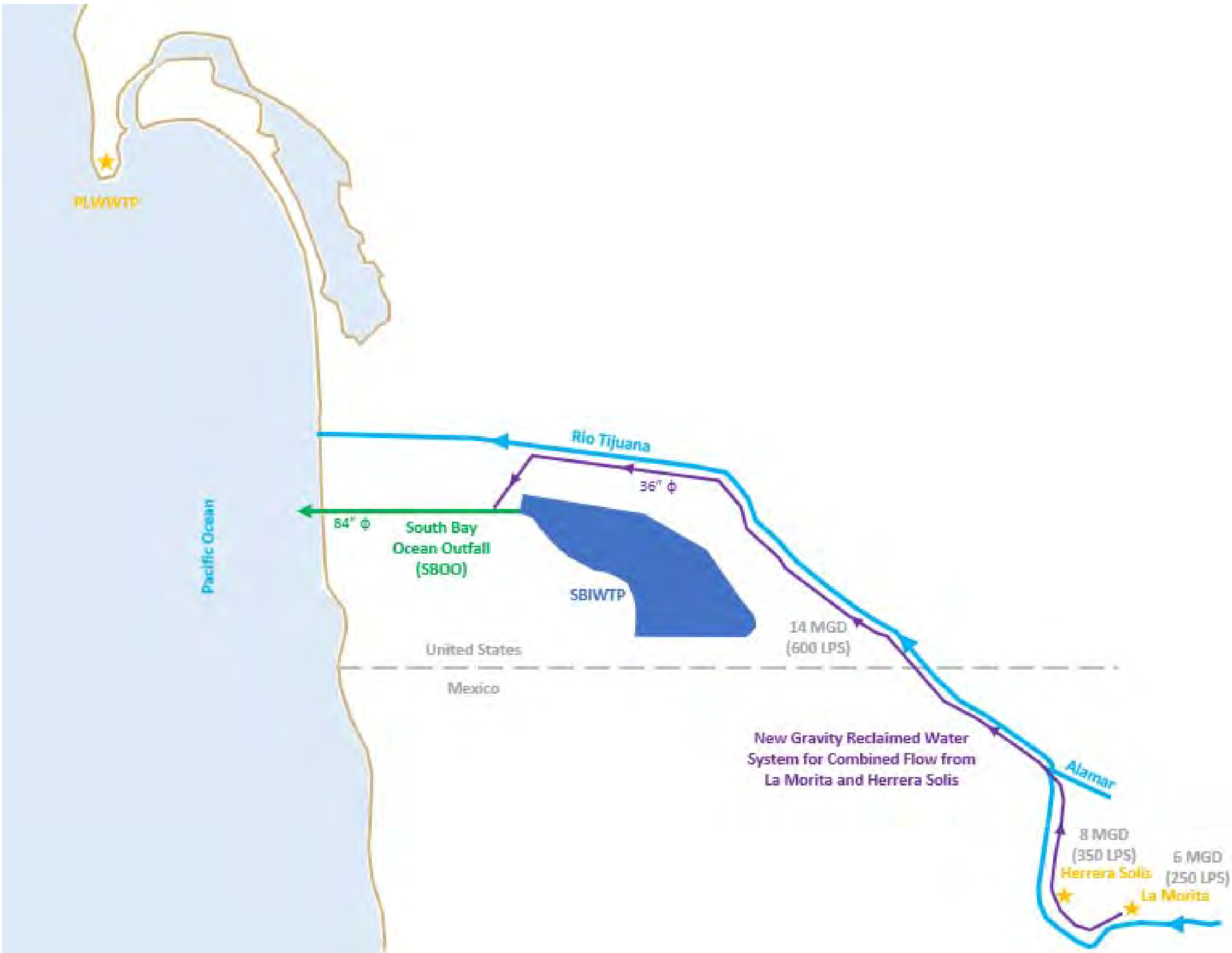


Figure 8. Reclaimed Water Pipeline connecting to SBOO (Alternative 2a)

Alternative 2b

Reclaimed water flow would be carried to the Point Loma WWTP. An existing wastewater line is in place to carry flows to Point Loma WWTP, however the condition portions of the pipeline are unknown. Since the segment pipeline from SBIWTP to about 1-mile north has been out of service for more than 10 years and is no longer functional, an open-cut method to replace approximately 5,600 linear feet of 30-inch reinforced concrete pipe would be required and is included as part of this Alternative. Discharge from Point Loma WWTP would be required to meet the water quantity and quality requirements established by the California Ocean Plan. However, because the influent water will be coming from La Morita/Herrera Solis WWTP, the Point Loma plant could be expected to continue to meet discharge permit conditions with the additional treatment capacity made available by re-direction of reuse water from the plant under Phase 1 of the San Diego Pure Water Project. A schematic of the proposed pipeline location is shown in Figure 9.

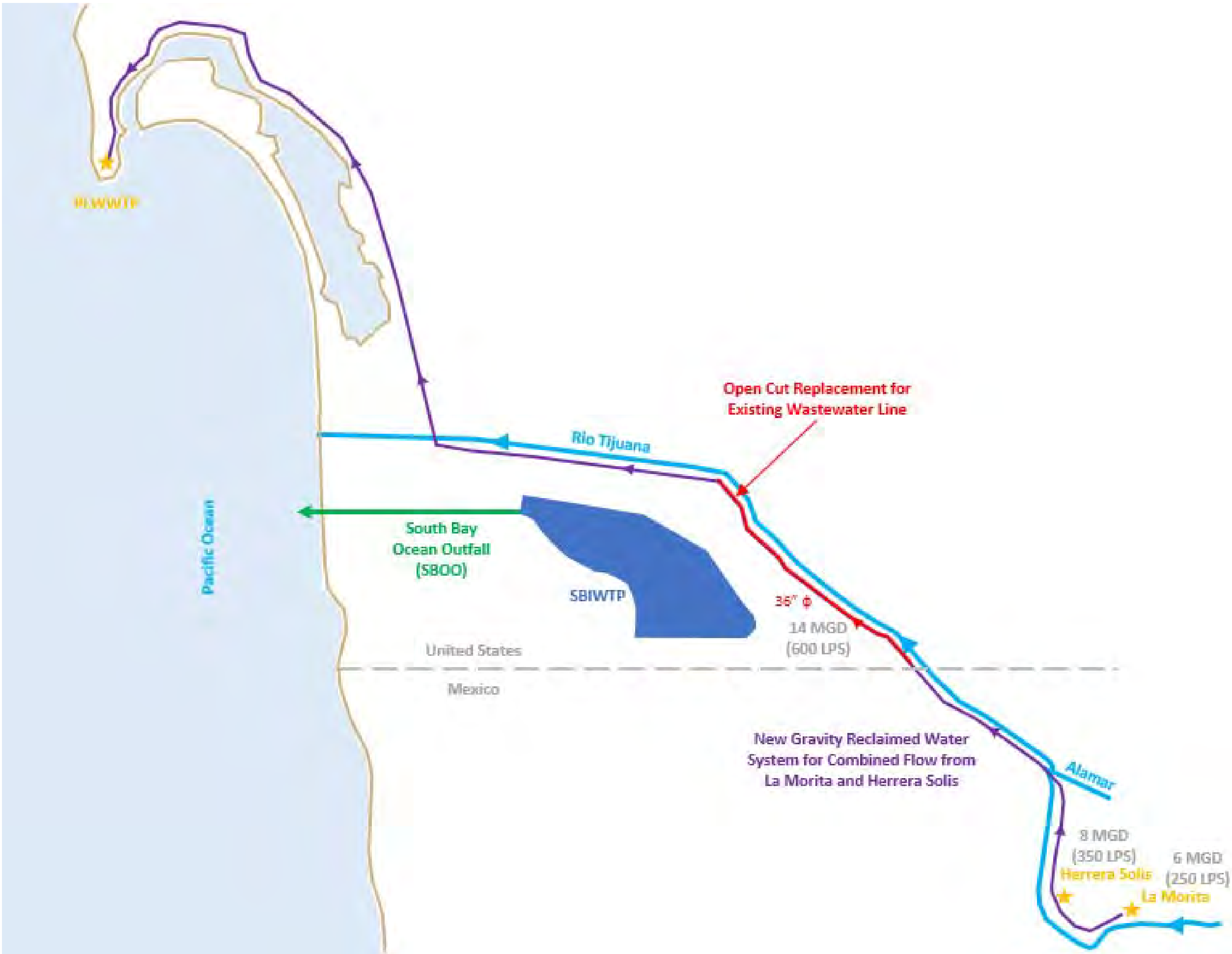


Figure 9. Reclaimed Water Pipeline connecting to Point Loma Force main (Alternative 2b)

Alternative 3

For this Alternative, four 16-foot high inflatable dam system along the Tijuana river channel within Mexico will serve as detention ponds during storm events to help reduce transboundary flows into San Diego County. The dams would impound water in the Tijuana River floodplain so that pump station PBCILA could divert flows at a constant rate of 29 MGD (1,300 lps) to match PBCILA capacity. Figure 10 shows a schematic profile view of the inflatable dam system behavior of hydraulics of the water for a total of four 16-ft tall temporary inflatable dams. A system of diversion pipes in between each dam would allow a combined continuous diversion of approximately 29 MGD into PBCILA to enable normal operation. With normal PBCILA operation, no bypass flows would occur until the impoundments fill and the dams overtop, after which bypass flows in excess of 29 MGD would occur. Consequently the system will be most effective for dry-weatehr flows, smaller rainfall events and less effective for larger events.

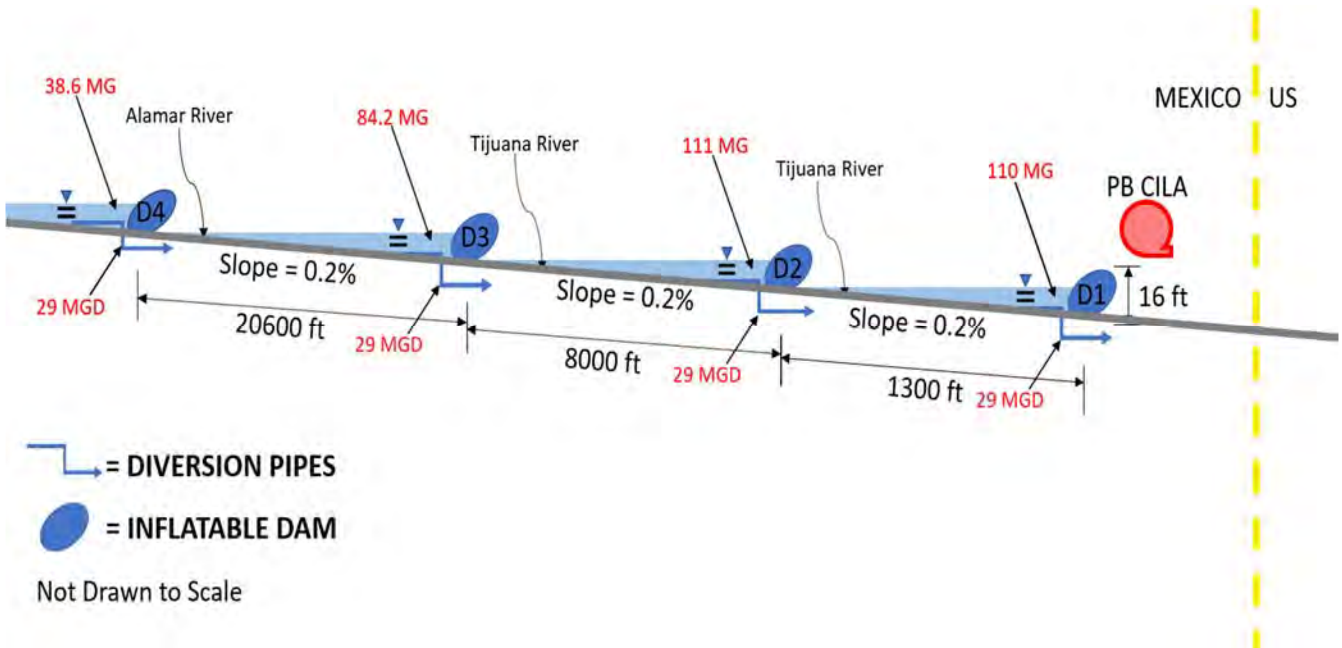


Figure 10. Lateral view of proposed inflatable dam systems (Alternative 3)

LOCATIONS

Alternative 1a

Main components for the new lift station will include the new concrete intake structure, suction and discharge pipelines with all required fittings and appurtenances, a new wet well sized to withhold a minimum volume of 5 minutes pump running time, which may require consideration for a six-hour emergency storage due to the sensitivity of the area. New pump system, electrical controls, I&C and pump and control housing in accordance with the ANSI and Hydraulics Institute design recommendations. A system with a total dynamic head of 20 feet and for a flow of approximately 18,000 gallons per minute (gpm) will be needed at the lift station. This can be arranged as three pumps in parallel with an optional space for two future pumps. Figure 12 shows a possible arrangement for a new intake structure, a 25 MGD lift station, and discharge connection from the lift station to SBOO in green. The location of the lift station is within the footprint of SBIWTP to secure land easement for its construction.

Alternative 1b

Main components for the new lift station remain similar to Alternative 1a, with system with a total dynamic head of 20 feet and for a flow of approximately 18,000 gpm. **Error! Reference source not found.** shows Alternative 1b in light orange; which will discharge at SBIWTP and run through the primary treatment process only, then blend with the full plant effluent and discharge to the ocean through the SBOO.

Alternative 1c

Main components for the new lift station remain similar to Alternative 1a, however as showed in Figure 12 in yellow, Alternative 1c reroutes the discharge from the new lift station to permit for the transboundary flows to go throughout the entire plant process.

Alternative 1d

The Lift station system will take flows from the TJ channel and discharge into the abandoned pipeline directing flow into Point Loma WWTP. Figure 11 shows the abandoned pipeline while **Error! Reference source not found.** shows the re-routing in pink. This option will not discharge any flows through the SBOO, since it will be diverting the flows north to Point Loma WWTP and eventually discharge into the Point Loma Ocean Outfall (PLOO).

Figure 13 on page 13, shows the pipeline from the U.S.-Mexico border reaching Point Loma WWTP with approximately 25 miles of pipelines, crossing lift stations: Grove Avenue, PS #1 and PS #2.

Figure 11. Abandoned Line connection to Point Loma WWTP

Figure 12. Proposed Lift Station with connections at several locations (Alternatives 1a to 1d)

Figure 13. New Lift Station conveying flows to Point Loma WWTP (Alternative 1d)

Alternative 2a

The reclaimed water pipeline extending at about 82,000 feet is shown on **Error! Reference source not found.** in orange (south of the border). The line starts at La Morita WWTP, connects through Herrera Solis WWTP and ties in at SBIWTP to discharge through SBOO. The proposed sizing of the line starts at a 30-in for the connection between the WWTPs and progressively increases to a 36-in to connect to SBOO gravity main.

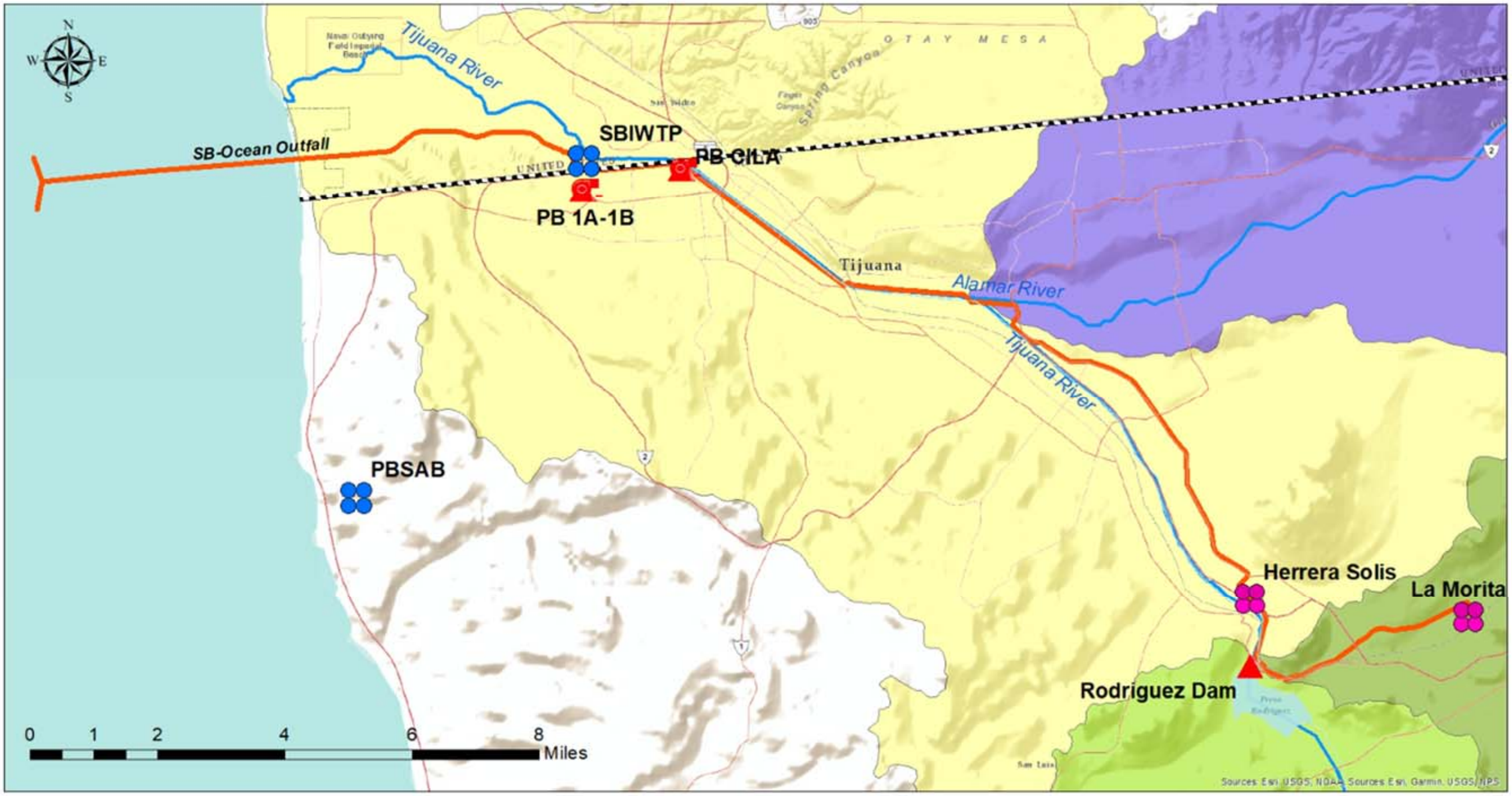


Figure 14. Reclaimed Water pipeline connecting at SBOO (Alternative 2a)

Alternative 2b

The proposed reclaimed water pipeline is shown on Figure 15. Similar to Alternative 2a, the new line connects La Morita and Herrera Solis WWTPs until it intercepts the abandoned line that connects flows to Point Loma WWTP. This abandoned line, shown in blue in Figure 11, will be rehabilitated to carry flows into the U.S. before discharging into the ocean. Point Loma WWTP is located at the far north end of the bay.

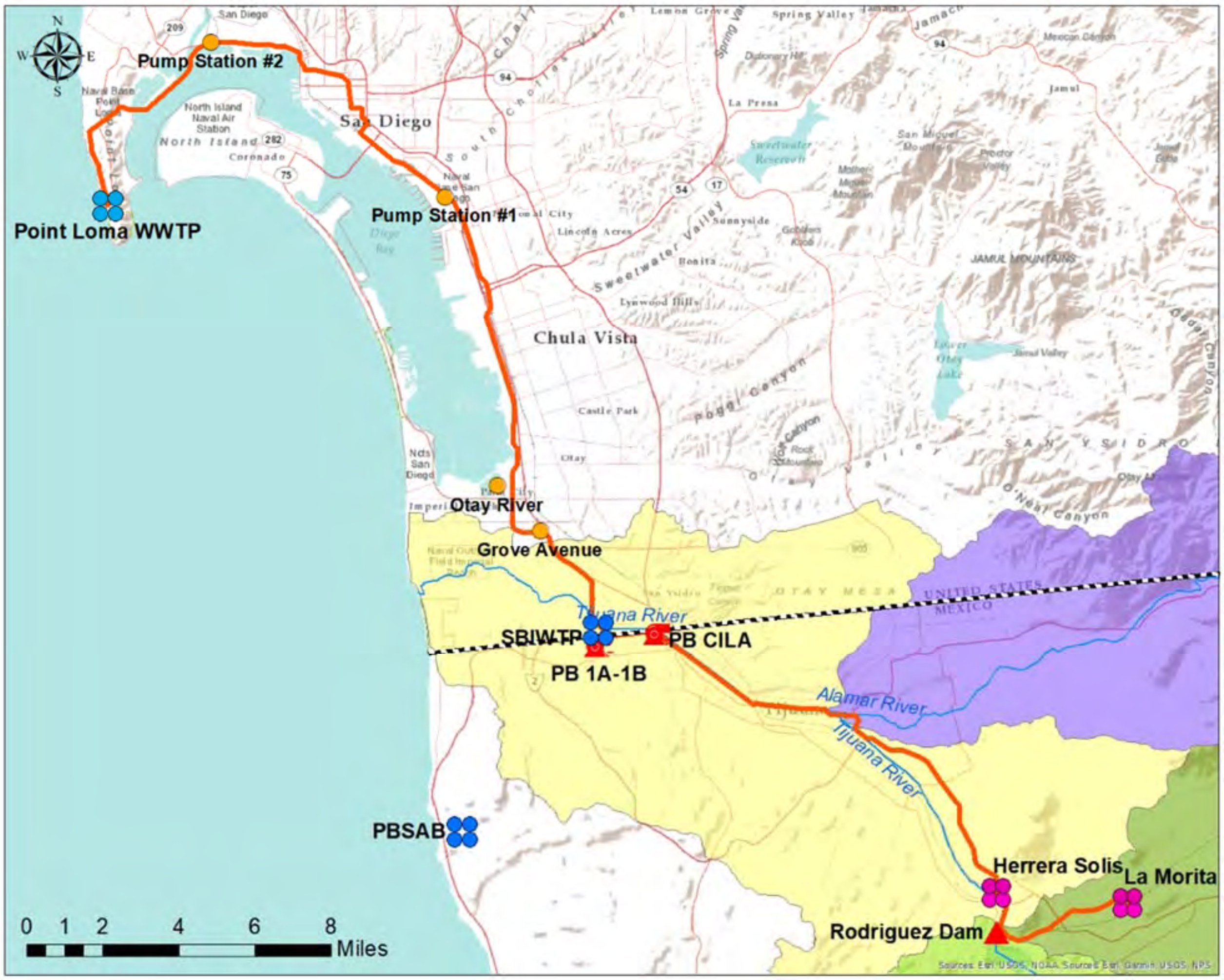


Figure 15. Reclaimed Water pipeline connecting to Point Loma WWTP force main (Alternative 2b)

Alternative 3

Figure 16 shows the proposed inflatable dam locations along the Tijuana channel and the Alamar River. The fist inflatable dam is set approximately 500 feet south of the PBCILA intake, to withhold any flooding into the intake and into PBCILA lift Station. A second temporary dam is set at midpoint between the confluence of Tijuana and Alamar rivers and dam no. 1; while a third inflatable dam will be strategically positioned at the Tijuana-Alamar Rivers confluence point and a last dam at the Alamar river to temporarily holds flows into the Tijuana channel from Tecate and from the Alamar Sub-basin.

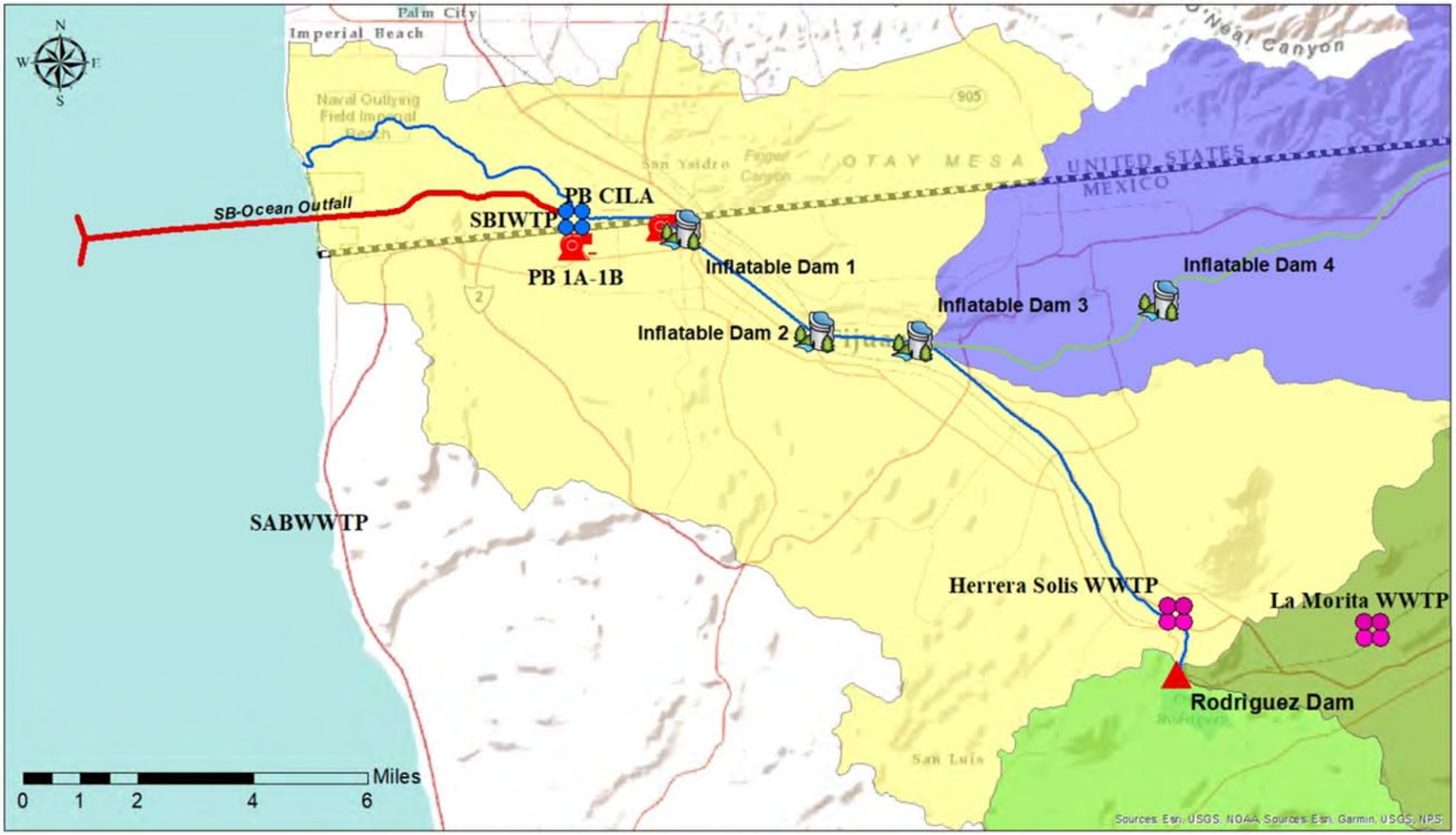


Figure 16. Proposed Inflatable Dam locations (Alternative 3)

PRELIMINARY LEVEL OPINION OF COST

Arcadis developed a preliminary level opinion of probable cost for each alternative using RS Means, historical bid tabs from the region, vendor/manufacturer estimates and previous studies. This cost includes improvements and/or modifications to existing infrastructure and a 30% contingency to account for unknows at this early stage.

Alternative 1a

This option includes concrete river intake box, approximately 5,100 linear feet of new ductile iron pipelines 36 and 42 inch in diameter, a 25 MGD lift station with its appurtenances, and the SBOO tie-in. All amounts are shown as the total lump sum (LS) or number of linear feet (LF) of each description.

Description	Quantity	Unit	Amount
River Intake Structure	1	LS	$17,740.00
Suction and Discharge Wastewater Pipelines, fittings and appurtenances	5,100	LF	$6,489,600.00
Lift Station complete with pumps, piping and appurtenances, electrical controls and instrumentation	1	LS	$3,042,000.00
SBOO tie-in	1	LS	$860,500.00
	Total Construction Cost		**$10,410,000.00**
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$520,500.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		15.00%	$1,249,200.00
Construction Phase Services		12.00%	$1,041,000.00
Construction Contingency		30.00%	$3,966,210.00
General Contractor OH&P		15.00%	$1,795,725.00
Alternative 1a Rounded Total Construction Cost			**$18,983,000.00**

Alternative 1b

Cost includes the components of the lift station as shown on Alternative 1a, 3,500 linear feet of new ductile iron pipelines 36 and 42 inch in diameter along with SBIWTP improvements throughout the primary treatment (Headworks, grit chambers and primary sedimentation basins) to have the additional 25 MGD treated through the primary treatment; the additional flows would blend with the plant effluent at the blending effluent box. Monitoring will be required to understand any additional requirements to maintaining the NPDES discharge permit.

Description	Quantity	Unit	Amount
River Intake Structure	1	LS	$17,740.00
Suction and Discharge Wastewater Pipelines, fittings and appurtenances	3,500	LF	$4,925,600.00
Lift Station complete with pumps, piping and appurtenances, electrical controls and instrumentation	1	LS	$3,042,000.00
SBIWTP Headworks Modification Improvements	1	LS	$3,692,200.00
SBIWTP Primary Treatment Basins Improvements	1	LS	$6,122,400.00
	Total Construction Cost		**$17,800,000.00**
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$890,000.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		12.00%	$2,136,000.00
Construction Phase Services		10.00%	$1,780,000.00
Construction Contingency		30.00%	$6,781,800.00
General Contractor OH&P		15.00%	$3,070,500.00
	Alternative 1b Rounded Total Construction Cost		**$32,458,000.00**

Alternative 1c

Cost for this alternative includes the previous 1b cost with the addition of the improvements for secondary treatment including activated sludge and secondary sedimentation basins. Alternative 1c will have an additional flow of 25 MGD treated through the full plant to the meet the existing NPDES discharge permit requirements. This option more than doubles the cost of Alternative 1b.

Description	Quantity	Unit	Amount
River Intake Structure	1	LS	$17,740.00
Suction and Discharge Wastewater Pipelines, fittings and appurtenances	3,500	LF	$4,925,600.00
Lift Station complete with pumps, piping and appurtenances, electrical controls and instrumentation	1	LS	$3,042,000.00
New Junction Box	1	LS	$5,870.00
SBIWTP Headworks Modification Improvements	1	LS	$3,692,200.00
SBIWTP Primary Treatment Basins Improvements	1	LS	$5,000,000.00
SBIWTP Activated Sludge & 2ry SS Basins Improvements	1	LS	$77,223,074.00
		Total Construction Cost	**$93,606,000.00**
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$4,669,800.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		12.00%	$11,267,520.00
Construction Phase Services		10.00%	$9,389,600.00
Construction Contingency		30.00%	$37,067,976.00
General Contractor OH&P		15.00%	$16,427,853.00
		Alternative 1c Rounded Total Construction Cost	**$171,219,000.00**

Alternative 1d

This estimate includes the lift station with appurtenances included in Alternative 1a, a river intake structure, wastewater pipeline replacement and tie-in. About 25 MGD of combined flow will be diverted into the force main leading to Point Loma WWTP.

Description	Quantity	Unit	Amount
River Intake Structure	1	LS	$17,740.00
Suction and Discharge Wastewater Pipelines, fittings and appurtenances	1,050	LF	$1,635,800.00
Wastewater Pipeline Replacement	5,630	LF	$12,282,087.00
Lift Station complete with pumps, piping and appurtenances, electrical controls and instrumentation	1	LS	$3,190,416.00
Tie-in to Abandoned Pipe	1	LS	$748,250.00
		Total Construction Cost	$17,874,000.00
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$893,700.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		12.00%	$2,144,880.00
Construction Phase Services		10.00%	$1,787,400.00
Construction Contingency		30.00%	$6,809,994.00
General Contractor OH&P		15.00%	$3,083,265.00
		Alternative 1d Rounded Total Construction Cost	**$32,593,000.00**

Alternative 2a

Reclaimed water pipelines include more than 100,000 linear feet of pipe replacement, trenching, backfill and tie-in at SBOO.

Description	Quantity	Unit	Amount
Trenching: cut, fill, compaction, haul away excess (Tijuana Portion)	1,244,760	CY	$4,537,160.00
Reclaimed Water Pipelines, concrete replacement, fittings and appurtenances (Tijuana Portion)	99,581	LF	$55,077,088.00
Trenching: cut, fill, compaction, haul away excess (San Diego County Portion)	10,833	CY	$379,167.00
Reclaimed Water Pipelines, concrete replacement, fittings and appurtenances (San Diego County Portion)	650	LF	$1,029,600.00
SBOO Tie-in	1	LS	$861,000.00
		Total Construction Cost	$61,818.00
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$3,090,900.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		12.00%	$7,418,160.00
Construction Phase Services		10.00%	$6,181,800.00
Construction Contingency		30.00%	$23,552,658.00
General Contractor OH&P		15.00%	$10,663,605.00
		Alternative 2a Rounded Total Construction Cost	**$112,725,000.00**

Alternative 2b

Reclaimed water pipelines include more than 100,000 linear feet of pipe replacement, trenching, backfill and tie-in to abandoned pipeline with 5,630 linear feet of replacement.

Description	Quantity	Unit	Amount
Trenching: cut, fill, compaction, haul away excess (Tijuana Portion)	1,244,760	CY	$4,537,160.00
Reclaimed Water Pipelines, concrete replacement, fittings and appurtenances (Tijuana Portion)	99,581	LF	$55,077,088.00
Tie-in to Abandon Pipeline	1	LS	$748,250.00
Trenching: cut, fill, compaction, haul away excess (San Diego County Portion)	93,833	CY	$3,284,167
Wastewater pipeline replacement, concrete replacement, fittings and appurtenances (San Diego County Portion)	5,630	LF	$8,917,920
		Total Construction Cost	**$71,350,000.00**
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$3,567,500.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		12.00%	$8,562,000.00
Construction Phase Services		10.00%	$7,135,000.00
Construction Contingency		30.00%	$27,184,350.00
General Contractor OH&P		12.00%	$9,846,300.00
		Alternative 2b Rounded Total Construction Cost	**$127,645,000.00**

Alternative 3

The four dams and their fixtures are included in the lump sum amount, diversion piping includes appurtenances, freight and training. The alternative includes onsite inspection for one day and deployment and /or recovery of dams for future use. O&M costs are not included on this cost estimate such as temporary storage and transportation of the dams when they're not in use or need to be deployed.

Description	Quantity	Unit	Amount
16 feet Inflatable Dams	4	EA	$1,175,100.00
Diversion Piping including valves, flow meter and appurtenances	4	LS	$2,141,100.00
Electrical Control Room	4	LS	$837,255.00
Freight and Training	1	LS	$363,800.00
	Total Construction Cost		**$4,238,000**
Mobilization, demobilization, insurance, bonds, and related expenses		5.00%	$211,900.00
Engineer's Fee (W/geotechnical investigation and topographic survey)		12.00%	$508,560.00
Construction Phase Services		10.00%	$423,800.00
Construction Contingency		30.00%	$1,614,678.00
General Contractor OH&P		15.00%	$731,055.00
Alternative 3 Rounded Total Construction Cost			**$7,728,000.00**

Recommendations

Any level of diversion with treatment and disinfection will help to alleviate the problematic. At this stage, alternative 3 appears to be the most cost-effective solution with a $7.73 million capital cost, it should be studied in more detail, this is a concept that will detain water within the Tijuana River Channel while bypassing approximately 29 MGD. The by-pass should allow PBCILA to operate (after lift station improvements) as typically done during dry-weather conditions to continue diverting flows to SBIWTP or SAB WWTP. O&M has been a problem for CESPT, which more than likely will could continue to be an issue until a Sewer System Management Plan is developed with an emphasis on O&M. Any U.S. funding for capital investment in Tijuana may prove to be risky until such O&M plan is in place and implemented; an O&M program should prolong the capital investments for such projects as alternative 3.

Due to the O&M program deficiencies within the CESPT, a U.S. based solution may prove to be a more favorable answer for reaching reductions to ocean spills from the Tijuana River basin, although capital costs in San Diego County, will have a magnitude of difference when compared to costs in Tijuana. Alternative 1b appears to be the most U.S. cost-effective option with a capital investment of $32.45 million, however early coordination with the CRWQCB San Diego Region should reach a memorandum of understanding (MOU) prior developing this option. This alternative could be split into two phases by initially completing the SBIWTP retrofit improvements at the primary unit processes, then followed by constructing a new diversion lift station as a secondary phase.

Alternative 1d is an option with a capital cost of $32.59 million similar to alternative 1b, however a condition assessment is highly recommended at the abandoned pipeline portion and at Grove Ave Pump Station to further detail the improvements at these two locations. County of San Diego has communicated to Arcadis that no further discharges can be made to Point Loma WWTP, early coordination with the CRWQCB San Diego Region is needed to reach a MOU that can permit additional flows to be conveyed and treated at Point Loma WWTP. This option may require having the San Diego Reuse Program in place to access capacity at the plant for additional flows from Tijuana WWTPs.

Alternative 1c, which has a high capital cost, over $171 million, may be a phased option that could be proposed as an additional third phase from alternative 1b for long-term solution. However, since most of the additional flows will probably have a high hydraulic loading versus a high organic loading, significant modeling considerations are needed to preserve optimal plant conditions. An independent CSO treatment facility may be a preferred option.

The conveyance alternatives 2a and 2b are the very least cost-effective alternatives, however these will have a low O&M requirement.

Table 2 displays a summary description of the alternatives with the costs, pros and cons for each.

Table 2. Alternative Summary

Alt No.	Name	Description	Cost	Pros	Cons
1a	LS to SBOO no treatment	Lift station to divert flow (U.S.) from the TJ river with discharge into SBOO without treatment	**$18.9 Million**	U.S. based infrastructure investment where O&M procedures are applied.	This option does not offer treatment. the CRWQCB San Diego Region will require to update existing NPDES to emergency conditions to allow raw discharge.
1b	LS to SBIWTP with advanced primary treatment	Lift station in the U.S. with discharge at SBIWTP for primary treatment only	**$32.5 Million**	Most cost-effective U.S. based infrastructure investment where O&M program is implemented more actively. Plant may have capacity to practice as a chemical Enhanced Primary Treatment for the additional flows.	Early coordination with the CRWQCB San Diego Region should reach a memorandum of understanding (MOU) prior developing this option.
1c	LS to SBIWTP with full treatment	Lift station in the U.S. with discharge at SBIWTP for full plant treatment	**$171.2 Million**	Higher O&M implementation at facility. Will meet existing NPDES permit.	Option that requires modelling to preserve optimal plant conditions.
1d	LS convey and treat at Point Loma WTP	Lift station in the U.S. connecting to replacement of abandoned line connecting to Point Loma WWTP	**$32.5 Million**	U.S. based infrastructure investment with O&M	Condition assessment of abandoned pipeline and Grove Ave Pump Station is needed. This option requires early coordination with the CRWQCB San Diego Region to reach a MOU that can permit additional flows to be conveyed and treated at Point Loma WWTP.
2a	Gravity reclaimed pipeline replacement to SBOO	Reclaimed water pipeline from La Morita and Herrera-Solis WWTP with tie-in at SBOO	**$112.7 Million**	Low O&M requirements	Least cost-effective solution
2b	Gravity reclaimed pipeline replacement to Point Loma WWTP	Reclaimed water pipeline from La Morita and Herrera-Solis WWTP with tie-in at abandoned line reaching Point Loma WWTP	**$127.6 Million**	Low O&M requirements	Least cost-effective solution
3	Temporary inflatable dams	A series of four inflatable dams along the TJ River for water storage during heavy rainfall events that will allow PBCILA to divert flows at its capacity	**$7.7 Million**	Most cost-effective solution which should be studied in more detail. This is a concept that will detain water within the TJ River Channel while bypassing 29 MGD to allow PBCILA to operate at its full capacity.	Requires O&M procedures to be implemented by CESPT. Requires PBCILA improvements by CESPT.

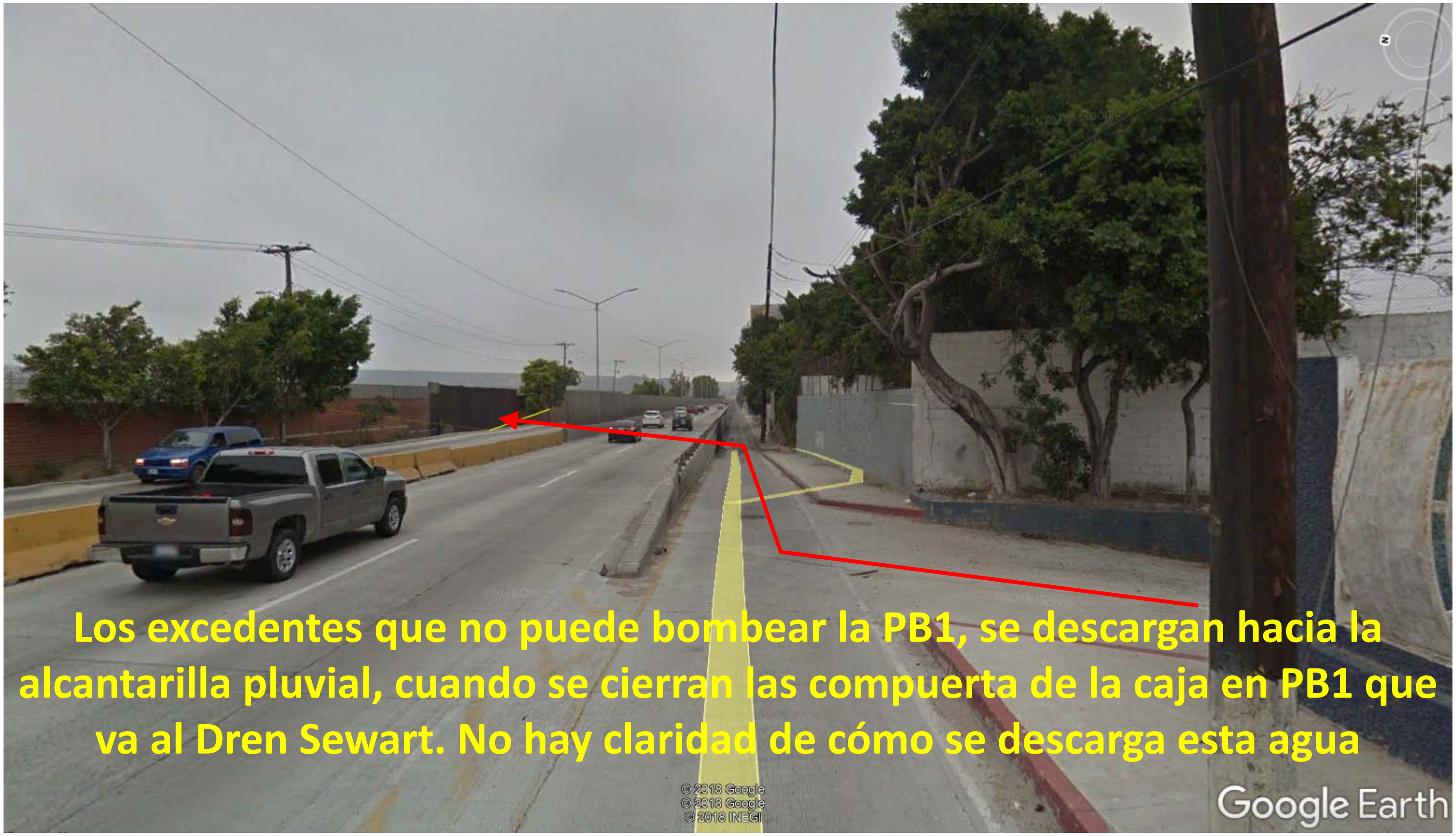
APPENDIX M

Stewart's Drain Evaluations (in Spanish)/CESPT evaluation letter of Stewart's Drain

REPORTE DE LAS DESCARGAS AL DREN STEWART


PUERTA BLANCA
DESCARGA ANTIGUA
DE EXCEDENCIAS
CAJA DE ENTRADA
Google Earth


PB1
INTERCEPTOR
INTERNACIONAL
DREN STEWART, LÍNEA
INTERNACIONAL
POZO CAJA QUE DESCARGA
AL DREN STEWART,
REPARACIÓN MAYO 2018


Los excedentes que no puede bombear la PB1, se descargan hacia la alcantarilla pluvial, cuando se cierran las compuerta de la caja en PB1 que va al Dren Sewart. No hay claridad de cómo se descarga esta agua
© 2018 Google
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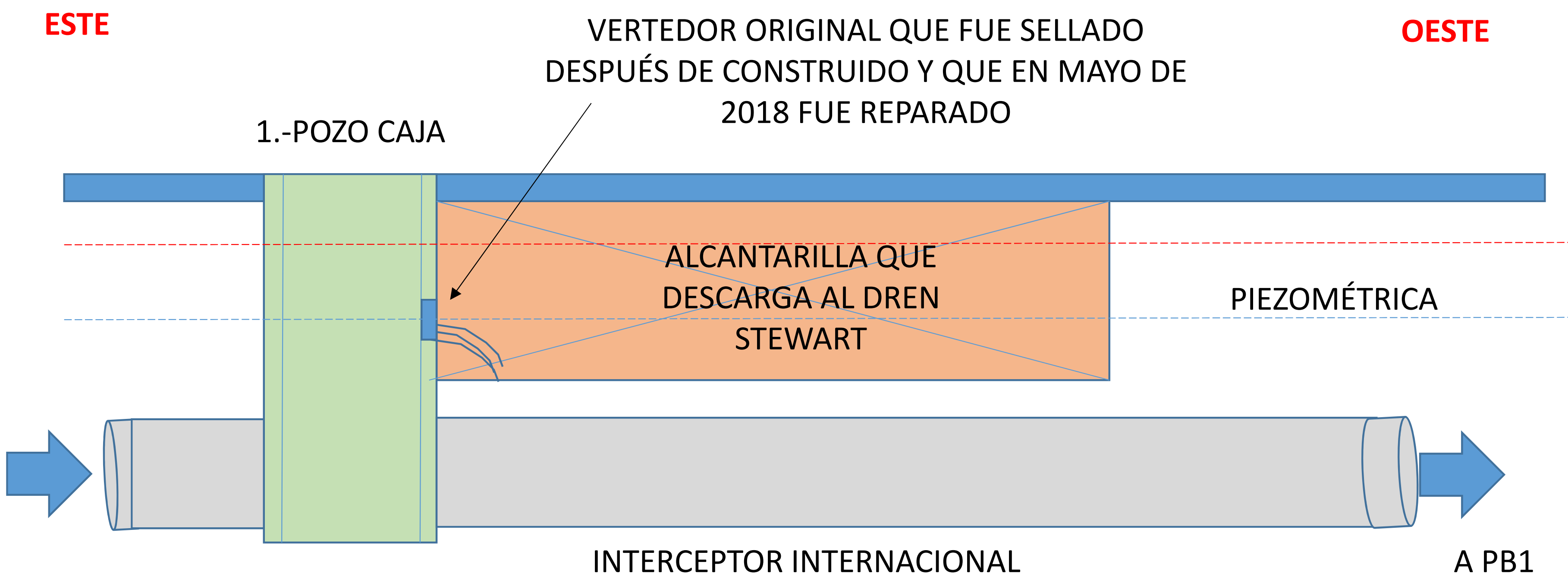
Google Earth

CAJA CON COMPUERTAS DENTRO DE PB1. INVESTIGAR CÓMO LLEGA EL AGUA A DRÉN STEWART CUANDO SE CIERRRAN COMPUERTAS

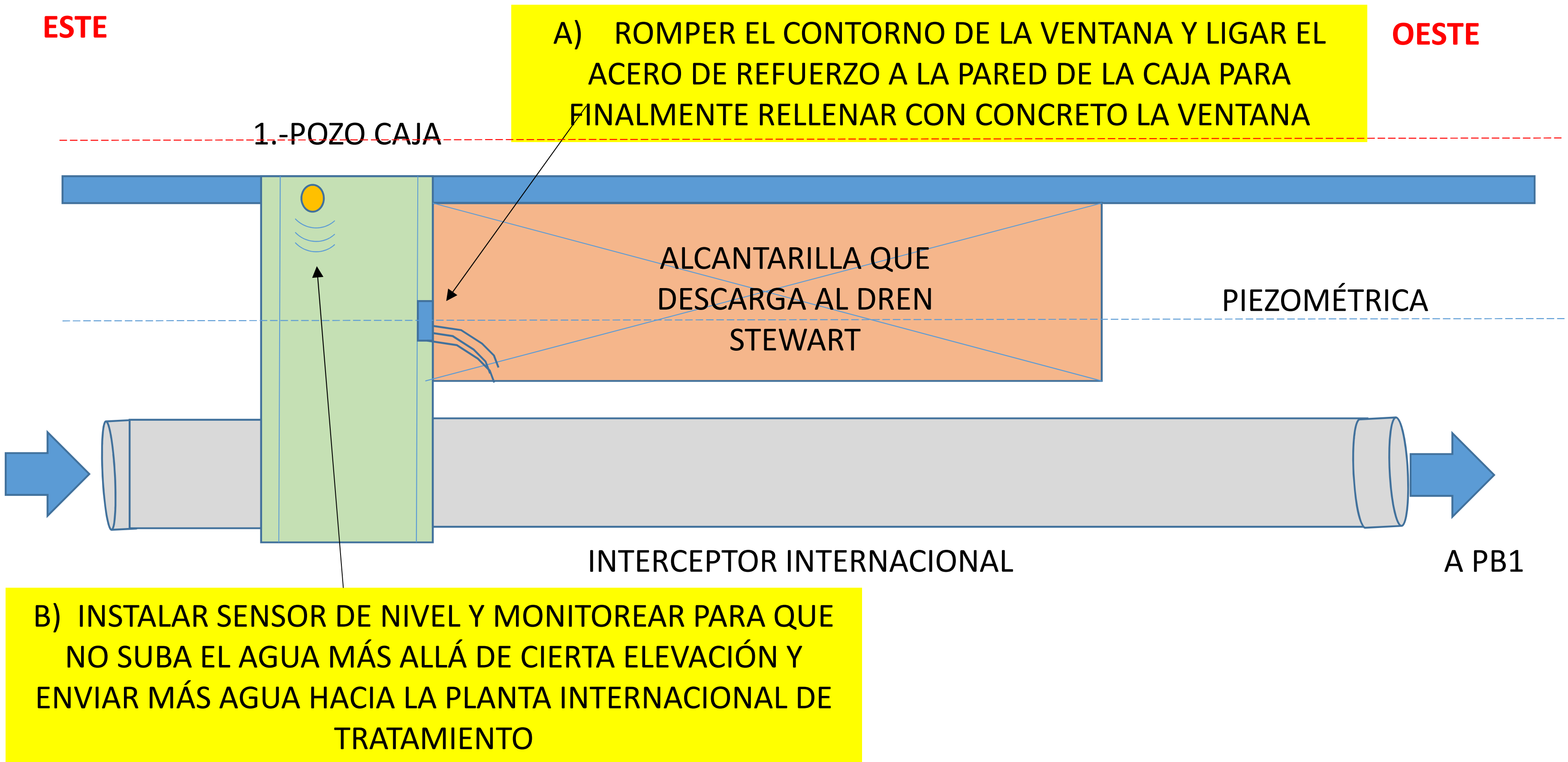
REPARACIÓN DE POZO CAJA EN MAYO DE 2018

El pozo caja del Interceptor Internacional, reparado en Mayo de 2018, tiene una de sus caras en contacto con la alcantarilla del Dren Stewart. La ventana se localiza por encima del lomo de la tubería de 72 pulgadas de diámetro



EL HECHO DE QUE POR EL VERTEDOR ESCURRIERA AGUA SIGNIFICA QUE EL INTERCEPTOR INTERNACIONAL TRABAJA A PRESIÓN Y POR LO TANTO ESTÁ EXCEDIDO EN SU CAPACIDAD DE DISEÑO. CON LA REPARACIÓN QUE SE HIZO EL NIVEL DE AGUA EN LA CAJA AUMENTARÁ Y PROBABLEMENTE ROMPERÁ POR EMPUJE EL TAPÓN, YA QUE NO SE LIGÓ EL ACERO DE REFUERZO A LA ESTRUCTURA Y SE SELLÓ CON CONCRETO LA PARED

RECOMENDACIONES A CORTO PLAZO



RECOMENDACIONES

B) REVISAR LA CAPACIDAD CONJUNTA DE LA PB1A, PB1B Y PBCILA Y LOS EMISORES DE PBCILA ASÍ COMO TODOS LOS EMISORES PARALELOS QUE VAN A SAB Y DESCARGAN AL MAR, PARA BOMBEAR MÁS AGUA Y EVITAR DESCARGAS AL DREN STEWART

C) REVISAR OTRAS ALTERNATIVAS COMO PARTE DEL PRESENTE ESTUDIO. ES PRIMORDIAL CONTAR CON INFORMACIÓN DETALLADA DE LA CESPT PARA ELABORAR OPCIONES QUE RESULEVAN LA PROBLEMÁTICA

Tijuana B.C., 24 mayo 2018

NOTA INFORMATIVA
BROTE TEMPORAL DE AGUA RESIDUAL PLUVIAL PUERTA BLANCA

ANTECEDENTES

A petición de CILA sección mexicana se programó la revisión con cámara a la infraestructura sanitaria de CESPT en la avenida Internacional cuerpo norte, a la altura de la colonia Castillo, próximo al cajón pluvial denominado Puerta Blanca, toda vez que fue detectado un brote temporal de agua residual que se dirigió hacia Estados Unidos. El pasado 22 de noviembre del 2017 se realizó una inspección visual del lado norteamericano, sin estar activo el brote de agua, donde se recabó el testimonio de las personas que lo habían detectado dentro del cajón pluvial de concreto, observándose la existencia de un pozo-caja del Interceptor Internacional DT131-033 en las proximidades del evento descrito. La video inspección al pozo-caja fue programada hasta el 4 de enero del 2018 en virtud de que el equipo se encontraba en reparación.

Es importante mencionar que en mayo del 2017 se elaboró una actualización del diagnostico del Interceptor Internacional, donde se introdujo el equipo de video inspección, encontrándose que la línea opera de manera general en aceptables condiciones, sin haber detectado fracturas en la tubería de concreto de 72 pulgadas, concluyendo dicho estudio que será necesario programar a corto plazo la rehabilitación de la tubería, cajas y pozos, para garantizar su correcto funcionamiento, este diagnostico se envió a la Subdirección de Construcción de CESPT donde se analiza el proyecto para su rehabilitación.

RESULTADO DE LA VIDEO INSPECCIÓN A POZO DE VISITA DT131-033

Derivado de la inspección del 4 de enero del 2018 se identificó que el pozo-caja con el código DT131-033, localizado en las cercanías del sitio conocido como Puerta Blanca, presenta al menos una fractura (oquedad) en una de sus paredes (situada por arriba del flujo normal de operación), la cual es posible que cuando se presenta nivel alto del interceptor internacional, se genere el brote de agua descrito. El nivel alto en la tubería puede presentarse por condiciones particulares como lo es aportación extraordinaria ó el cierre de compuerta a la llegada de la planta de bombeo PB1 al fallar el suministro de energía eléctrica por mencionar ejemplos. Esta fractura es la que consideramos dejó escapar de manera puntual aguas negras que se encausaron por el pluvial existente, cruzando de inmediato a territorio de los Estados Unidos, que de acuerdo a testimonios pudieran ser en el orden de 3 a 5 lps.

SOLUCION

Se solicitó al área operativa de CESPT realizar sondeo en el sitio en mención y realizar la reparación correspondiente. Como parte de esta solicitud se enviaron además anexos del sitio e imágenes de la inspección. El trabajo correctivo concluyó el 12 de mayo 2018.

OTROS FLUJOS OBSERVADOS EN PLUVIAL PUERTA BLANCA

En la inspección visual del 22 de noviembre del 2017 también se observó que el pluvial conducía un pequeño flujo adicional de agua de origen no residual, proveniente de aguas arriba, el cual fue rastreado encontrando que se debe a las actividades de lavado y fuga de agua potable por vandalismo de robo de medidores.

ATENTAMENTE

OFICINA DE ESTUDIOS TECNICOS

APPENDIX N

Arcadis Presentations to Stakeholders

ARCADIS Design & Consultancy for natural and built assets

TIJUANA RIVER DIVERSION STUDY

Flow Analysis, Infrastructure Assessment and Development of Alternatives – 30% Progress Meeting | August 28, 2018

Outline

- H&S Moment
- Project Background and Objectives
- Task 1 – Flow Analysis
- Task 2 – Infrastructure and Operations Diagnostic
- Task 3 – Alternatives Analysis
- Project Schedule
- Next Steps
- Questions/Discussion

Health and Safety Moment: 6 Fundamental Health & Safety Principles

- Undertake Health and Safety Planning
- Demonstrate H&S Stewardship Daily
- Practice if not me, then who
- Exercise Stop Work Authority
- Report Near Misses and Incidents
- Use TRACK every day

Project Objectives

- Task 1 – Review of Existing Information and Transbounday Flow Analysis
  - Identify previous problems and solutions from completed studies
  - Collect and analyze data on Tijuana River flows, border flows, water quality, beach closure reports, rainfall events
- Task 2 – Infrastructure and Operations Diagnostic
  - Determine infrastructure current capacities and conditions
  - Condition and Operational diagnostics, identify failures resulting in transboundary flows
  - Impact of unserved areas in Tijuana
- Task 3 – Alternatives Analysis
  - Alternative evaluation of 15 total alternatives
  - Provide decision matrix for alternative selection by Binational Core Group
- Task 4 – PM & Stakeholder Coordination
  - Meetings, stakeholder interviews, draft and final reporting

Task 1 – Transboundary flow analysis scope

1) Compilation and review of existing studies and data identified in the Request for Proposals (RFP)
2) Statistical analysis of transboundary flow data and development of flow-frequency and flow-duration relationships
3) Estimation of annual probability and duration of transboundary flows under low-flow (under 1,000 lps) and higher-flow conditions (up to 3,000 lps) due to operational failure or non-operation of the PB-CILA facility
4) Derivation of relationships between transboundary flows, precipitation, beach closures, and diversion operational failures
5) Estimation of number of undocumented PB-CILA operational failures based on responses to questionnaires designed to elicit relevant information from system operators and appropriate USEPA, USIBWC, CILA, CONAGUA, and CESPT staff (County of San Diego questionnaire responses provided in Appendix A of 30% report)
6) Derivation of distributions of causes of failure and annual probabilities of failure by cause and by flow rate

Task 1 – Study reports and data collection

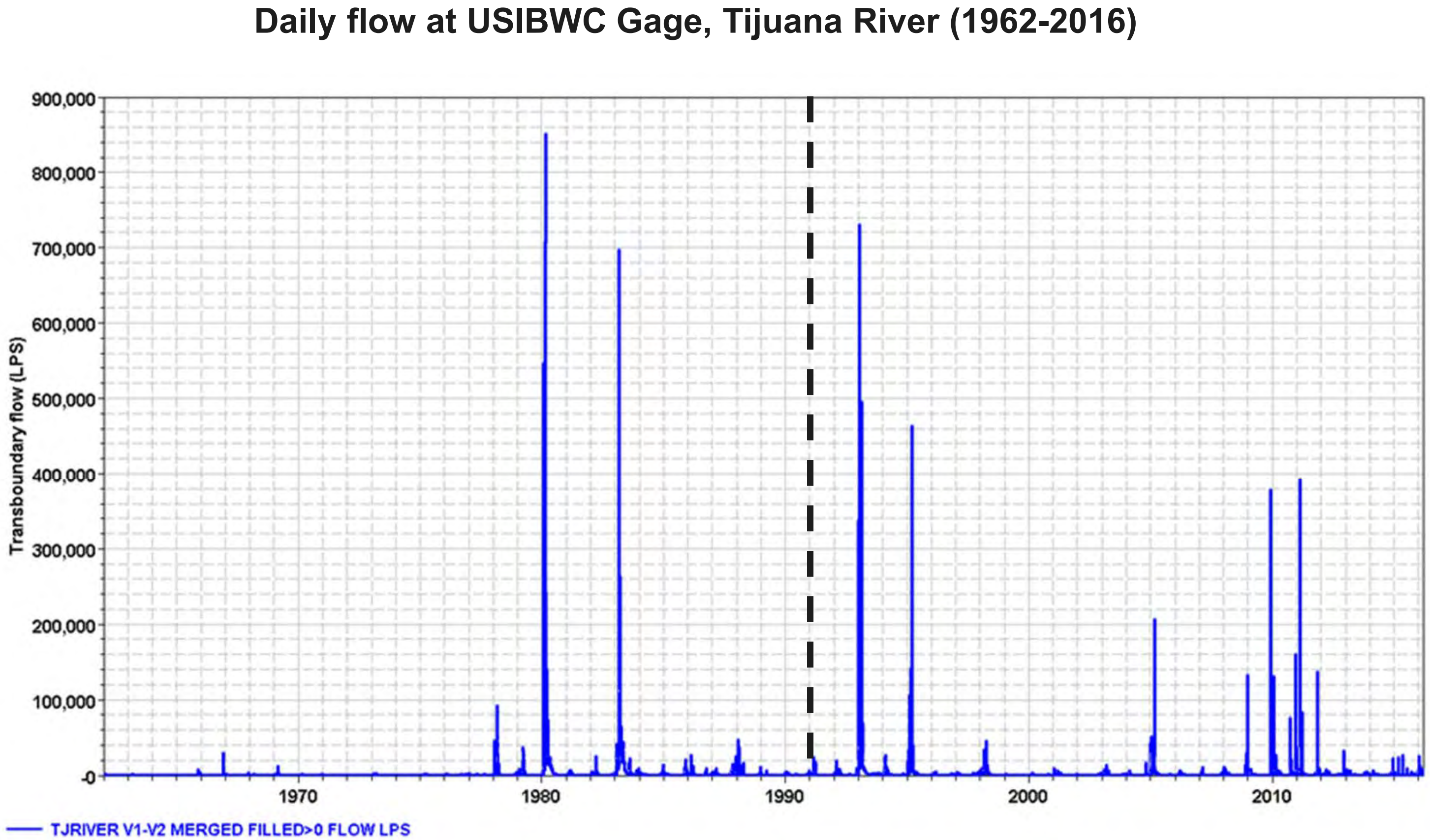
Study reports:

1) CESPT (2017). *Plan for a Comprehensive Wastewater Treatment and Reuse System for the City of Tijuana*.
2) IBWC (2017). *Report of Transboundary Bypass Flows into the Tijuana River.*
3) IBWC (undated) *CILA Pump Station Operations and Notification Protocol*

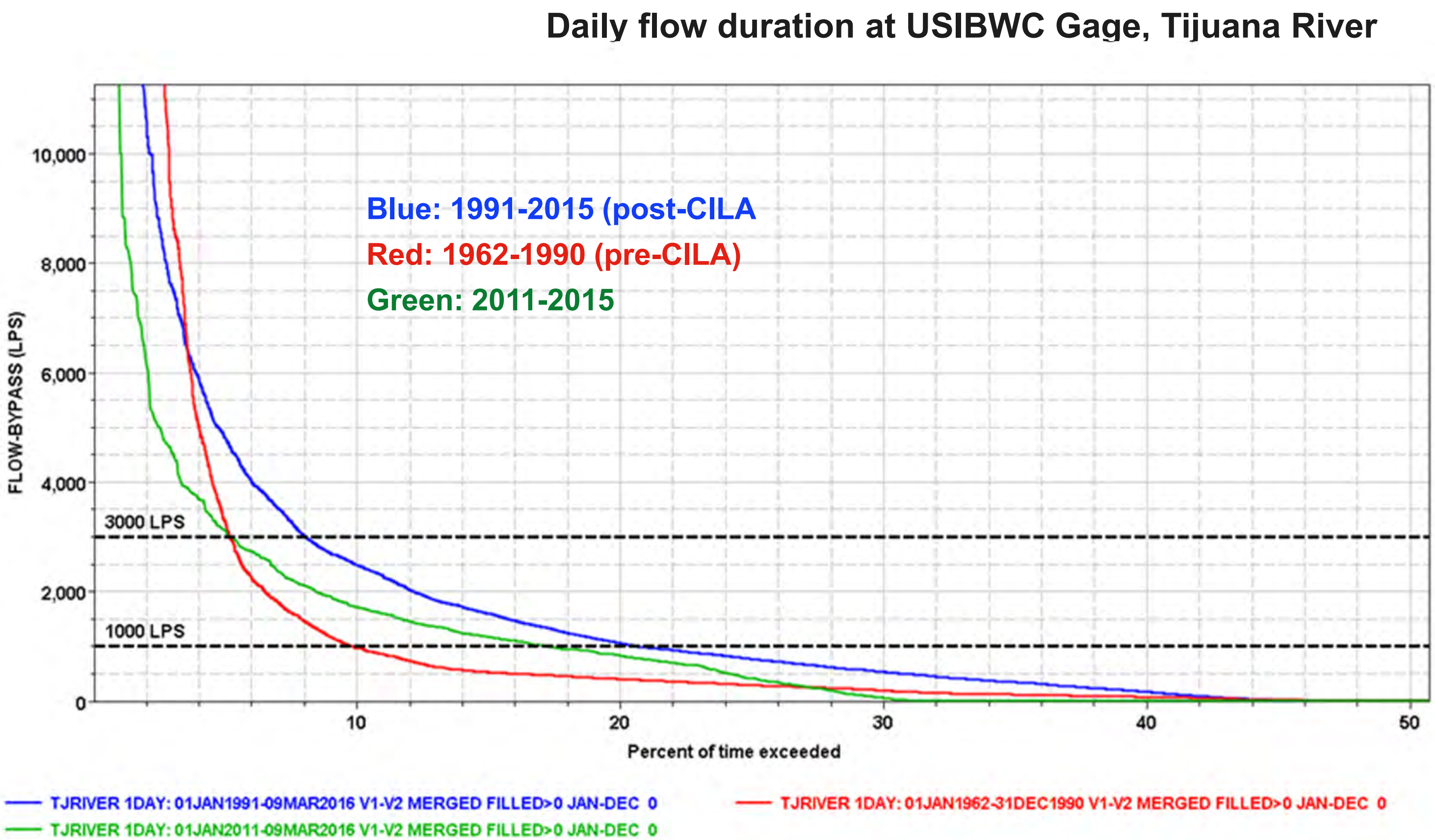
Data:

1) Daily and/or monthly transboundary Tijuana River flows measured at the USIBWC streamgage just downstream of the U.S. – Mexico border
2) Daily and/or monthly Tijuana River flows measured at the PB-CILA facility
3) Daily and/or monthly precipitation in the Tijuana River Basin
4) Dates of San Diego County beach closures
5) Dates of known PB-CILA operational failures and causes (e.g. mechanical, accidental, planned outage, operator decisions, etc.)
6) Magnitude and frequency of undocumented operational failures based on questionnaire responses

Task 1 – Transboundary flow statistics



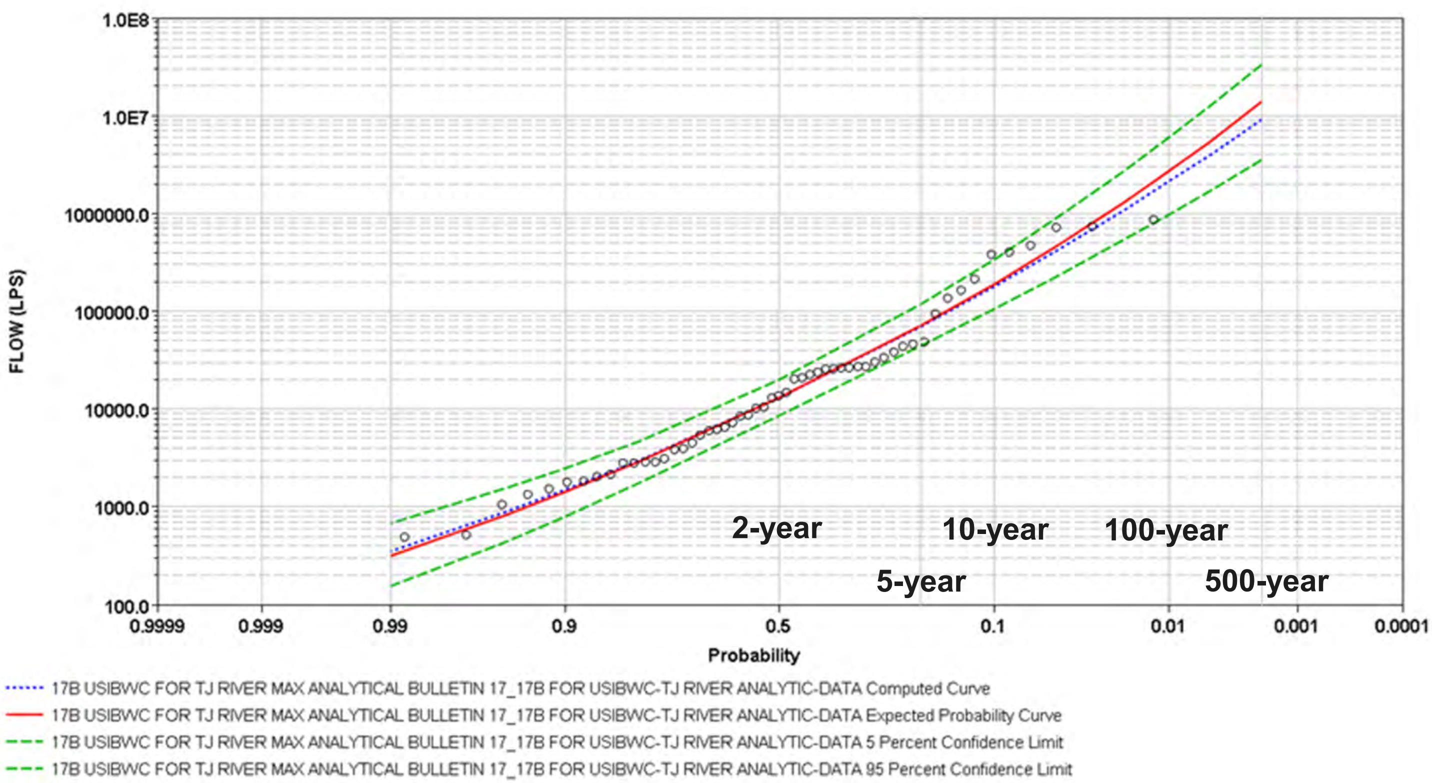
Task 1 – Transboundary flow statistics



1) Average annual transboundary flow volume could be reduced about 80% with dependable capacity increase of an additional 1,000-lps.
2) Marginal effectiveness of increased diversion capacity diminishes beyond 3,000 lps.

Task 1 – Transboundary flow statistics

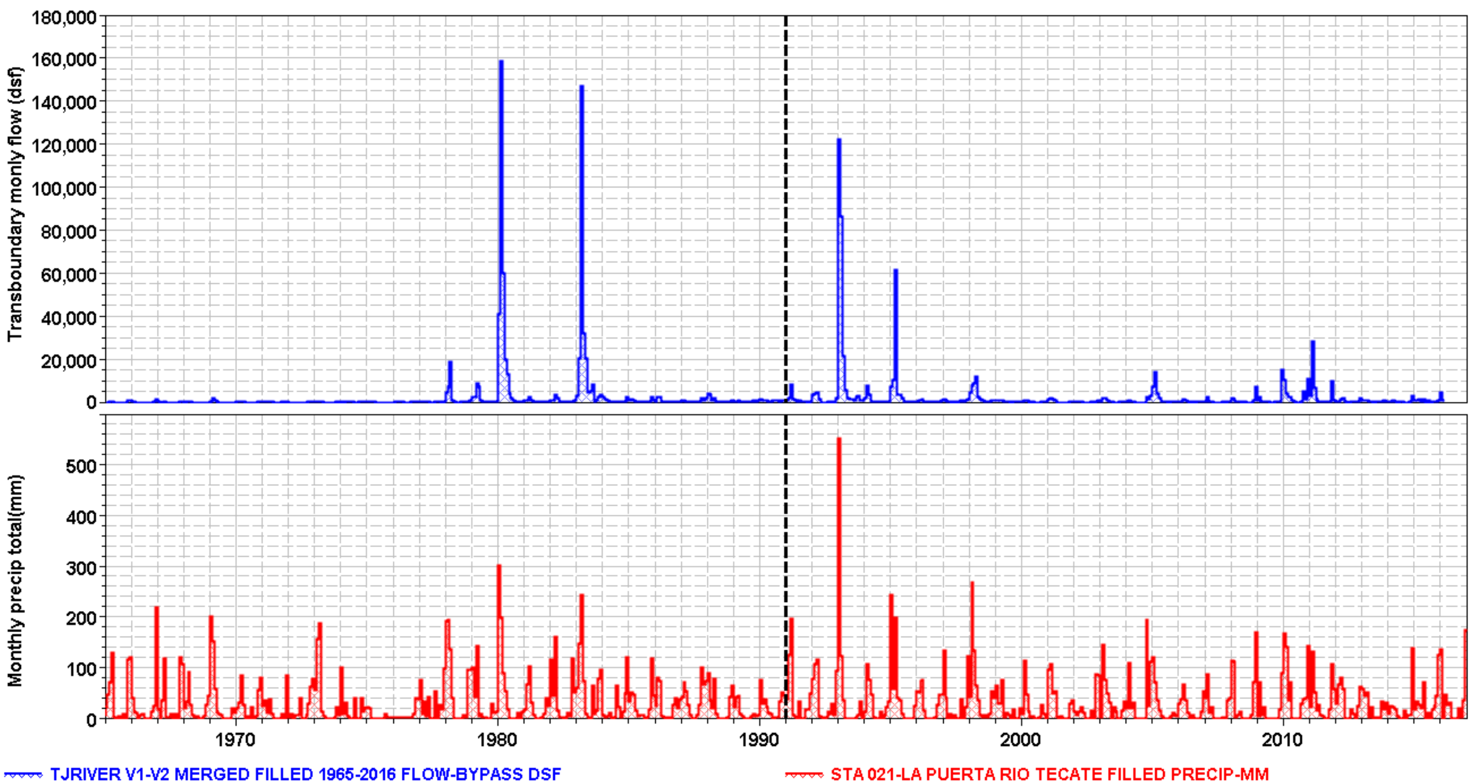
Flow frequency at USIBWC Gage, Tijuana River (1962-2016)



1) **Existing PB-CILA diversion capacity (1,200 lps) is equivalent to ~ 1-year flood**
2) **Increasing diversion capacity to handle stormwater from minor floods appears to be impractical (e.g. 10,000-lps dependable treatment capacity needed to divert/treat 2-year flood)**

Task 1 – Transboundary flow statistics

Monthly transboundary flow volume and cumulative precipitation at La Puerta Rio Tecate station, Mexico (1991-2016)



One-way ANOVA: Are pre- and post-CILA transboundary flow volumes statistically different?

1) Pre-CILA (1965-1990)
2) Post-CILA (1991-2016)
3) Conclusion: Post-CILA monthly TBFs average 45 lps (~2.2%) > Pre-CILA monthly TBFs

One-way ANOVA: Are pre- and post-CILA monthly precipitation depths statistically different?

1) Pre-CILA (1965-1990)
2) Post-CILA (1991-2016)
3) Conclusion: Post-CILA monthly precipitation averages 2mm (~6.6%) > Pre-CILA monthly precipitation

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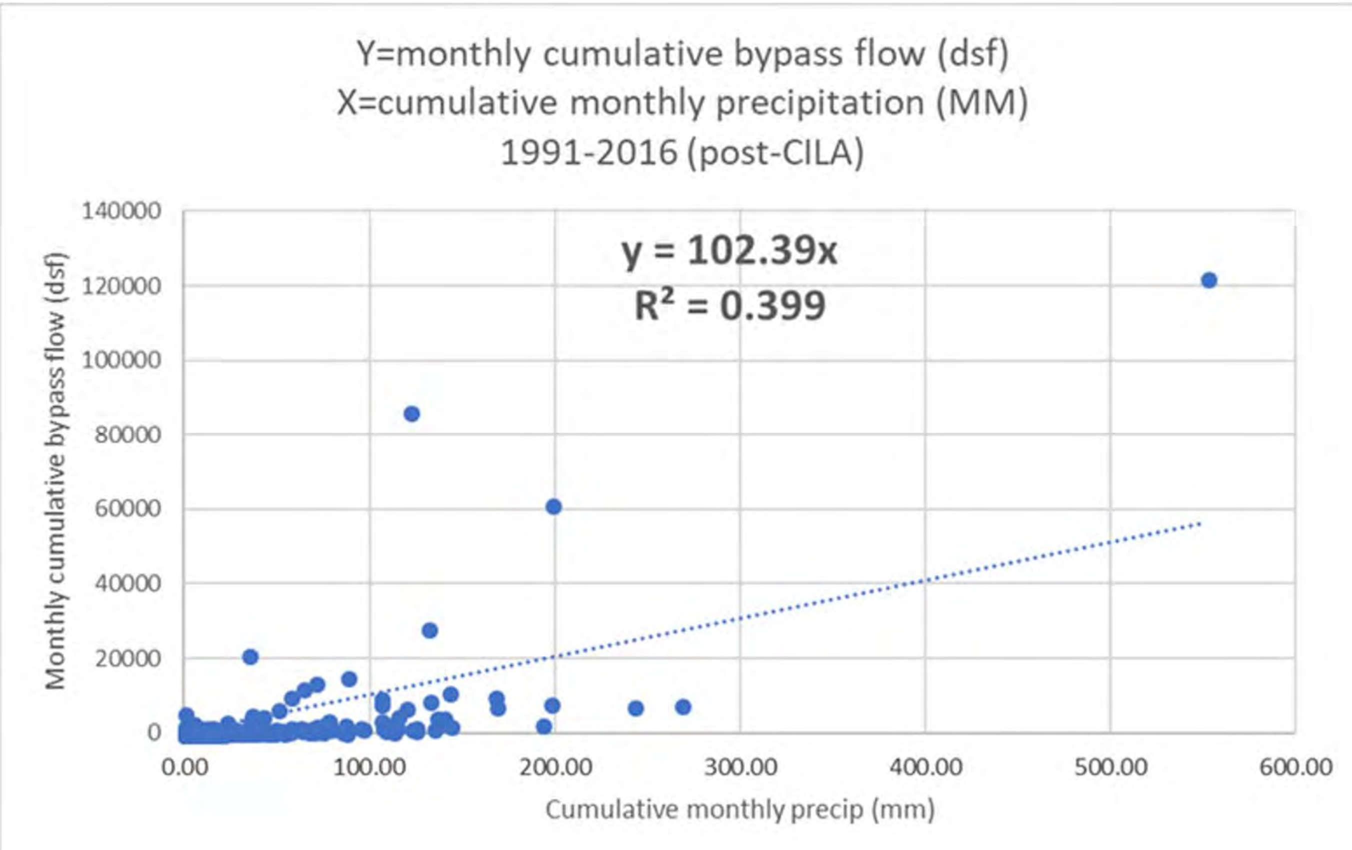
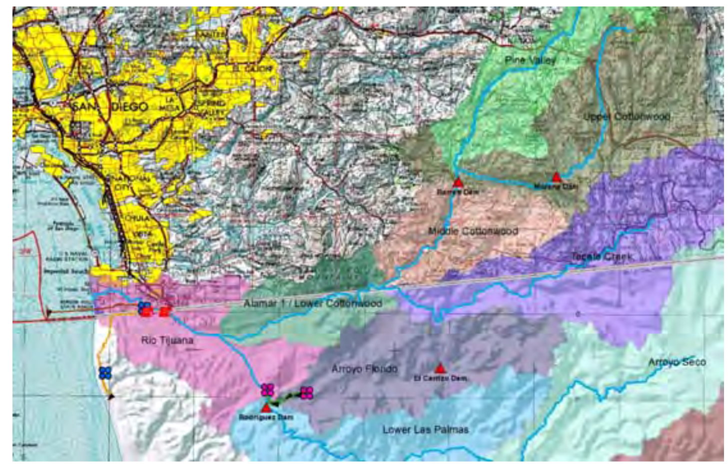
Task 1 – Transboundary flow statistics

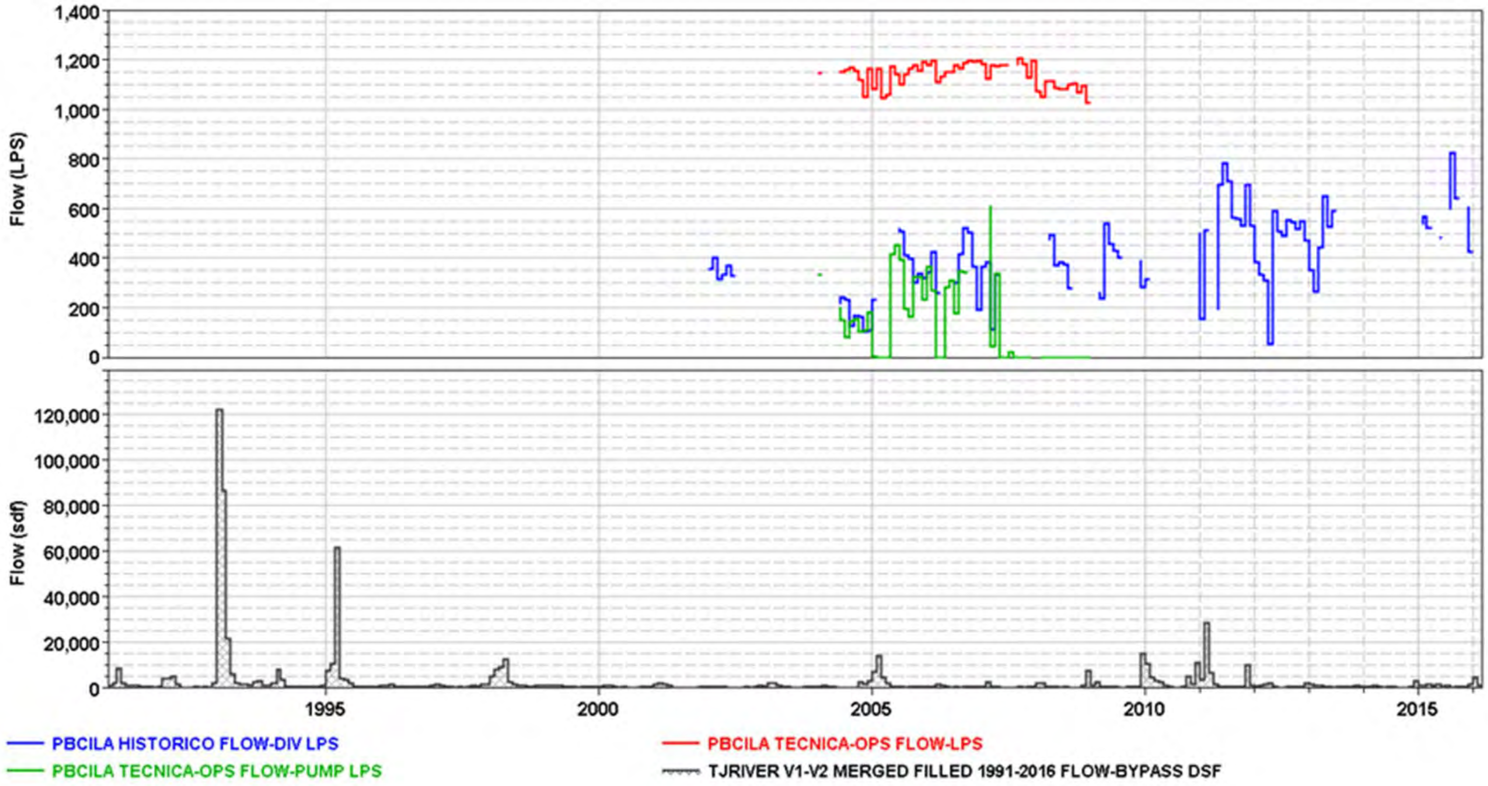
Monthly transboundary flow volume and cumulative precipitation regression (1991-2016)





Task 1 – PB-CILA operational data

Monthly PB-CILA diversion data (2004-2016)



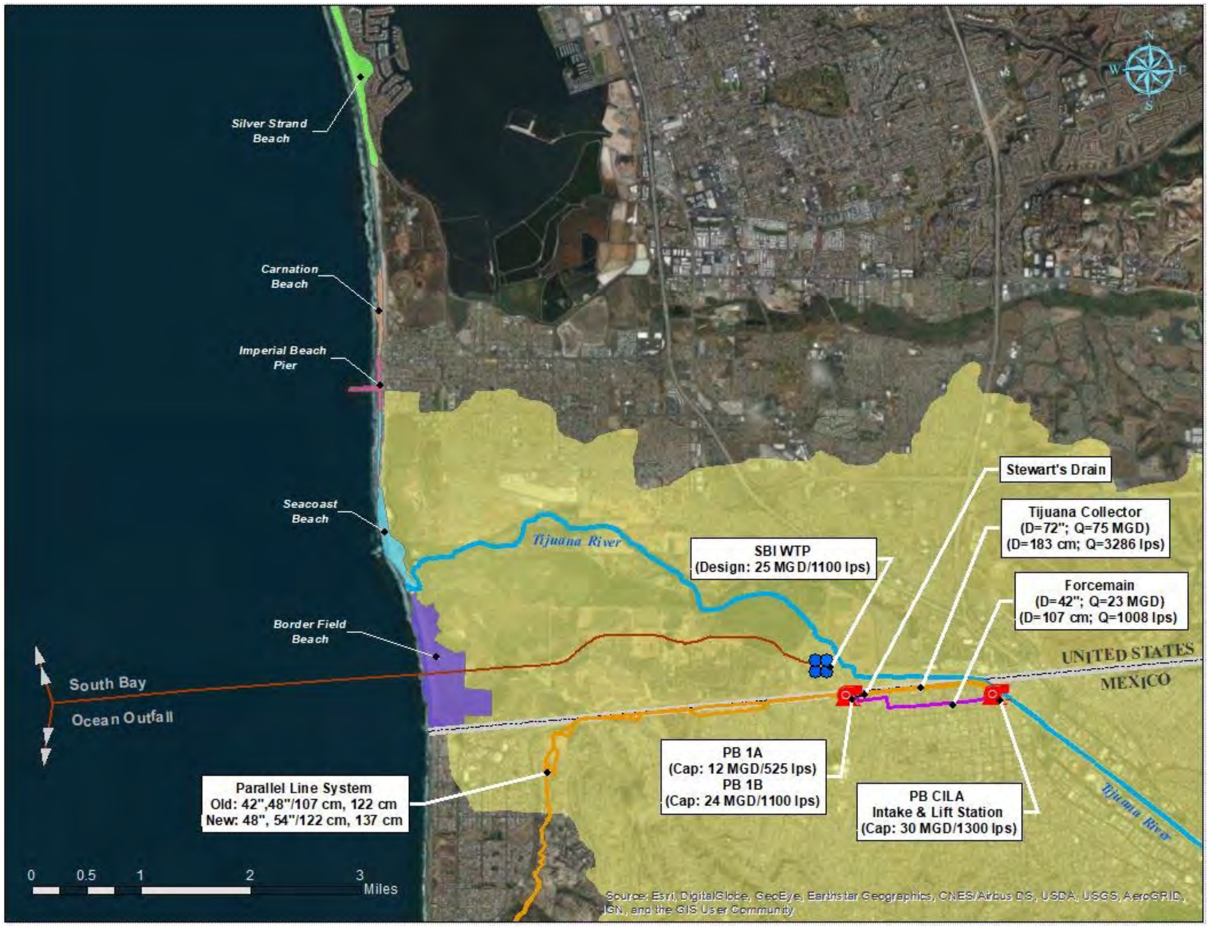
1) Indicates that PB-CILA operated at or near full capacity for much of 2005-2009

2) Have just received monthly residual flow (pumping) data for PB-CILA from 1999-2016.

3) Have just received monthly outage days for PB-CILA residual flow (pumping) from 2000-2013

Task 1 – Beach closures

South San Diego beaches subject to closure

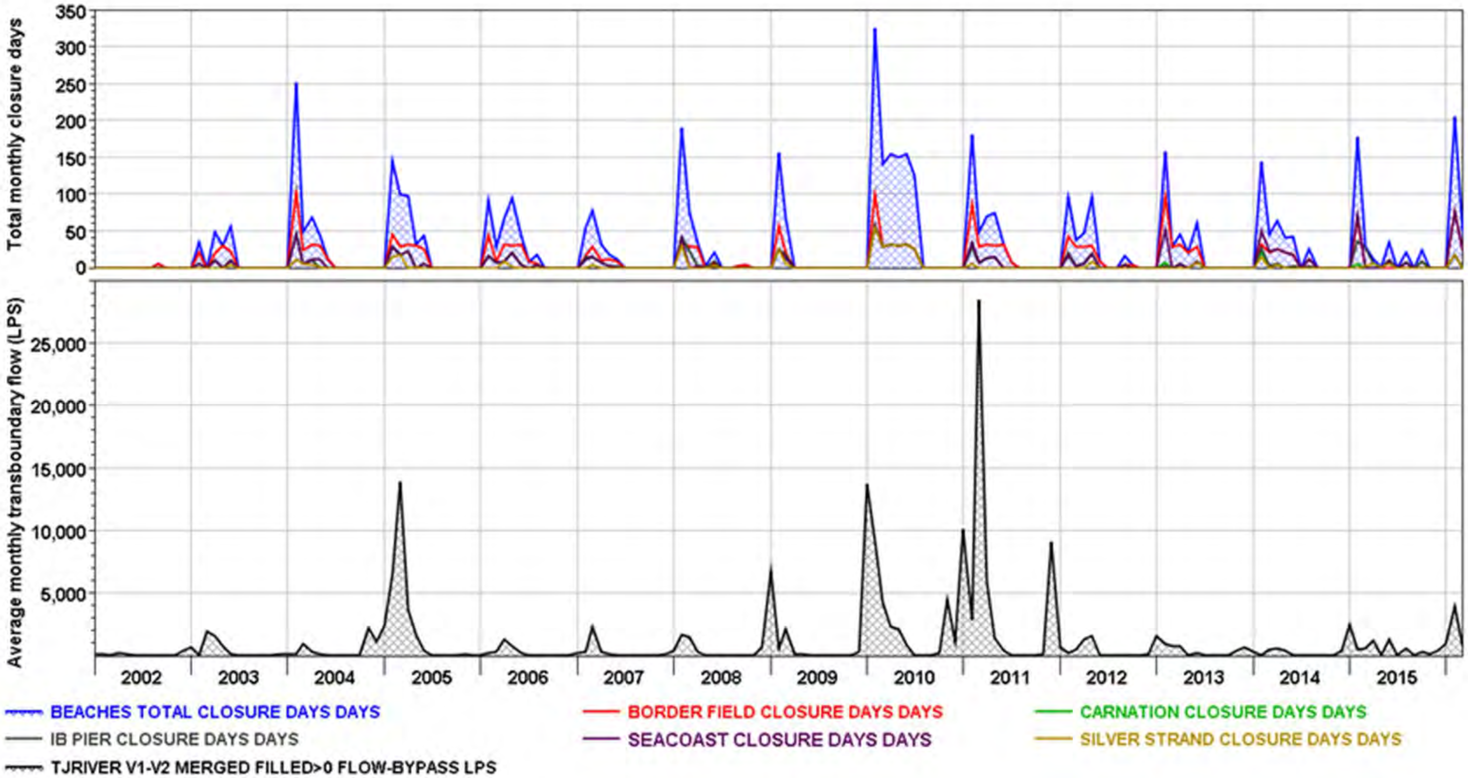


Closure days totaled monthly for:

1) Silver Strand Beach
2) Carnation Avenue Beach
3) Imperial Beach Pier
4) Seacoast Beach
5) Border Field Beach
6) Sum (1) – (5)

Task 1 – Beach closures

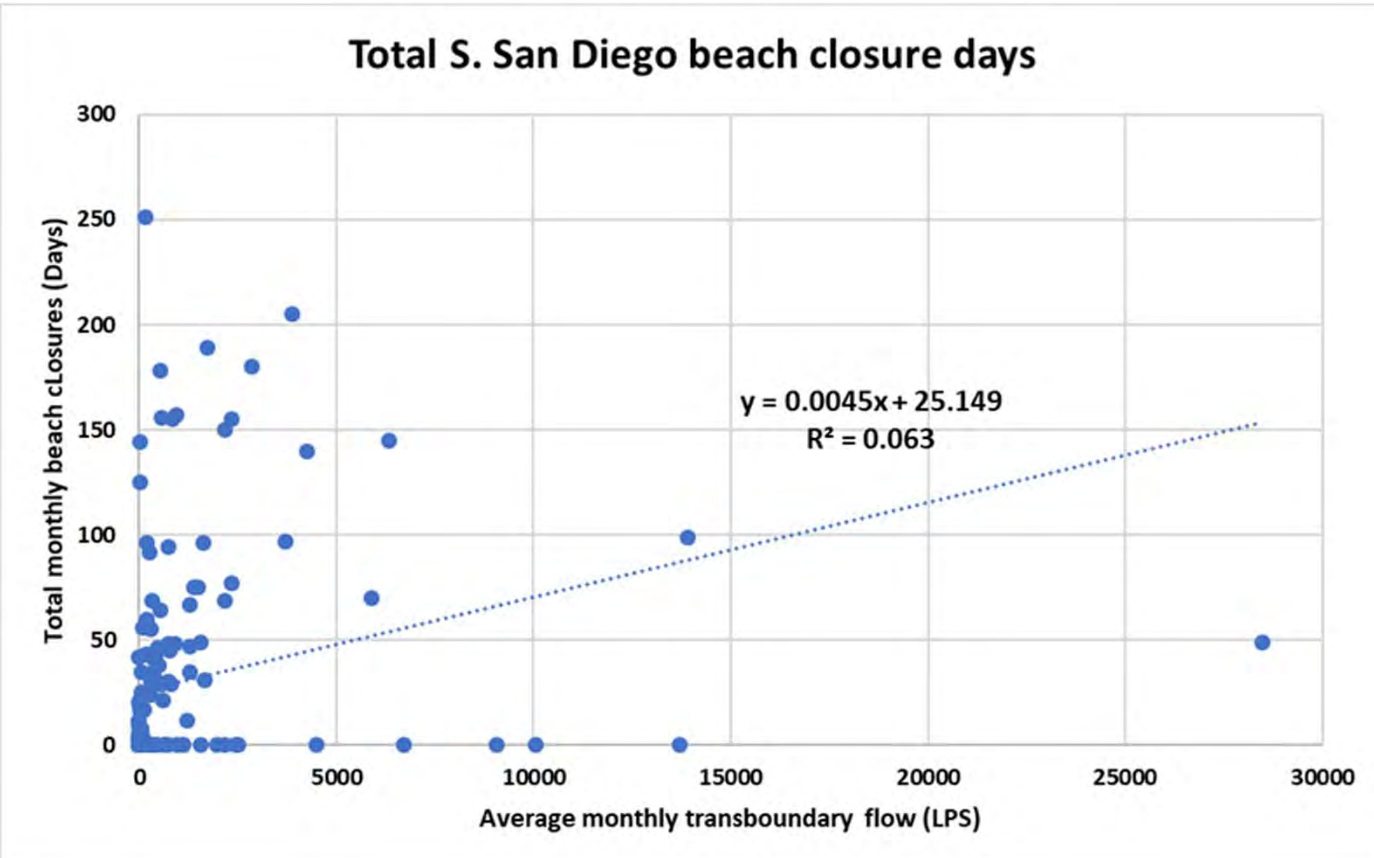
Beach closure days/month vs. average monthly transboundary flow (2002-2016)



1) **Beach closures and transboundary flow events appear to be seasonal (i.e. from January-June) in most years.**
2) **Timing but not magnitude of beach closure and transboundary flow volumes appear to be related.**

Task 1 – Beach closures

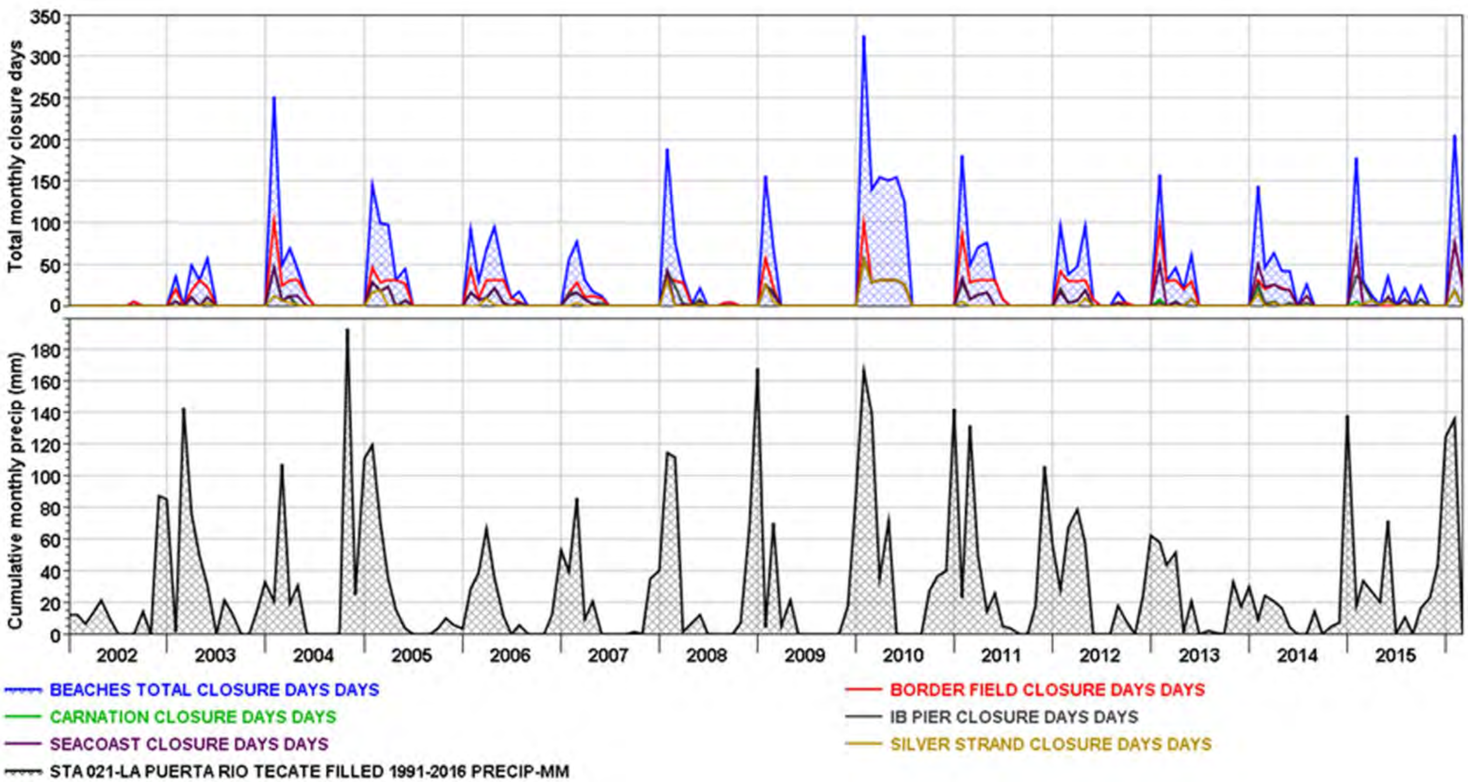
Beach closure days/month vs. average monthly transboundary flow (2002-2016)



1) **Weak correlation indicates that factors other than transboundary flows are likely to be more significant determinants of beach closures.**

Task 1 – Beach closures

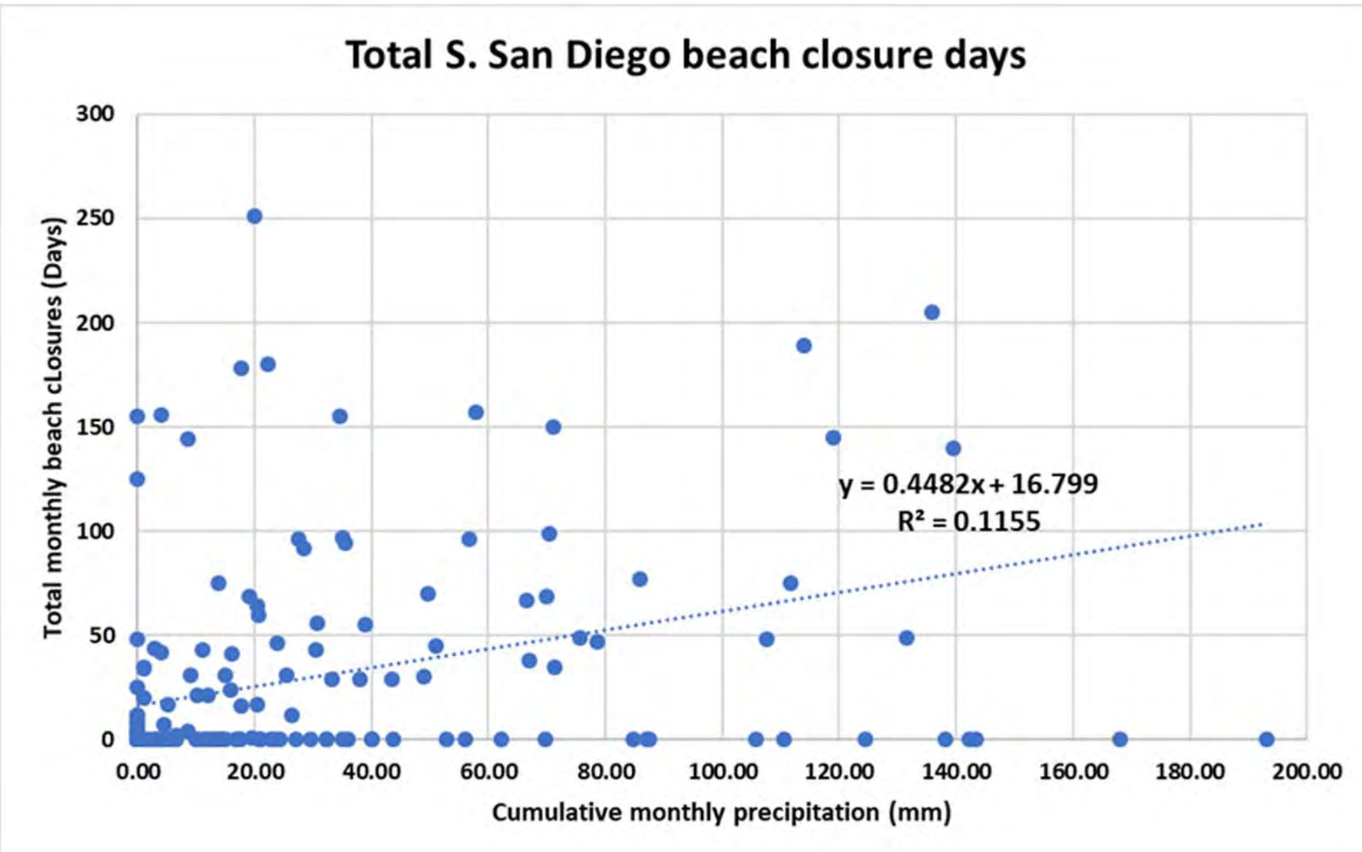
Beach closure days/month vs. cumulative monthly precipitation (2002-2016)



1) **Beach closure days appear to increase in wet periods.**
2) **Number of beach closure days appears to be slightly better correlated with precipitation than with transboundary flow events.**

Task 1 – Beach closures

Beach closure days/month vs. cumulative monthly precipitation (2002-2016)



1) Correlation coefficient about 2x that for transboundary flows.
2) Results indicate that precipitation may be a stronger determinant of beach closures than transboundary flows.
3) Stormwater may be more detrimental to beach use than dry-weather transboundary flows.

Task 1 – Summary of findings

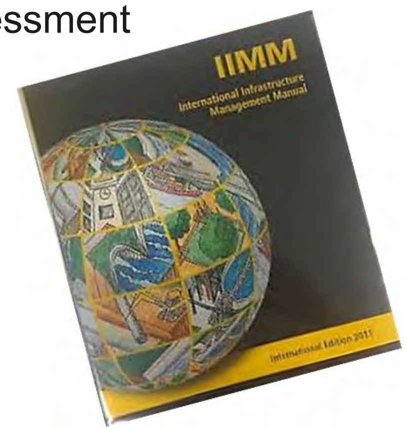
1) Average annual transboundary flow volume could be reduced by 80% with dependable diversion capacity increase of 1,000-lps.
2) Marginal effectiveness of increased diversion capacity diminishes beyond 3,000 lps.
3) Existing PB-CILA diversion capacity (1,300 lps) is equivalent to ~ 1-year flood.
4) Increasing diversion capacity to handle stormwater from minor floods appears to be impractical (e.g. 10,000-lps dependable treatment capacity needed to divert/treat 2-year flood).
5) Average monthly transboundary flows increased by 45 lps (~2.2%) since 1991 when PB-CILA was placed into operation; however, monthly precipitation also increased by 2 mm (~6.6%) from 1991-2016 in comparison to 1965-1990.
6) PB-CILA operational data available at time of analysis indicates that the plant operated at or near full capacity (1,300 lps) for much of 2005-2009. Monthly residual flow (pumping) data for PB-CILA from 1999-2016 and outages by month from 2000-2013 have just been made available but not yet analyzed.
7) Beach closures and transboundary flow events appear to be seasonal (i.e. from January-June) in most years. Beach closure and transboundary flow volumes appear to happen concurrently. Volume of transboundary flows has a weak correlation to beach closure days, implying that factors other than transboundary flows at the Tijuana River are likely to be more significant determinants of beach closures.
8) Beach closure days appear to increase in wet periods; stormwater runoff may be more detrimental to beach use than Tijuana River transboundary flows during dry weather.

Task 2 – Infrastructure and Operations Diagnostic

✓ Review of Historical and Maintenance Data.

For Lift Station/WWTP diagnostics, our assessors established condition scores using a 1 to 5 scoring system.

✓ *For buried infrastructure diagnostics,* our assessors worked with key stakeholders to collect asset information and/or identify assets in need of additional condition assessment technologies.



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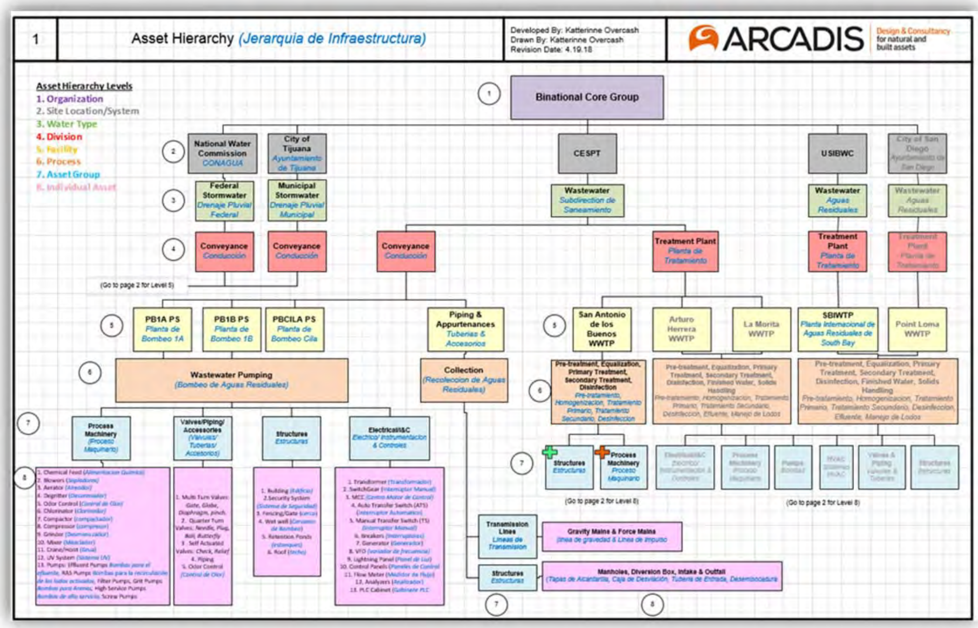
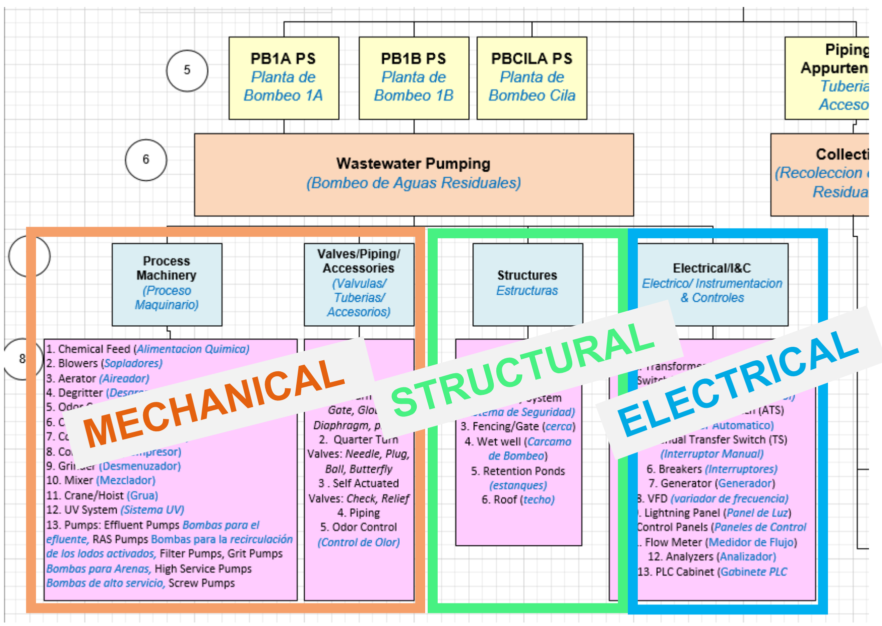
Task 2 – Infrastructure and Operations Diagnostic

Asset Hierarchy, Visual Diagnostic Criteria, and Technology Tools



Task 2 – Infrastructure and Operations Diagnostic

Physical Condition Approach



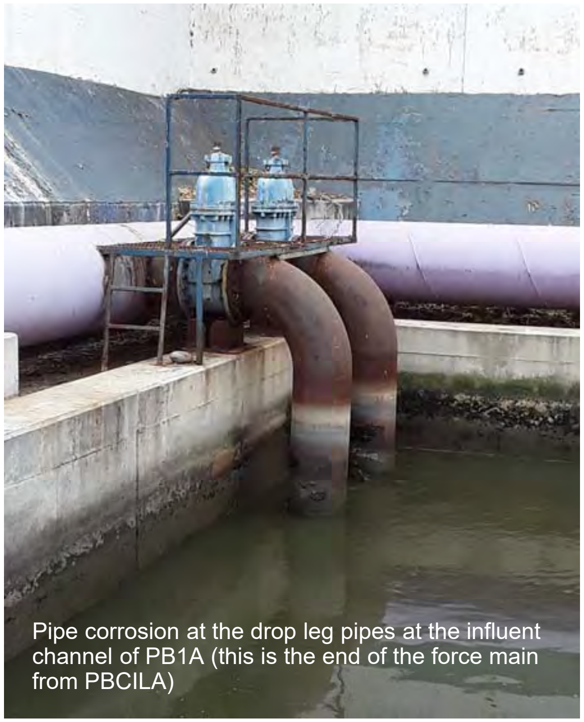
Mechanical Asset Hierarchy							
1. Organization	2. Site Location	3. Water Type	4. Division	5. Facility	6. Process	7. Asset Group	8. Individual Asset
organization	system	produc	division	facility	process	asset_gro	asset
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 1
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 2
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 3
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 4
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 5
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 6
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 7
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 8
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 9
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 10

Physical Diagnostic						
Field Code	Corrosion	Leakage	Vibration /Noise	Concrete Supports	Steel Supports	Electrical Connections
field_code	c1	c2	c3	c4	c5	c9
Condition Assessed	2	4	4	2	3	3
Condition Assessed	NS	NS	NS	2	3	3
Condition Assessed	NS	NS	NS	2	4	4
Condition Assessed	NS	NS	NS	3	2	NS
Condition Assessed	3	5	NS	3	3	2
Condition Assessed	3	5	NS	3	3	3
Condition Assessed	NS	NS	NS	1	1	1
Condition Assessed	NS	NS	NS	1	1	1
Condition Assessed	NS	NS	NS	1	1	1
Condition Assessed	NS	NS	NS	1	1	1

Task 2 – Infrastructure and Operations Diagnostic

Physical Condition Approach: Mechanical Assets

Mechanical/HVAC Equipment Visual Condition Assessment						
Criteria	**Evaluation**	**1**	**2**	**3**	**4**	**5**
CORE CRITERIA						
Corrosion	Surface only	None	<10%	10% - <25%	25% - 50%	>50%
	Structural (loss of metal)	None	-	-	1 location	>1 location
Leakage	Gaskets / Connections	None	Historic only	Drip only	Stream 1 location	Stream >1 location
	Holes / Failures	None	-	-	1 location	>1 location
Vibration / Noise	Vibration Apparent with Noise	None	<10% normal	10% to 20% normal	>20% to 30% normal	>30% normal
	Non-Structural Damage	None	-	-	Yes	-
	Structural Damage	None	-	-	-	Yes
Concrete Supports	Surface Cracking / Loose Grout	None	<10%	10% - <25%	25% - 50%	>50%
	Through Cracks	None	-	<10%	10% - 25%	>25%
	Damaged / Missing Anchors	None	-	<5% / 1	5% - 20% / 2	>20% / >2
Steel Supports	Surface Corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Structural Corrosion	None	-	<10%	10% -25%	>=25%
	Damaged / Missing Anchors	None	-	<5% / 1	5% - 20% / 2	>=20% / >2
ANCILLARY CRITERIA						
Electrical Connections	Conduit / J. Box - surface corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Damage - gaps / missing gaskets	None	-	-	1 location	>1 location
	Exposed wiring	None	-	-	1 location	>1 location


Pipe corrosion at the drop leg pipes at the influent channel of PB1A (this is the end of the force main from PBCILA)


Historical leaks showing at the manifold coming out from PB1B

Task 2 – Infrastructure and Operations Diagnostic

Physical Condition Approach: Mechanical Assets

Stagnant wastewater from pump 6 at PBCILA from their 6" vent (instead of a combo valve)

Missing pumps 2 and 3 at PBCILA

New 2,700 GPM pump setup at PBCILA

Task 2 – Infrastructure and Operations Diagnostic

Physical Condition Approach: Electrical Assets

Electrical/I&C Visual Condition Assessment						
Criteria	**Evaluation**	**1**	**2**	**3**	**4**	**5**
		CORE CRITERIA				
Corrosion	Surface only	None	<10%	10% - <25%	25% - 50%	>50%
	Structural	None	-	-	1 location	>1 location
Dielectric Leakage	Transformer/Connection Leaks	None	Historic only	-	-	Active
	Holes / Failures	None	-	-	-	1 location
Vibration/Noise	Vibration Apparent with Noise	None	<10% normal	10% to 20% normal	>20% to 30% normal	>30% normal
	Non-Structural Damage	None	-	-	Yes	-
	Structural Damage	None	-	-	-	Yes
Electrical Damage	Evidence of Overheating/Arcing	None	-	-	1 location	>1 location
	Evidence of Water Damage	None	-	-	1 location	>1 location
	Grounding Missing/Damaged	None	-	-	1 location	>1 location
	Insulation Wear	None	-	-	1 location	>1 location
	Cooling System Damage	None	-	-	1 location	>1 location
	Connections Loose/Broken	None	-	-	1 location	>1 location
	Hot Spots	None	-	-	-	1 location
	Damaged / Non-Functional Devices	None	-	1 location	2 locations	>2 locations

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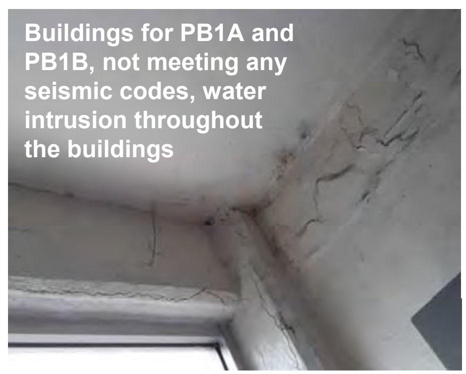
Task 2 – Infrastructure and Operations Diagnostic

Physical Condition Approach: Structural Assets

Structural Visual Condition Assessment						
Criteria	**Condition**	**1**	**2**	**3**	**4**	**5**
CORE CRITERIA						
Leakage	Cracks / Joints	None	Historic only	Drip only	Stream 1 location	Stream >1 location
	Penetrations / Failures	None	-	-	1 location	>1 location
Concrete / Masonry Damage	Joint Deterioration	None	<10%	10% - <30%	30% - 50%	>50%
	Cracking (width of crack)	None	< 1mm	1-2mm	>2mm	Not Serviceable
	Exposed Reinforcement	None	-	-	1 location	>1 location
	Spalling, Exposed Aggregate, Pitting, Delamination,	None	-	<10%	10% - 30%	>30%
Steel Damage	Surface Corrosion	None	<10%	10% - <25%	25% - 50%	>50%
	Cracking	None	-	-	1 location	>1 location
	Fatigue/Connection Failure	None	-	-	1 location	>1 location
	Deformation / Deflection	None	-	<5%	5% to 10%	>10%
	Loss of Section	None	-	<10%	10% - 30%	>30%
Wood Damage	Dry Rot	None	-	-	1 location	>1 location
	Warping/Splitting	None	-	-	1 location	>1 location
	Connection Failure	None	-	-	1 location	>1 location
	Loss of Section	None	-	<10%	>10% - 30%	>30%
Water / Drainage	Standing Water Potential (% of foundation)	None	-	<=5%	>5% - 10%	>10%
Roof / Cover	Leaks- Cracks/Joints	None	Historic Only	Drip Only	Stream 1 location	Stream >1 location
	Leaks- Penetrations/Failures	None	-	-	1 location	>1 location
	Sagging	None	-	<=5%	>5% - 10%	>10%
	Support Damage	None	-	-	<20%	>=20%





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Task 2 – Infrastructure and Operations Diagnostic

Performance Condition Approach

Criteria	Condition	1	2	3	4	5
Capacity	Ability to meet current capacity	Average – Yes*	Average – Yes*	Average – Yes*	Average – Yes**	Average – No**
		Peak – Yes*	Peak – Yes**	Peak – No**	Peak – No**	Peak Max Day – No**
	Ability to meet future capacity	Average – Yes*	Average – Yes*	Average – Yes**	Average – No*	Average – No**
		Peak – Yes*	Peak – No*	Peak – No**	Peak – No**	Peak Max Day – No**
Regulatory	Ability to meet current regulations and utility goals	Yes	Yes	Yes	Yes – with some modifications required	No
	Ability to meet future regulations and utility goals	Yes	Yes – with some modifications required	No	No	No
Reliability	Average time equipment is available when needed	99-100%	95-99%	90-94%	85-89%	< 84%
		(4 days O/S)	(up to 18 days O/S)	(up to 36 days O/S)	(up to 55 days O/S)	(over 55 days per year)
O&M Issues	Frequency of O&M Issues (Excluding Breakdowns)	None	Very Infrequently (Quarterly)	Infrequently (Monthly)	Frequently (Weekly)	Very Frequently (Daily)
Obsolescence	Equipment Technology	Technology Best Available/ State of the Art	Technology Industry Standard/ "Tried and True"	Technology Considered Appropriate	Technology Nearing Obsolescence	Technology Obsolete / Out of Date

* - with one unit out of service
** - with all units in service
O/S - out of service

Mechanical Asset Hierarchy								Performance Diagnostic				
1. Organization	2. Site Location	3. Water Type	4. Division	5. Facility	6. Process	7. Asset Group	8. Individual Asset	Capacity	Regulatory	Reliability	O&M Issues	Obsolescence
organization	system	produc	division	facility	process	asset_gro	asset	capaci	regulatory	reliabilit	om_issu	obsolescenc
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 1	3	3	3	3	3
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 2	NS	5	NS	NS	NS
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 3	NS	5	NS	NS	NS
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 4	NS	5	NS	NS	NS
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 5	3	5	5	5	3
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 6	3	5	5	5	3
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 7	NS	5	NS	NS	NS
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 8	NS	5	NS	NS	NS
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 9	NS	5	NS	NS	NS
Binational Core Group	MX Site	Wastewa	Conveyance	PB Cila	Wastewater Pumping	Pumps	Pump 10	NS	5	NS	NS	NS

Task 2 – Infrastructure and Operations Diagnostic

Evaluating Consequence of Failure (CoF)

Criteria	Weight	1	2	3	4	5
Health and Safety Impact $CoF_{(safe)}$	20%	No Impact		Failure creates potential for minor injury to employee or public		Deficiency creates potential for severe injury to employee or public
Level of Service $CoF_{(Los)}$	20%	No Impact		Impact will occur if no response is made within 8 hours		Immediate and/or widespread impact.
Regulatory Compliance $CoF_{(Comp)}$	10%	No Impact		Impact will occur if no response is made within 8 hours		Immediate and/or widespread impact
O&M Impacts $CoF_{(O\&M)}$	30%	No Impact		Moderate O&M Cost/Effort		Large O&M Cost/Effort
Impacts to sensitive areas $CoF_{(Backup)}$	20%	Full generator backup available		Mobile generator ready		No ability for backup power connection

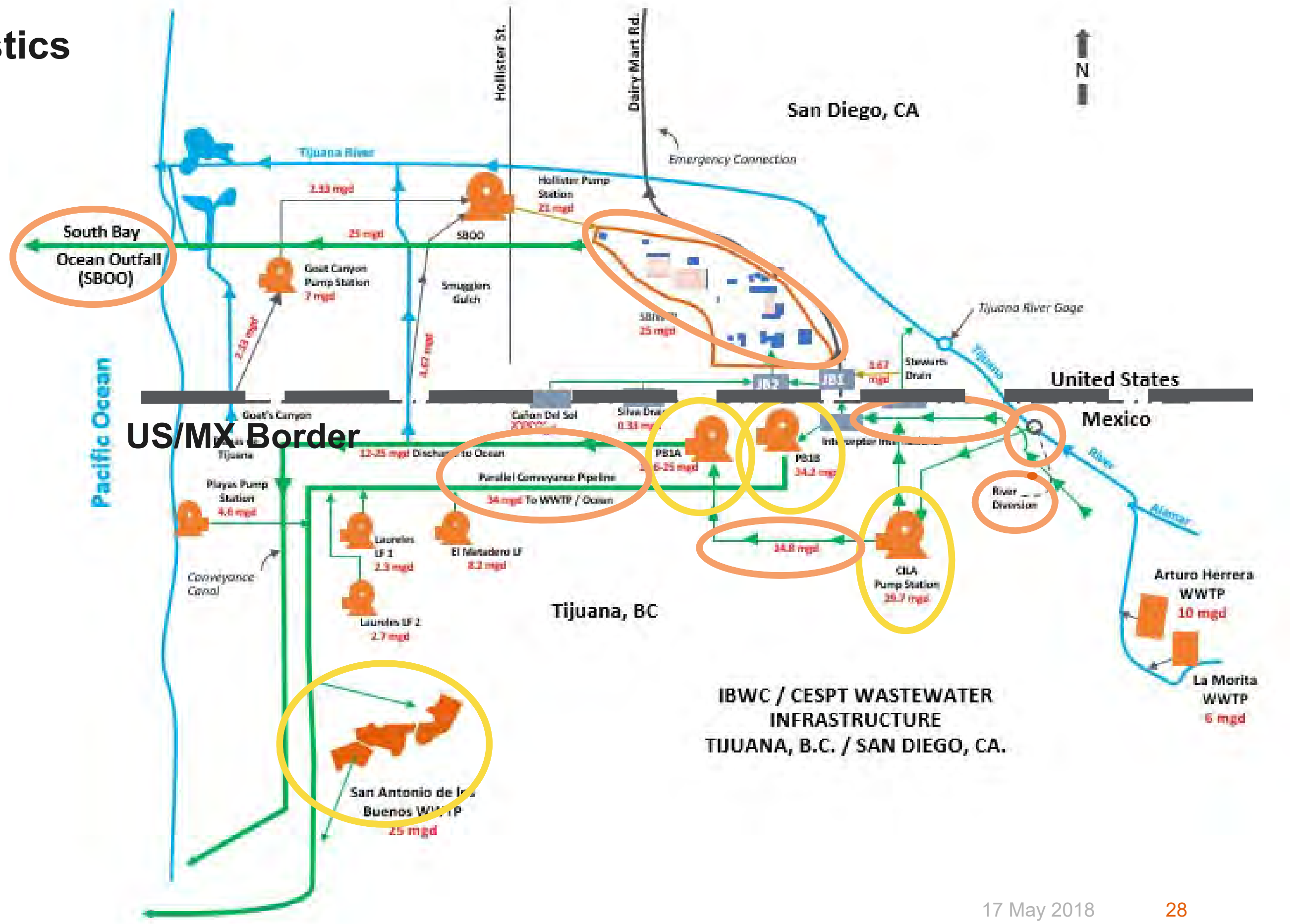
Mechanical Asset Hierarchy				Triple Bottom Line (TBL)					Physical Condition Score	Performance Condition Score	Likelihood of Failure (LOF)	Consequence of Failure (COF)
				Economic	Social Impact		Environmental					
5. Facility	6. Process	7. Asset Group	8. Individual Asset	O&M Impacts (30%)	Level of Service Delivery	Health and Safety	Regulatory Impacts (10%)	Impacts to Sensitive Areas				
facility	proces	asset_grc	asset									
PB Cila	Wastewat	Pumps	Pump 1	5	5	4	4	4	4	3	4	4.50
PB Cila	Wastewat	Pumps	Pump 2	3	4	4	3	4	3	5	5	3.60
PB Cila	Wastewat	Pumps	Pump 3	3	4	4	3	4	4	5	5	3.60
PB Cila	Wastewat	Pumps	Pump 4	3	4	4	3	4	3	5	5	3.60
PB Cila	Wastewat	Pumps	Pump 5	5	5	4	4	4	5	5	5	4.50
PB Cila	Wastewat	Pumps	Pump 6	5	5	4	4	4	5	5	5	4.50
PB Cila	Wastewat	Pumps	Pump 7	3	4	4	3	4	1	5	5	3.60
PB Cila	Wastewat	Pumps	Pump 8	3	4	4	3	4	1	5	5	3.60
PB Cila	Wastewat	Pumps	Pump 9	3	4	4	3	4	1	5	5	3.60
PB Cila	Wastewat	Pumps	Pump 10	3	4	4	3	4	1	5	5	3.60

Task 2 – Infrastructure and Operations Diagnostic

Conducting Condition Diagnostics

Risk-Based Field Sites:
1. PBCILA
2. PB1A
3. PB1B
4. SAB WWTP

Other Sites:
1. PBCILA force main
2. SBIWTP
3. South Bay Ocean Outfall
4. Parallel Ocean Outfall system - MX
5. PBCILA intake (SW)
6. Primary Effluent Return Connection - PERC
7. International Collector (Gravity Line)
8. River Diversion (SW)



Task 2 – Infrastructure and Operations Diagnostic

Conducting Condition Diagnostics

Risk-Based Field Sites:
1. PBCILA
2. PB1A
3. PB1B
4. SAB WWTP

Location	Condition Rating						Total Assets Assessed
	1	2	3	4	5	NR	
PBCILA	0	0	24	19	8	0	51
PB1A	0	2	37	15	1	0	55
PB1B	0	0	27	20	1	0	48
SAB	0	0	5	12	0	0	14
TOTAL	**0**	**21**	**101**	**52**	**4**	**0**	**171**

Asset Type	Condition Rating						Total Assets Assessed
	1	2	3	4	5	NR	
Structural	0	2	5	10	4	0	21
Mechanical	0	0	75	44	6	0	125
Electrical/I&C	0	0	13	12	0	0	25
TOTAL	**0**	**2**	**93**	**66**	**10**	**0**	**171**

Task 2 – Infrastructure and Operations Diagnostic

Conducting Condition Diagnostics

Other Sites:

1. PBCILA force main
2. SBIWTP
3. South Bay Ocean Outfall
4. Parallel Ocean Outfall system – MX
5. PBCILA intake (SW)
6. Primary Effluent Return Connection – PERC
7. International Collector (Gravity Line)
8. River Diversion (SW)

No.	Water Type	Location	Asset Information					Asset Failure Information			Estimated Useful Life (EUL)*	Remaining Useful Life (RUL)*	Recommendations
			Material	Year Installed/Rehabbed	Diameter (in)	Length (ft)	Flow (gpm)	Internal Pipe Corrosion	External Pipe Corrosion	General Comments			
1	Wastewater	PBCILA intake	Concrete	1988	36	65.62	15,852.05	Observed	Pending	It is necessary to increase the capacity of the intake and install bars above the water to prevent trash from entering the intake.	50*	Currently Working	A new project needs to be implemented in accordance with the new flows that are a combination of storm drains, treated waste water, and non-treated wastewater.
2	Wastewater	Gravity main from PBCILA intake		1988	36	328.08	15,852.05	Pending	Pending	Capacity needs to be increased (by means of driving?)	50	Currently Working	A new project needs to be implemented in accordance with the new flows that are a combination of storm drains, treated waste water, and non-treated wastewater.
3	Wastewater	Junction Box 1 to SBIWTP	Concrete	1987	72	16.40	17,437.25	Pending	Pending	Not accessible.	50*	Currently Working	Capacity seems working. Epoxy cover needed.
4	Wastewater	Junction Box 2 to SBIWTP	Concrete	1987	72	16.40	17,437.25	Pending	Pending	Not accessible.	50	Currently Working	Capacity seems working. Epoxy cover needed.
5	Wastewater	Primary Effluent Return Connection (PERC)	HDPE	1999	48	2,001.31	17,437.25	Observed at PB1B	Pending	Pipe has not been used for the past 10 years or so.	75	Currently Working	Upon internal corrosion, CIPP may be required.
6	Wastewater	Tijuana Collector (gravity main)	Concrete	1987	72	8,530.18	47,556.14	Pending	Pending	This collector does not have the capacity to carry the water that goes to the binational plant and PB1. A new collector is needed for peak flows.	50	Currently Working	It is necessary to review CESPT's general planning to change how wastewater will be treated between the international line and the Morita and Herrera Plants. The plans also have to be checked to confirm whether the sewage system has capacity for a short and long term. The plans also have to be checked to see where the new water treatment plants will be placed and where the treated waters will be discharged.
7	Wastewater	PBCILA force main to PB1A	PVC	2009	42	8,202.10	15,852.05	Pending	Pending	The capacity of the pipes needs to be increased. Further review is needed to see if it's worth increasing the pump load in PBCILA or if it's going to be necessary to construct an additional force main.	75	Currently Working	Mechanical joint restrained is recommended to ensure pipe integrity is not jeopardized from any water damage.

Task 2 – Infrastructure and Operations Diagnostic

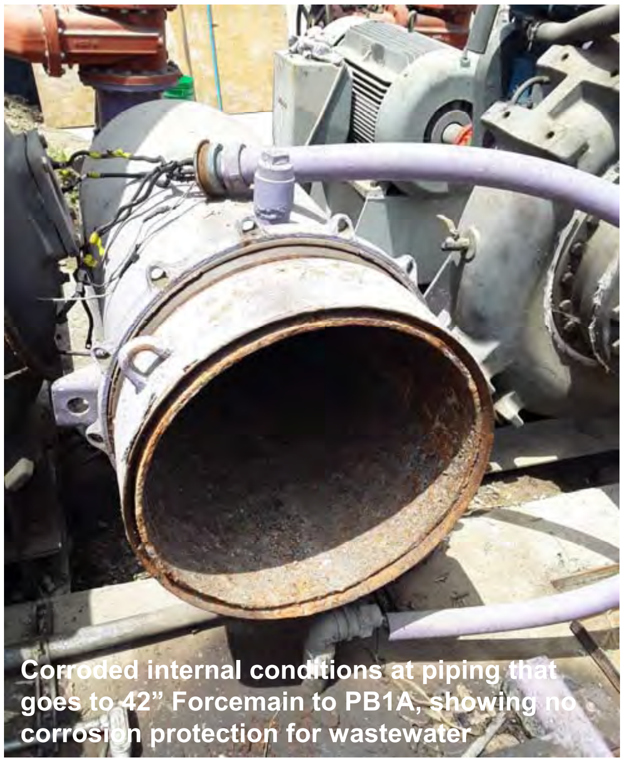
Conducting Condition Diagnostics

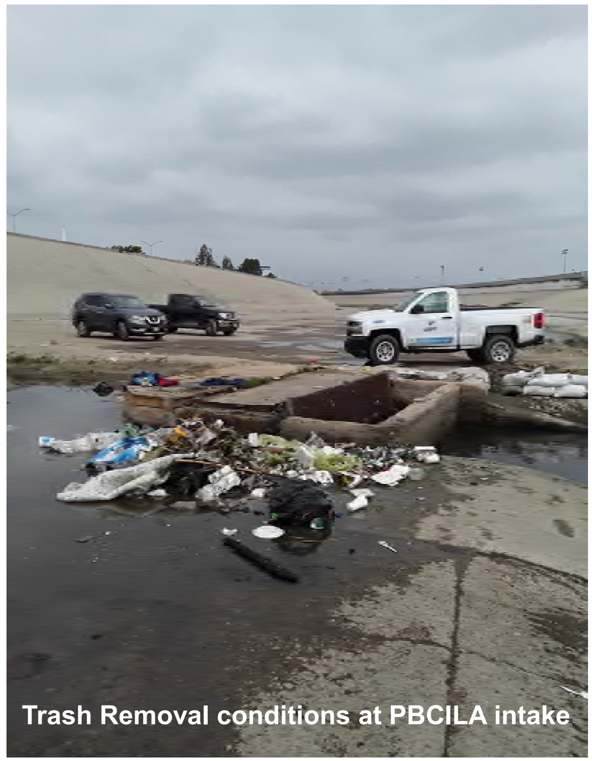
No.	Water Type	Location	Asset Information					Asset Failure Information			Estimated Useful Life (EUL)*	Remaining Useful Life (RUL)*	Recommendations
			Material	Year Installed/Rehabbed	Diameter (in)	Length (ft)	Flow (gpm)	Internal Pipe Corrosion	External Pipe Corrosion	General Comments			
8	Wastewater	PBCILA force main to PB1A	STEEL	2009	36	656.17	15,852.05	Observed	Pending	Pumps have lost the efficiency to send design to PB1A and PB1B.	75	Currently Working	Not typical material used for pressured lines. Restrained joints should be in place.
9	Wastewater	Parallel Ocean Outfall Pipeline System (older)	Concrete, Steel	1986	42,48	52,493.44	31,704.10	Observed at manhole locations	Pending	Check the steel siphons because they can have high level corrosion. Recently, the channels have been mostly substituted with pipe lines increasing their useful life. The rest of the piping needs its interiors to be inspected to prevent failures that can cause serious damages on the urban areas.	50*	Currently Working	This outfall needs to be rehabilitated, especially in the siphons and concrete lines. However, it is necessary to have a plan to place these assets out of commission and focus instead on increasing the capacity for PITAR. Check pump conditions to confirm.
10	Wastewater	Parallel Ocean Outfall Pipeline System (newer)	Ductile Iron, HDPE, Steel	2001	48, 54	52,493.44	31,704.10	Observed at manhole locations	Pending	Check the steel siphons because they can have high level of corrosion. The rest of the piping needs its interiors to be inspected to prevent failures that cause serious damages on the urban areas	60	Currently Working	Check the pump operating conditions.
11	Wastewater	Abandoned wastewater pipe to Point Loma WWTP		1968	-	15,419.95	9,511.23	Pending	Pending	Pending	75	Currently Working	It is necessary to review if there is additional capacity to add flows from Tijuana to the Point Loma outfall given the development of San Diego. In addition to that how much Mexico would have to pay for the additional infrastructure and operational costs. These costs will need to be compared to the costs of increasing treatment capacity at PITAR.
12	Stormwater	Stewart's Drain	Concrete	1975	-	65.62		Pending	Pending	The concrete drain for the storm drain has had some structural failures	100	Currently Working	For dry weather flows, the design seems fair. This drain is not designed for trash and debris.

*The concrete lines in Tijuana don't have an inner coat for the gases that come off of the waste water or the sulfates, therefore the useful life is neither 50 nor 70 years as appears in the American tables. There have been concrete lines in Tijuana that crumbles at 25 years and have caused roads to collapse. The steel lines from the siphons can be exposed to severe damage due to corrosion, or due to the absence or damage of interior coatings, or a lack of cathodic protection.

Task 2 – Infrastructure and Operations Diagnostic

Conducting Condition Diagnostics


Corroded internal conditions at piping that goes to 42" Forcemain to PB1A, showing no corrosion protection for wastewater


Trash Removal conditions at PBCILA intake


Corrosion showing corroded rebar at the influent channels, not much concrete compressive strength left

Design & Consultancy for natural and built assets

Task 3 – Alternatives Analysis

1. No action

2. **(2a)** Optimization of existing diversion facilities in Mexico for Dry Weather Flows at 1,000 lps (23 mgd) capacity
3. **(2b)** Existing Facility Optimization: Operational modifications for Post Storm Operations at 1,000 lps (23 mgd) capacity
4. **(2c)** Existing Facility Optimization: Operational modifications for During Storm Event Operations up to 2,000 lps (46 mgd)

Optimize existing facilities

5. **(3a)** Capacity Increase: New Diversion and conveyance infrastructure in Mexico including expanding intake, conveyance and pump capacity at PBCILA, PB1A&1B
6. **(3b)** Gravity WW/reclaimed water pipeline System from Alamar, La Morita/Herrera Solis WWTPs with discharge directly to PB1A, and infiltration at Valle de las Palmas

Increase capacity to capture Tijuana River flows in MX

New capacity to capture Tijuana River flows in US

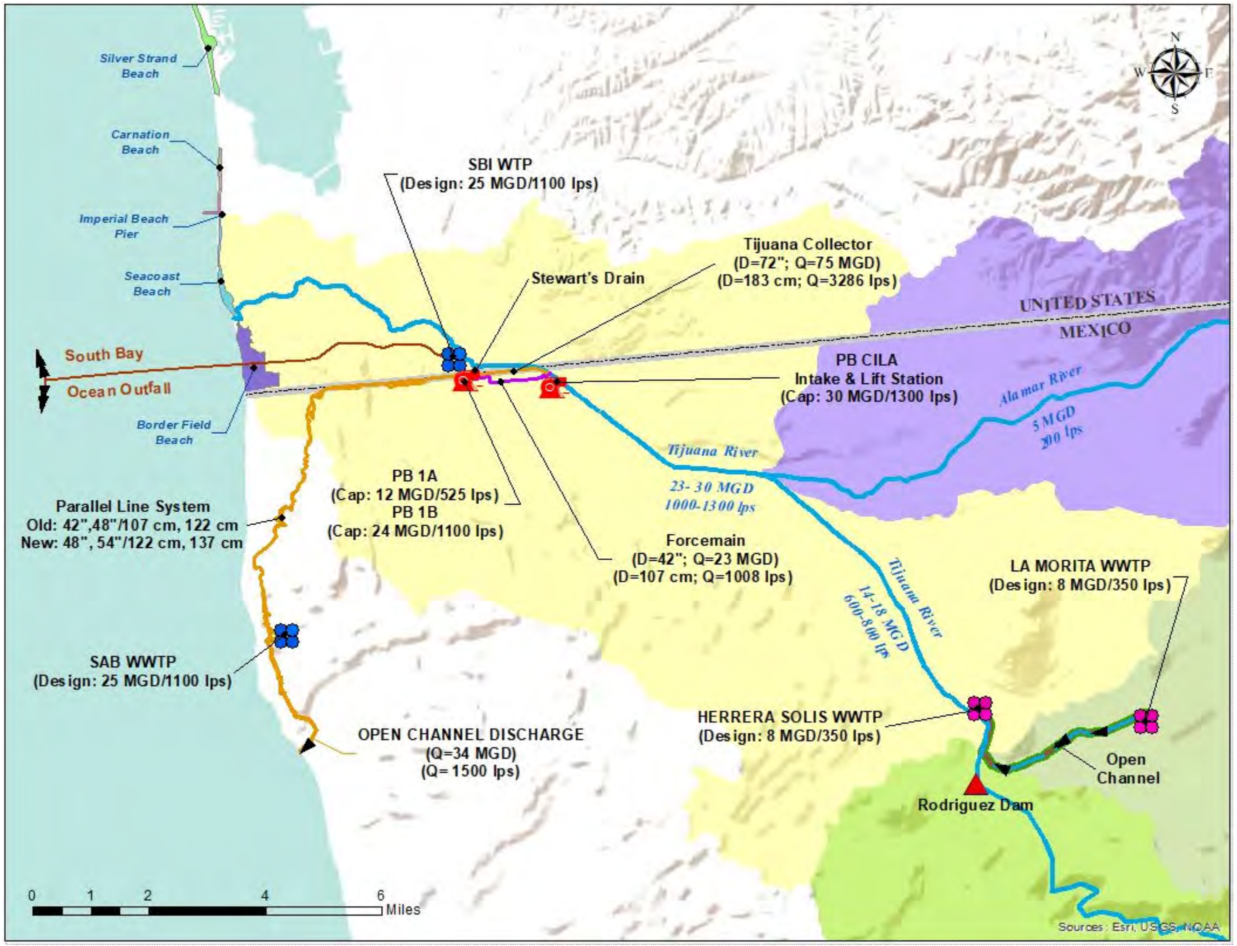
10. **(4a)** New Lift Station to discharge directly to South Bay Ocean Outfall (SBOO) without treatment
11. **(4b)** New Lift Station to Discharge at South Bay International Wastewater Treatment Plant (SBIWTP) for primary treatment only
12. **(4c)** New Lift Station to Discharge at SBIWTP for full plant treatment
13. **(4d)** New Lift Station to Discharge at Point Loma WWTP
14. **(4e)** Gravity flow to the SBOO

Combined diversion facilities in the U.S. and Mexico

15. **(5a)** Gravity reclaimed water pipeline System from La Morita/Herrera Solis WWTPs to SBOO
16. **(5b)** Gravity reclaimed water pipeline System from La Morita/Herrera Solis WWTPs to Point Loma WWTP
17. **(5c)** La Morita/Herrera Solis WWTPs discharge into the ocean in MX side Alamar WWTP discharges at SBOO
18. **(5d)** New Lift Station to Divert Flow in the U.S. with discharge to PERC and treatment at SAB WWTP

Alternative 1 - No Action

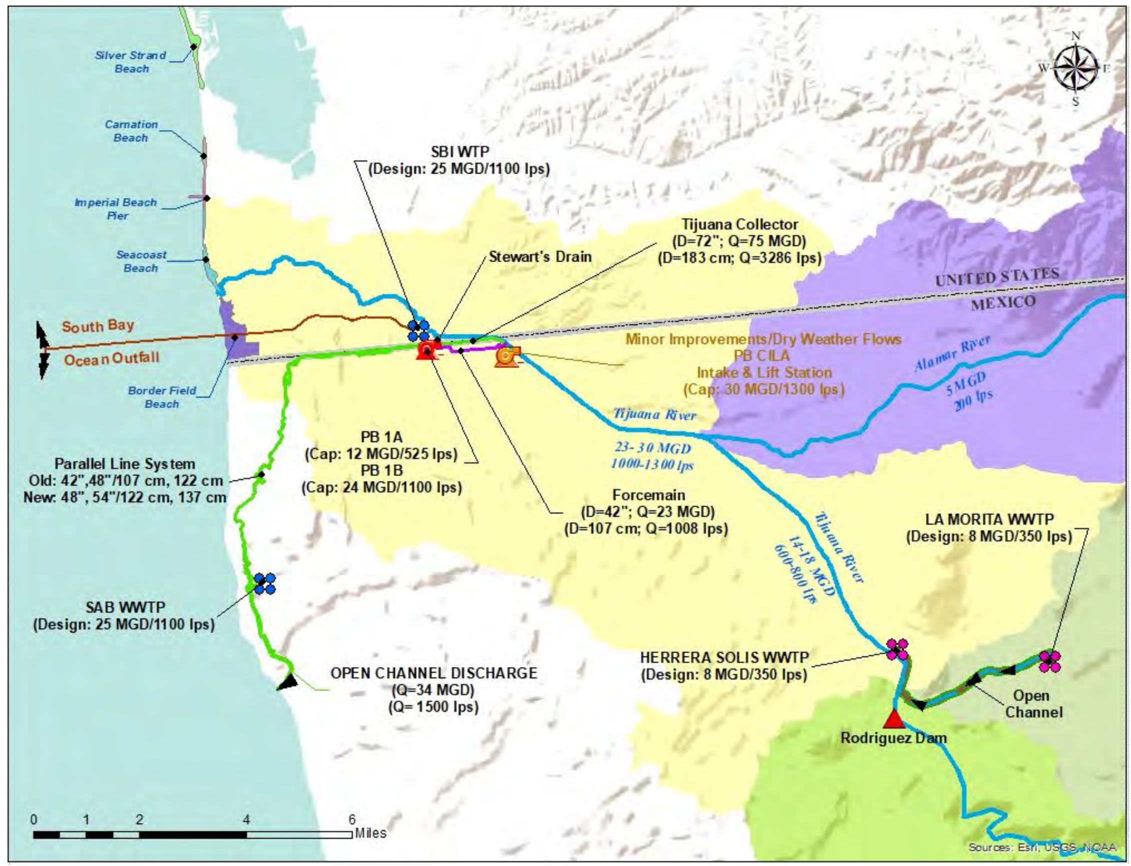
- No infrastructure improvements
- With no improvements, transboundary flows will continue to be a risk during dry and wet weather flows.
- Rain events will continue to bring a mix of storm and wastewater as transboundary flows
- **No capital investment**



Alternative 2a - Optimization of existing diversion facilities in Mexico for Dry Weather Flows

Infrastructure optimization includes improvements to the following:

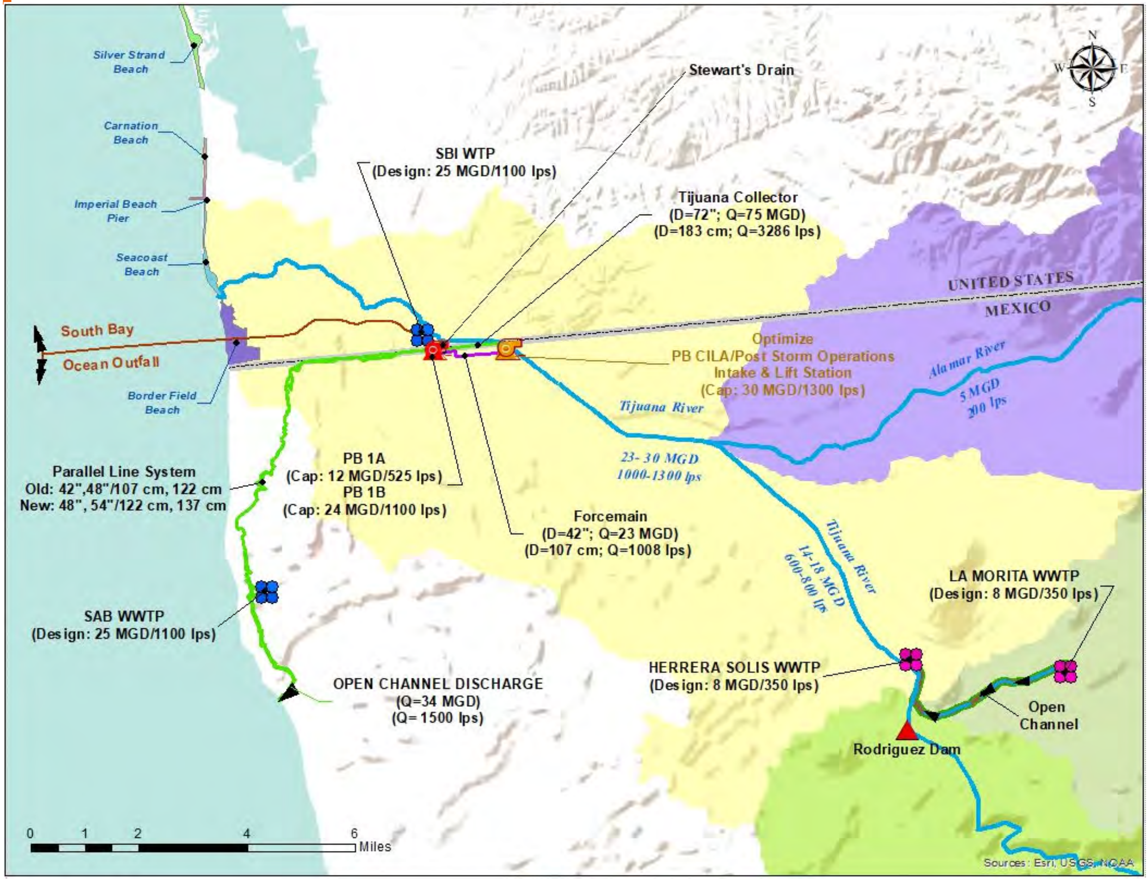
- PBCILA LS – concrete work with trash removal capabilities
- PBCILA – adding the decommissioned pumps #2, 3 & 4
- PB1A & PB1B – remove sludge, concrete work, replace non-working pumps (2 in series) in each PS
- Replacement of Hoists systems at all PS
- SCADA system at all PS
- Capital Cost: **$22.7M USD**



Alternative 2b - Existing Facility Optimization: Operational modifications for Post-Storm Operations

Infrastructure optimization includes improvements to the following:

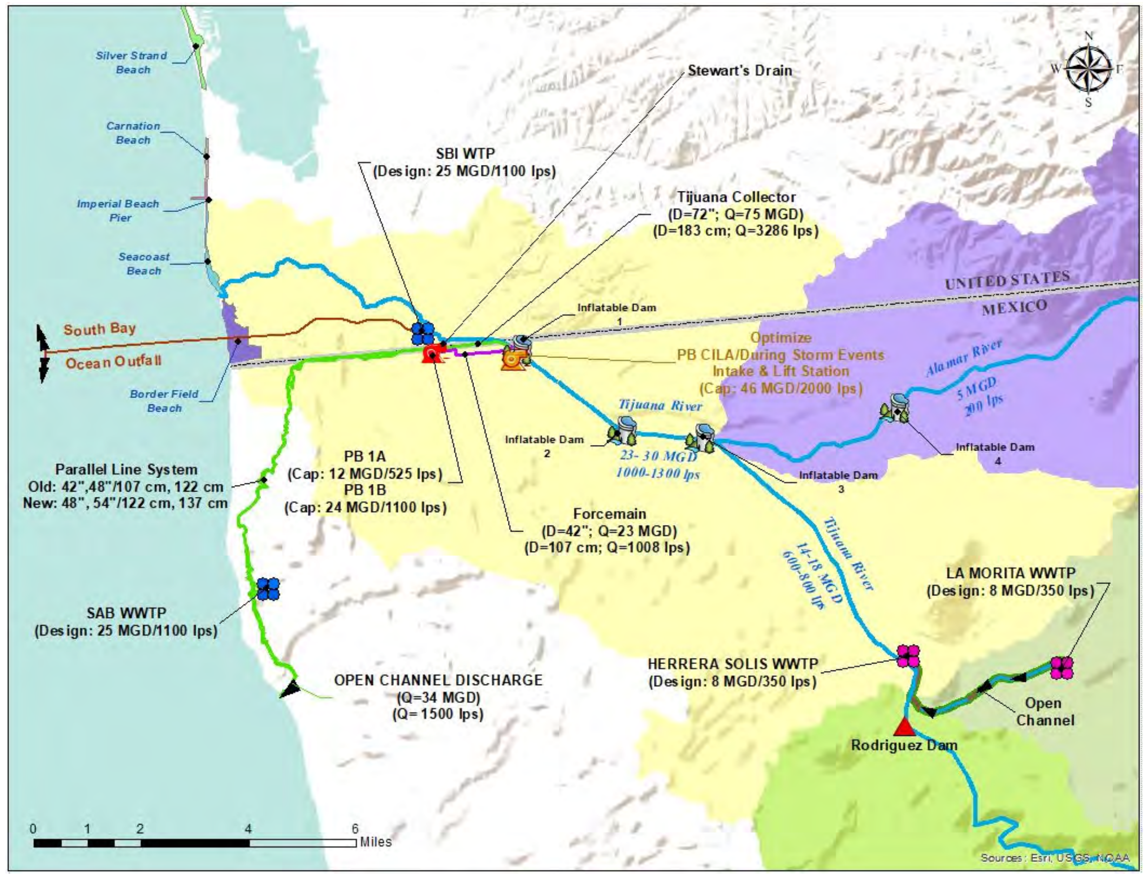
- All improvements from Alternative 2a
- PBCILA LS - Bar screens for coarse and fine sediments, emergency generator
- PB1A & PB1B – New emergency generator each
- Capital Cost: Cost: **$28.2M USD**



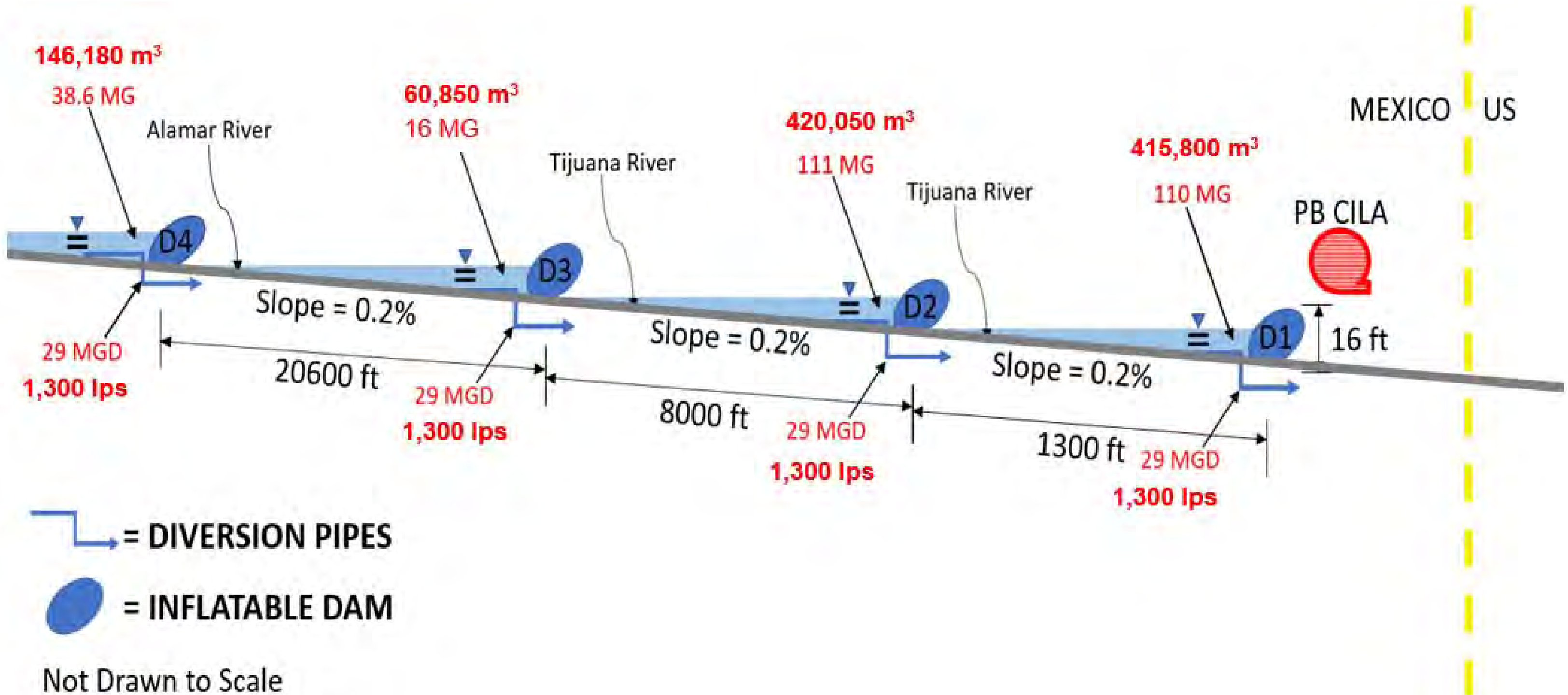
Alternative 2c - Existing Facility Optimization: Operational modifications for During Storm Event Operations

Infrastructure optimization includes improvements to the following:

- All improvements from Alternative 2b
- Addition of four inflatable dams
- Capital Cost: Cost: **$36.7M USD**



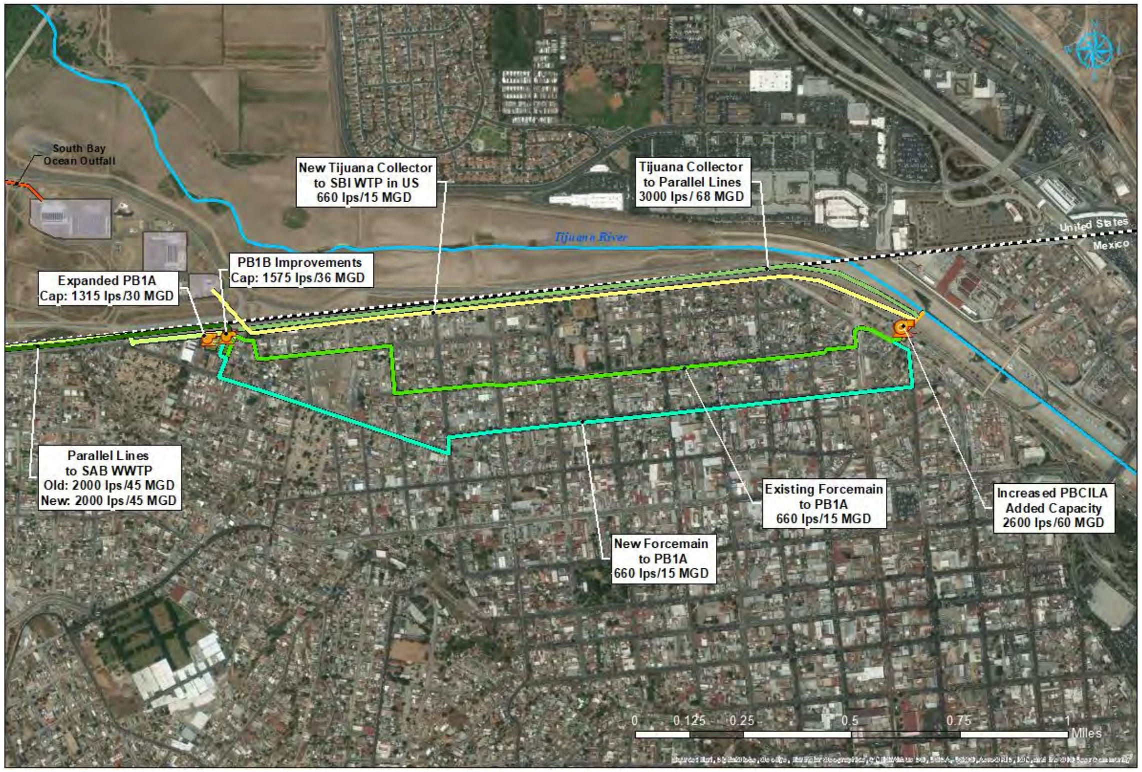
Alternative 2c - Existing Facility Optimization: Operational modifications for During Storm Event Operations



Alternative 3a – Capacity Increase: New Diversion and conveyance infrastructure in Mexico including expanding intake, conveyance and Pump at PBCILA, PB1A&1B

Infrastructure expansion and optimization includes the following improvements:

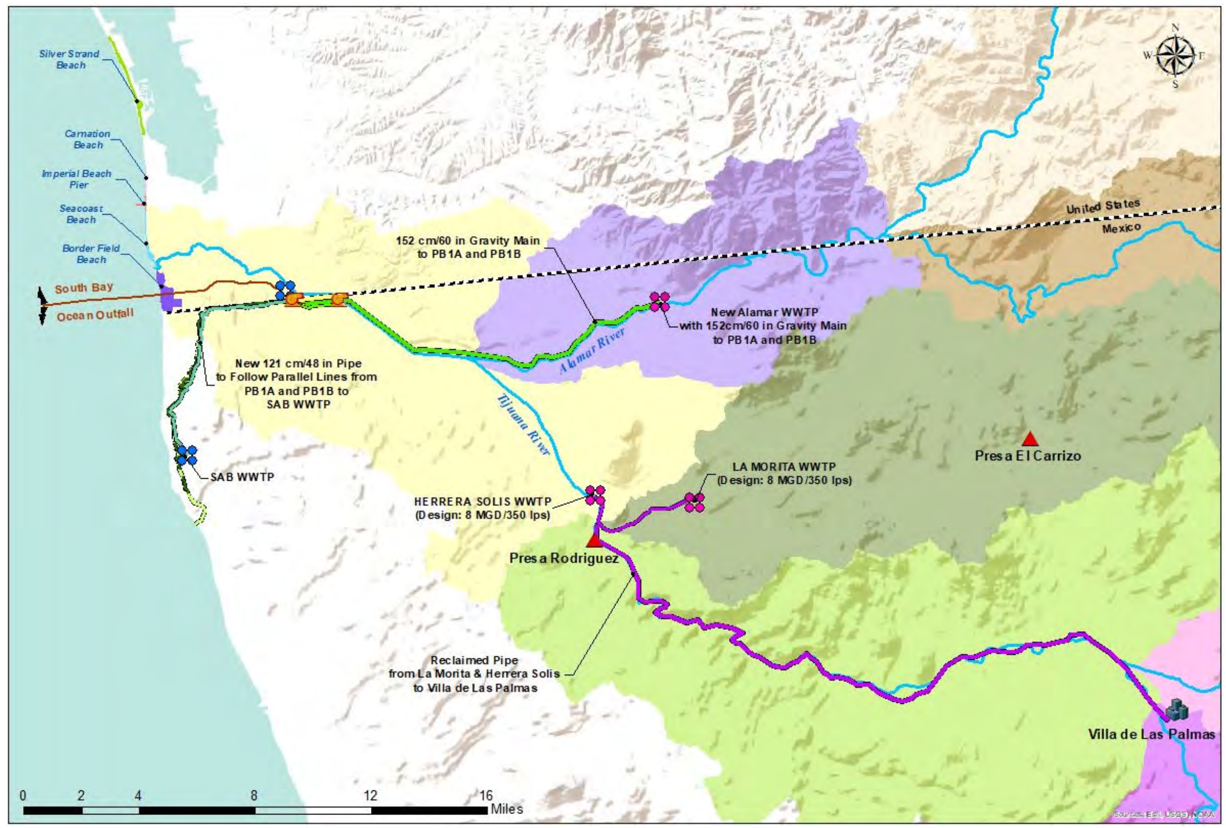
- Intake expansion, PBCILA expansion, Forcemain expansion from PBCILA to PB1A
- Pump stations with add 30 MGD (1,300 lps) of flows for PB1A and PB1B and generator
- Additional line added to Parallel Line system to tie into SAB WWTP
- Capital Cost: **$109.4M USD**



Alternative 3b - Gravity WW/reclaimed water pipeline System from Alamar, La Morita/Herrera Solis WWTPs with discharge directly to PB1A, and infiltration at Valle de las Palmas

Infrastructure expansion and optimization includes the following improvements:

- Improvements from Alternative 3a
- Addition of a proposed 32 MGD (1,400 lps) WWTP at Alamar
- New 104 km reclaimed water pipe to Villa de las Palmas
- Capital Cost: **$211.7M USD**



Alternative 4a - New Lift Station to discharge directly to South Bay Ocean Outfall (SBOO) without treatment

US based alternatives infrastructure includes the following:

- Concrete river intake box
- 35 MGD (1,500 lps) Lift station
- 5,100 linear feet (1,555 meters) new ductile iron pipelines, (36 and 42 inch diameter)
- Tie in to SBOO
- Capital Cost: **$22.1M USD**

Alternative 4b - New Lift Station to Discharge at South Bay International Wastewater Treatment Plant (SBIWTP) for primary treatment only

US based alternatives infrastructure includes the following:

- Alternative 4a lift station components
- 3,500 linear foot (1,080 meters) new ductile iron pipeline (36 and 42 inch diameter)
- SBI WTP improvements to have additional 35 MGD treated through primary treatment
- Capital Cost: **$36.8M USD**

Alternative 4c - New Lift Station to Discharge at SBIWTP for full plant treatment

US based alternatives infrastructure includes the following:

- Additions from 4b
- Addition of improvements for secondary treatments including activated sludge and sedimentation basins
- 35 MGD (1,500 lps) additional treated flow through the full plant
- Capital Cost: **$210.1M USD**

Alternative 4d - New Lift Station to Discharge at Point Loma WWTP

US based alternatives infrastructure includes the following:

- Concrete river intake box
- 35 MGD (1,500 lps) Lift station
- Tie in to abandoned pipeline
- Wastewater pipeline replacement and tie-in
- 35 MGD combined flow diverted into force main leading to Point Loma WWTP
- Capital Cost: **$36.2M USD**

Alternative 4e – Gravity flow to the SBOO

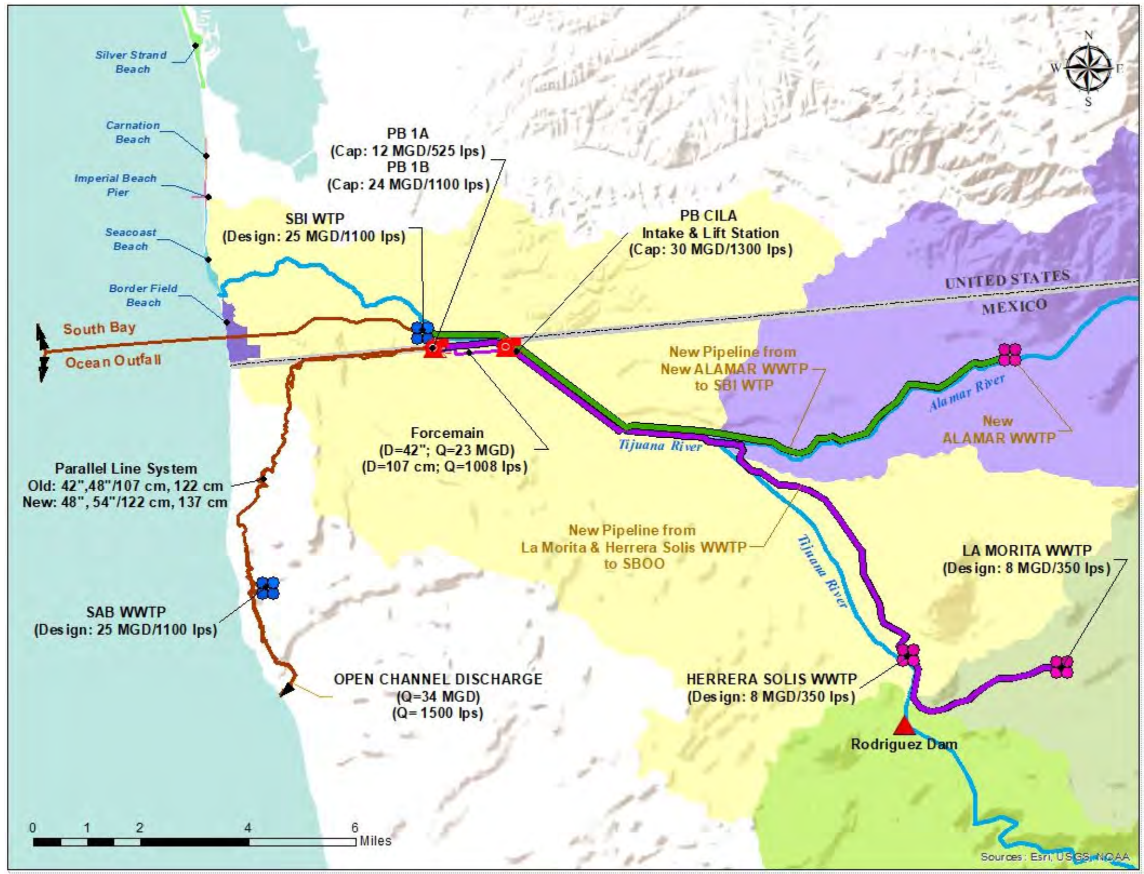
US based alternatives infrastructure includes the following:

- 4,200 linear foot (1,280 meters) new RCP 48 inch pipe to have additional 35 MGD flows to tie in to SBOO
- Capital Cost: **$15.2M USD**

Alternative 5a - Gravity reclaimed water pipeline System from La Morita/Herrera Solis WWTPs to SBOO

Combined diversion facilities in the U.S. and Mexico include:

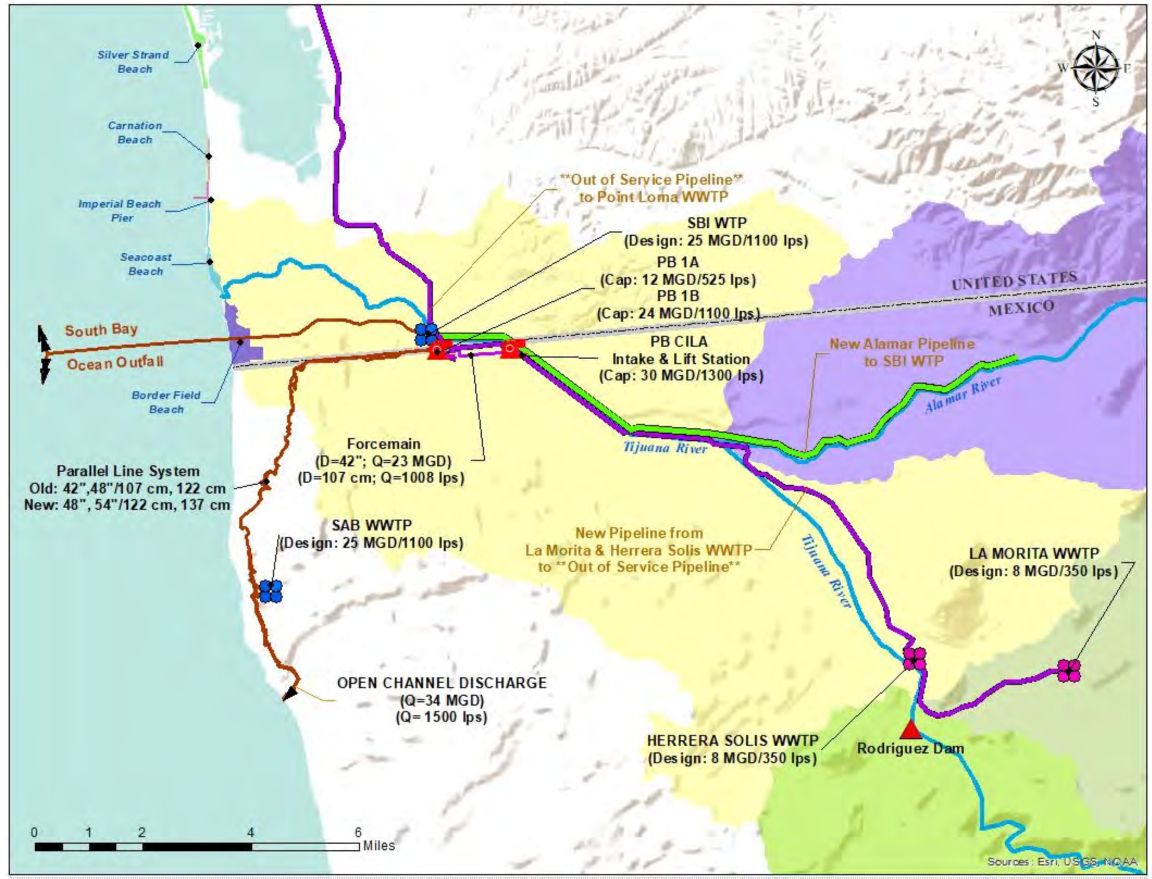
- New reclaimed water pipeline extending 12 miles (20 km) through Tijuana from La Morita/Herrera Solis WWTPs effluent to SBOO
- Proposed WWTP at Alamar
- 11 miles (18 km) Reclaimed water pipeline connecting Alamar WWTP with discharge to SBOO
- Capital Cost: **$233.3M USD**



Alternative 5b - Gravity reclaimed water pipeline System from La Morita/Herrera Solis WWTPs to Point Loma WWTP

Combined diversion facilities in the U.S. and Mexico include:

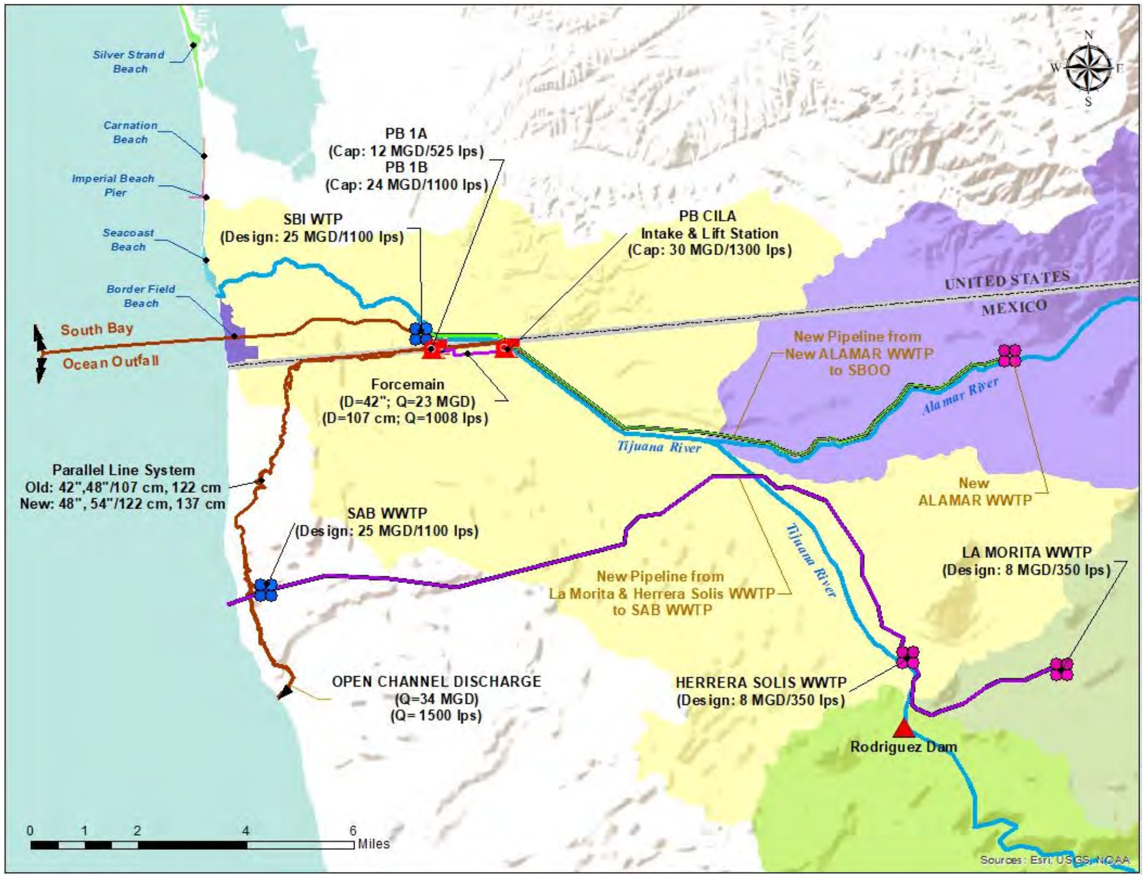
- New reclaimed water pipeline extending 12 miles (20 km) through Tijuana from La Morita/Herrera Solis WWTPs effluent
- Pipeline connection to Point Loma WWTP
- 60-in WW line connecting to SBIWTP for full treatment
- Capital Cost: **$387.5M USD**



Alternative 5c - La Morita/Herrera Solis WWTPs discharge into the ocean in MX side Alamar WWTP discharges at SBOO

Combined diversion facilities in the U.S. and Mexico include:

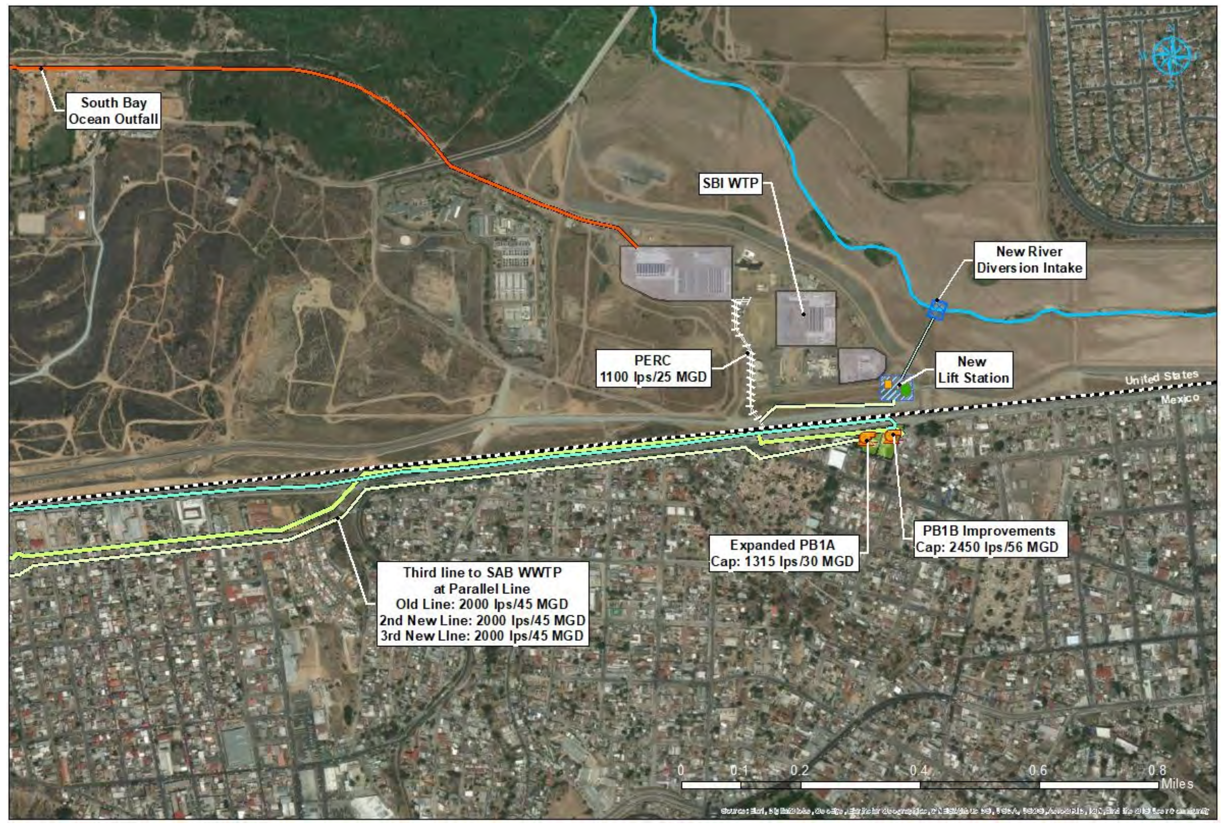
- 48-in reclaimed water line connecting La Morita/Herrera Solis effluent to SAB WWTP
- Proposed WWTP at Alamar with 48-in connection to discharge at SBOO
- Capital Cost: **$273.2M USD**



Alternative 5d - New Lift Station to Divert Flow in the U.S. with discharge to PERC and treatment at SAB WWTP

Combined diversion facilities in the U.S. and Mexico include:

- New intake and 356 MGD diversion lift station discharging at the PERC
- 10 mile long (16 km) 48-in forcemain/gravity combined parallel system with discharge to SABWWTP
- New wet well at PB1B
- PERC rehabilitation
- PB1B upgrade
- Capital Cost: **$105M USD**



Task 3 – Evaluation Matrix

- Defining the Parameters:

Capital Cost
O&M Cost
Jurisdictional Control
Operational flexibility
Regulatory/Institutional Complexity
Transboundary flow reduction
Public Perception
Phasing Flexibility

- Prioritize the Criteria
- Evaluate the alternatives relative to Criteria

Parameters

Jurisdictional Control – Degree of owner influence on the planning, design and operation of Tijuana diversion alternatives. The owner of the project would have much greater control with the new facilities compared to use of facilities owned by others.

Operational Flexibility – Flexibility available for managing the selected TJ diversion alternative. In general, the least number of new operational intensive components along with a larger operations support group is favorable.

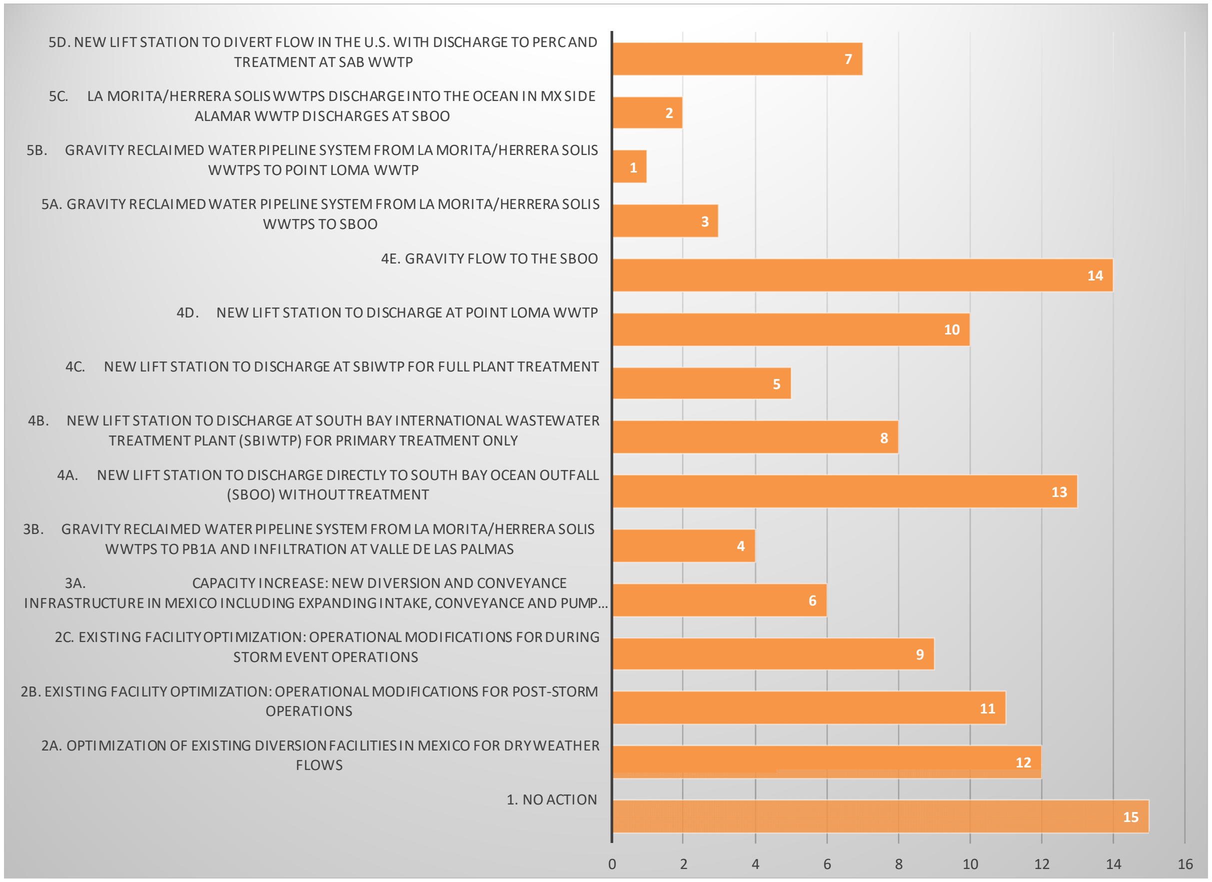
Regulatory/Institutional Complexity – Complexity of implementation, including compliance with binational agreements, regulatory standards, number and complexity of new lift stations and treatment facilities, agreements, other agency approvals and support, etc.

Transboundary Flow Reduction– Degree of ability to reduce the transboundary flows with a more efficient diversion system.

Public Perception – General perception of the public of the alternative reducing any potential contact with contaminated water

Phasing Flexibility – Degree of availability the project could be split into phases of construction without compromising daily operation of the existing infrastructure

Task 3 – Evaluation Criteria Scoring



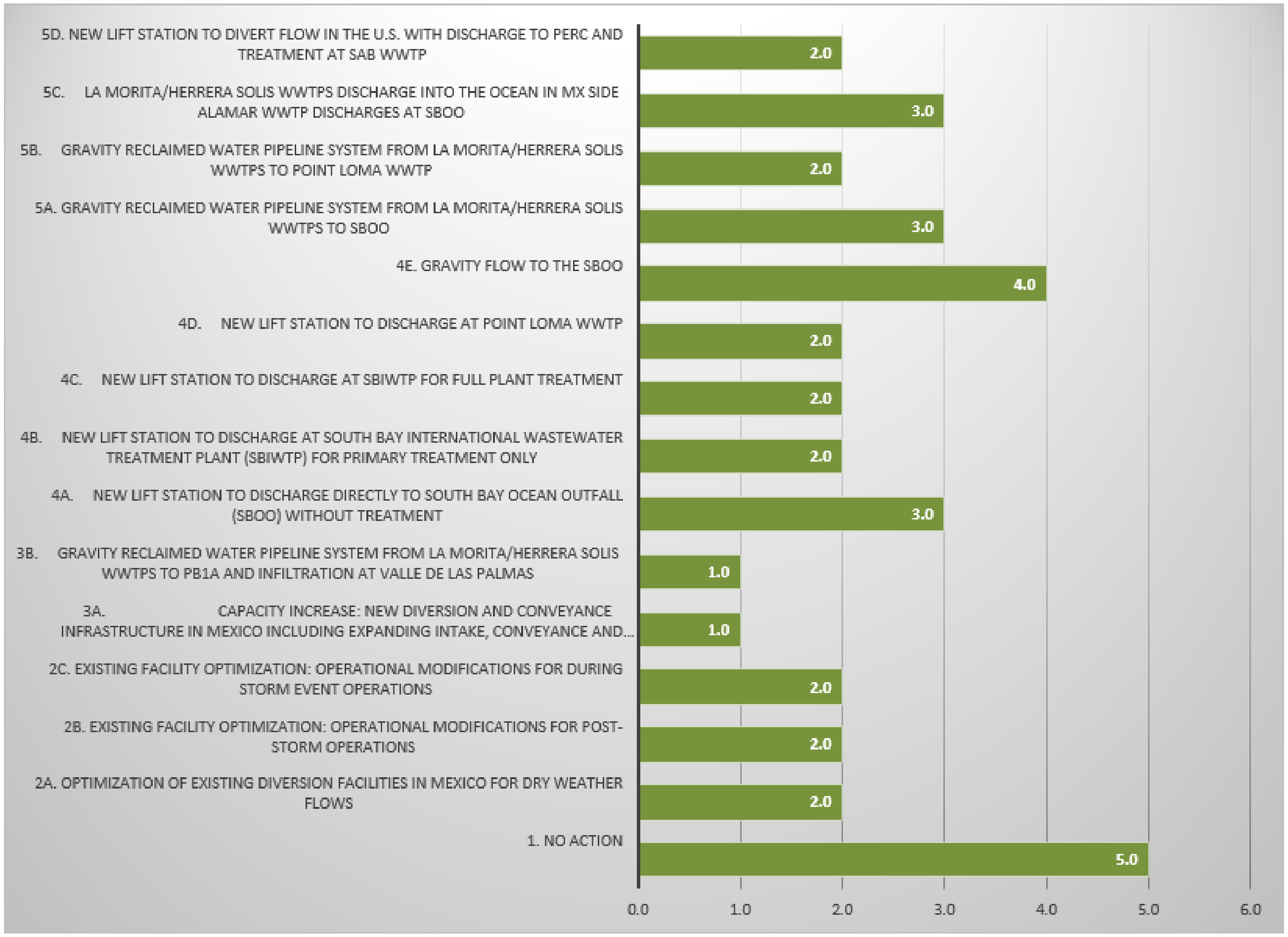
1 Highest Cost

15 Lowest Cost

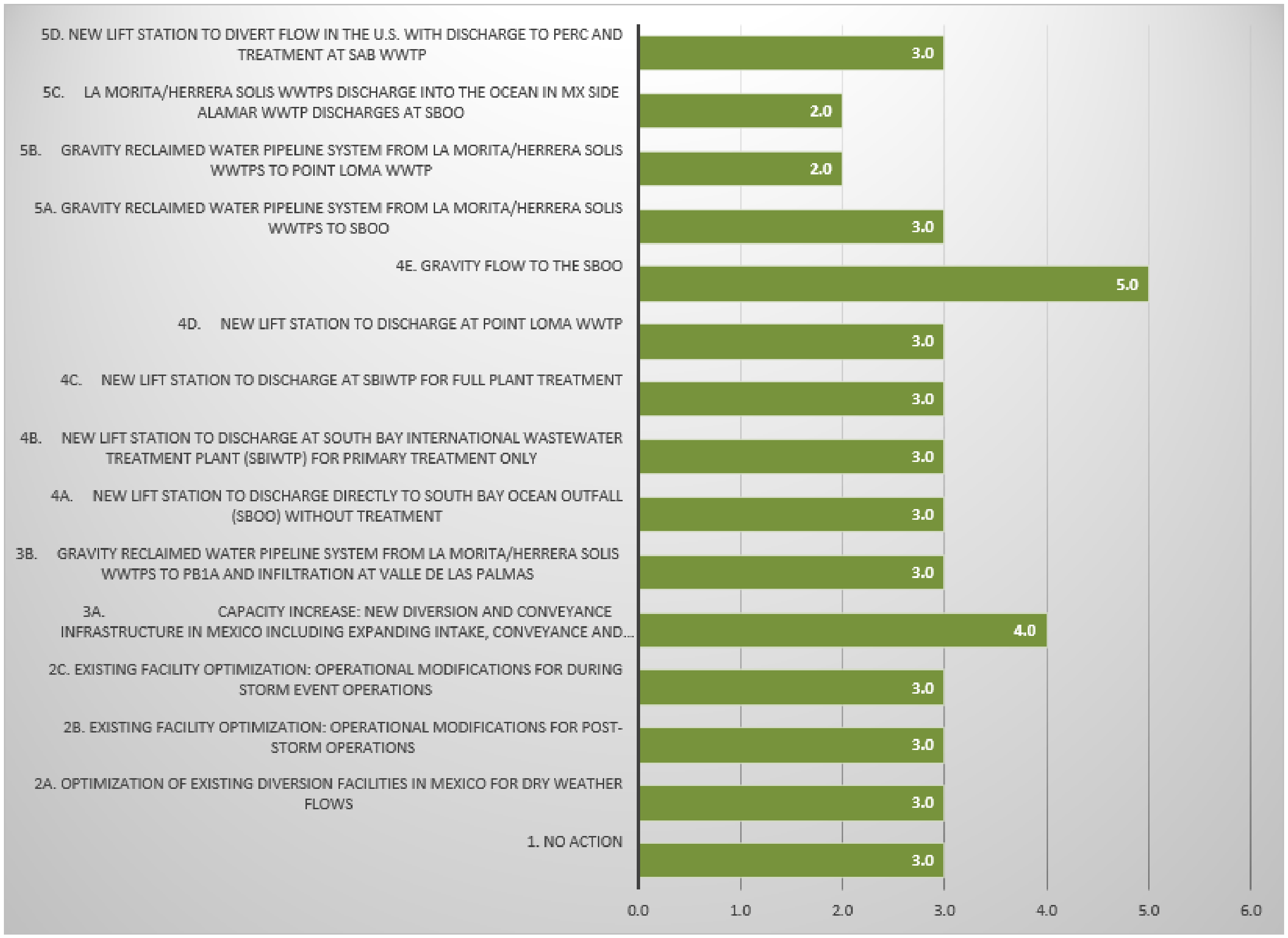
Highest Cost – 5b. Gravity reclaimed water pipeline System from La Morita/Herrera Solis WWTPs to Point Loma WWTP

Lowest Cost – 4e. Gravity flow to the SBOO

Task 3 – Evaluation Criteria Scoring



Task 3 – Evaluation Criteria Scoring



2 Lowest Op Flexibility
5 Highest Op Flexibility

Highest Op. Flex – 4e

Lowest op. Flex – 5c, 5b

Project Schedule

Tasks & Deliverable	Date
Kick off meeting	05/09/18
30% Progress deliverable	08/24/18
30% Review and presentation	**08/28/18**
60% Progress deliverable to NADB	*Early November*
Draft report review and presentation	*Early December*
Final report	*January*

Next Steps

- Finalizing Task 1 & Task 2
- Finalizing the Evaluation Matrix
- Updating alternatives from meeting's input
- In-depth analysis
- O&M Costs
- 60 percent deliverable

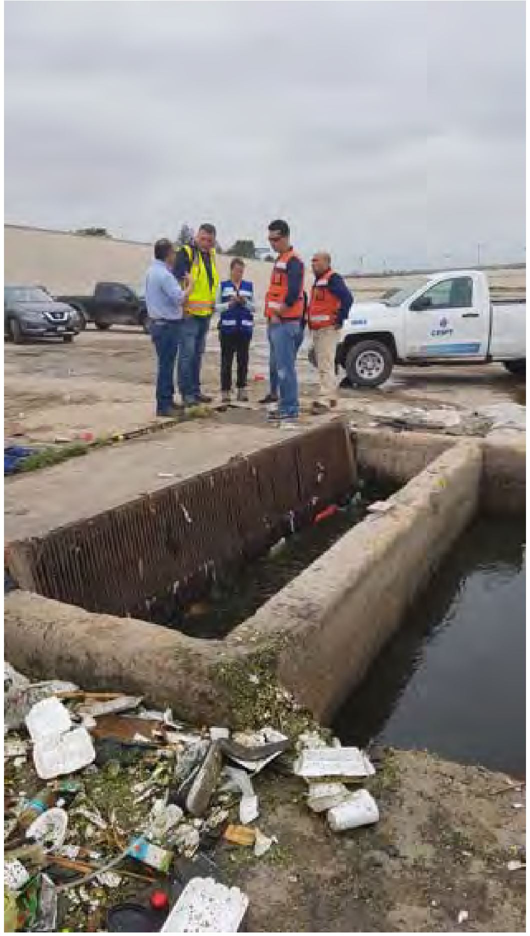
Questions/Discussion

TIJUANA RIVER DIVERSION STUDY

Flow Analysis, Infrastructure Assessment and Development of Alternatives – 60% Progress Meeting | December 20, 2018

Outline

- H&S Moment
- Project Objectives
- PBCILA Operational Protocol
- Transboundary Flow events Classification
- Infrastructure and Operations Diagnostics
- Initial List of Alternatives
- Evaluation Criteria Scoring
- Refined List of Alternatives
- Additional Components
- Schedule
- Next Steps
- Questions/Discussion



Health and Safety Moment: 6 Fundamental Health & Safety Principles

- Undertake Health and Safety Planning
- Demonstrate H&S Stewardship Daily
- Practice if not me, then who
- Exercise Stop Work Authority
- Report Near Misses and Incidents
- Use TRACK every day

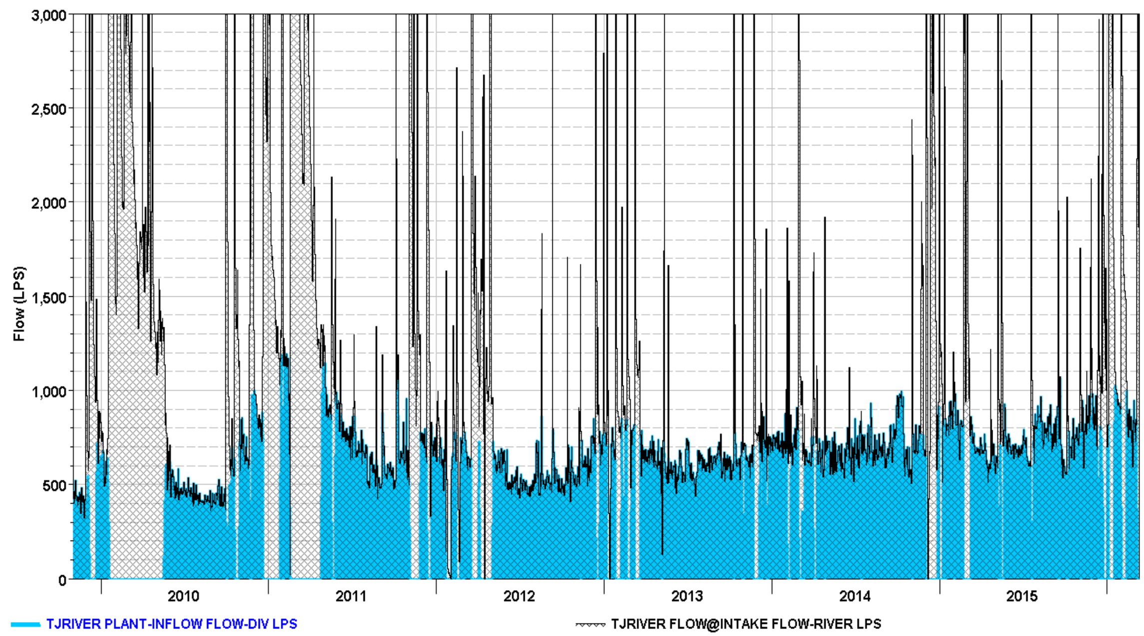
ARCADIS Design & Consultancy for natural and built assets

Project Objectives

- Task 1 – Review of Existing Information and Transboundary Flow Analysis
  - Identify previous problems and solutions from completed studies
  - Collect and analyze data on Tijuana River flows, border flows, water quality, beach closure reports, rainfall events
- Task 2 – Infrastructure and Operations Diagnostic
  - Determine infrastructure current capacities and conditions
  - Condition and Operational diagnostics, identify failures resulting in transboundary flows
  - Impact of unserved areas in Tijuana
- Task 3 – Alternatives Analysis
  - Alternative evaluation of 15 total alternatives
  - Provide decision matrix for alternative selection by Binational Core Group
- Task 4 – PM & Stakeholder Coordination
  - Meetings, stakeholder interviews, draft and final reporting

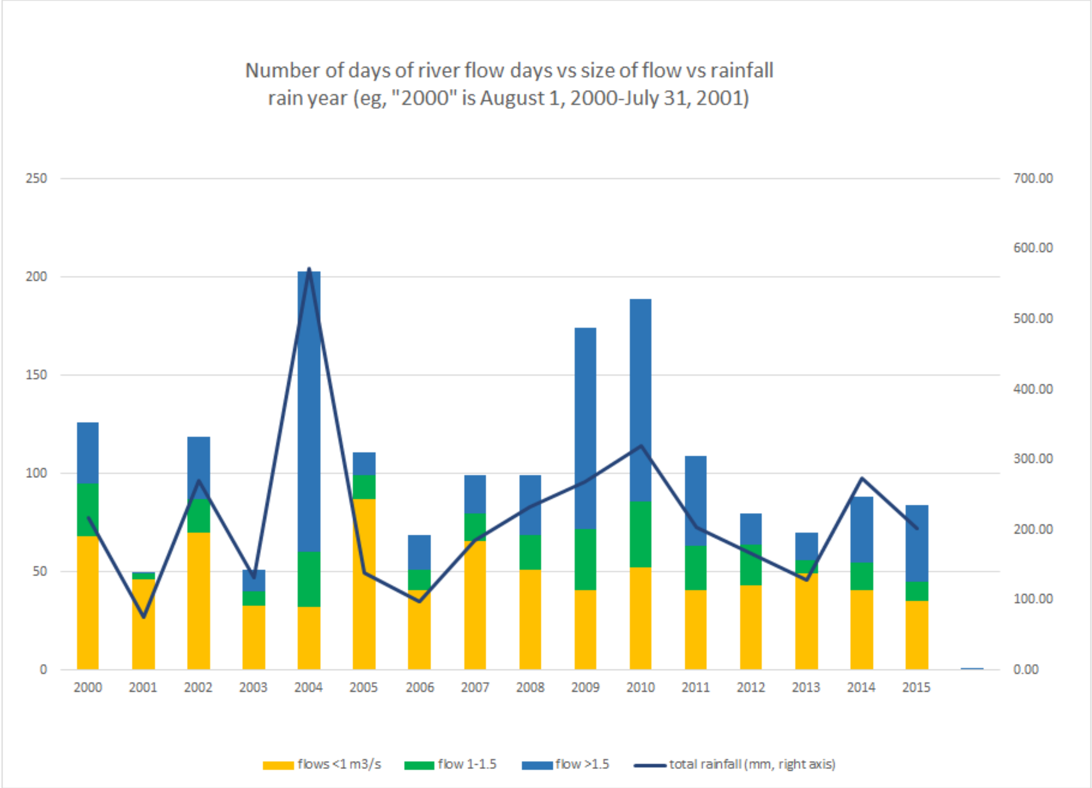
PBCILA operational protocol – diversions

- **Wet-weather flow:** Pump station shutdown when Tijuana River flow at intake approaches 1,000 l/s
- **Post -storm event flow:** Pump station restarted when Tijuana River flow at intake falls below 1,000 l/s



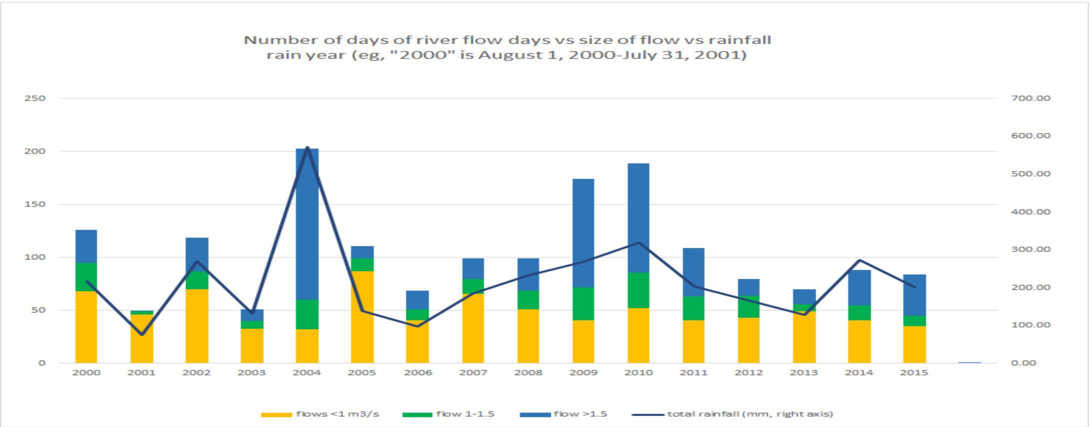
Transboundary flow event classification

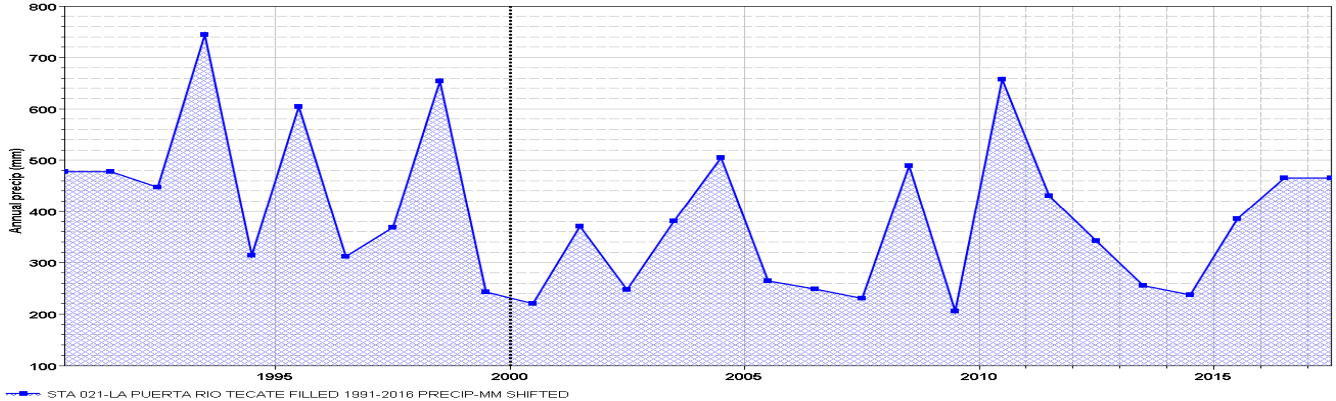
- **Low:** Transboundary flow less than 1.0 m³/s (1,000 l/s)
- **Medium:** Transboundary flow from 1.0 – 1.5 m³/s (1,000 – 1,500 l/s)
- **High:** Transboundary flow greater than 1.5 m³/s (1,500 l/s)



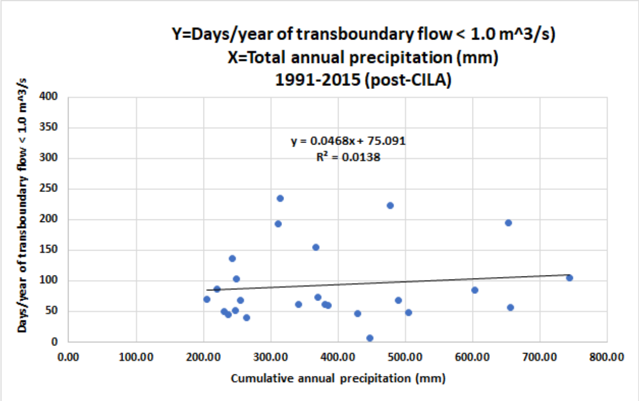
Weather conditions

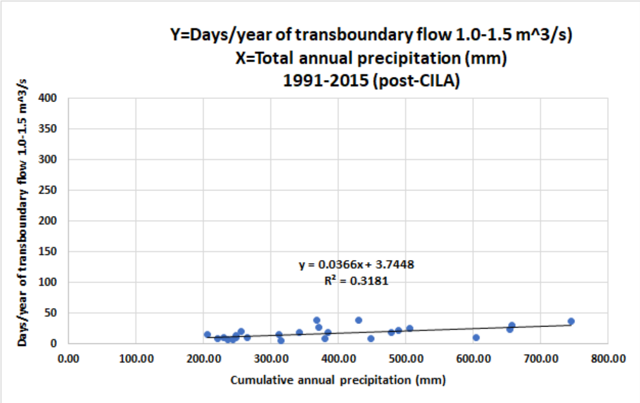
- Dry, normal and wet weather conditions identified based on total annual precipitation at La Puerta, Rio Tecate (Station 021), 1991-2016

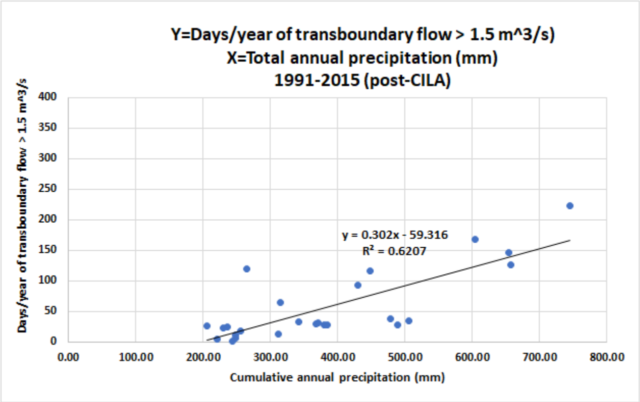


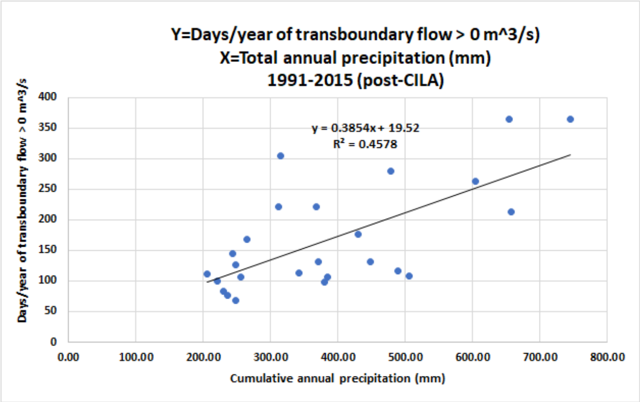


Statistical analysis – days/year transboundary flows vs. annual precipitation

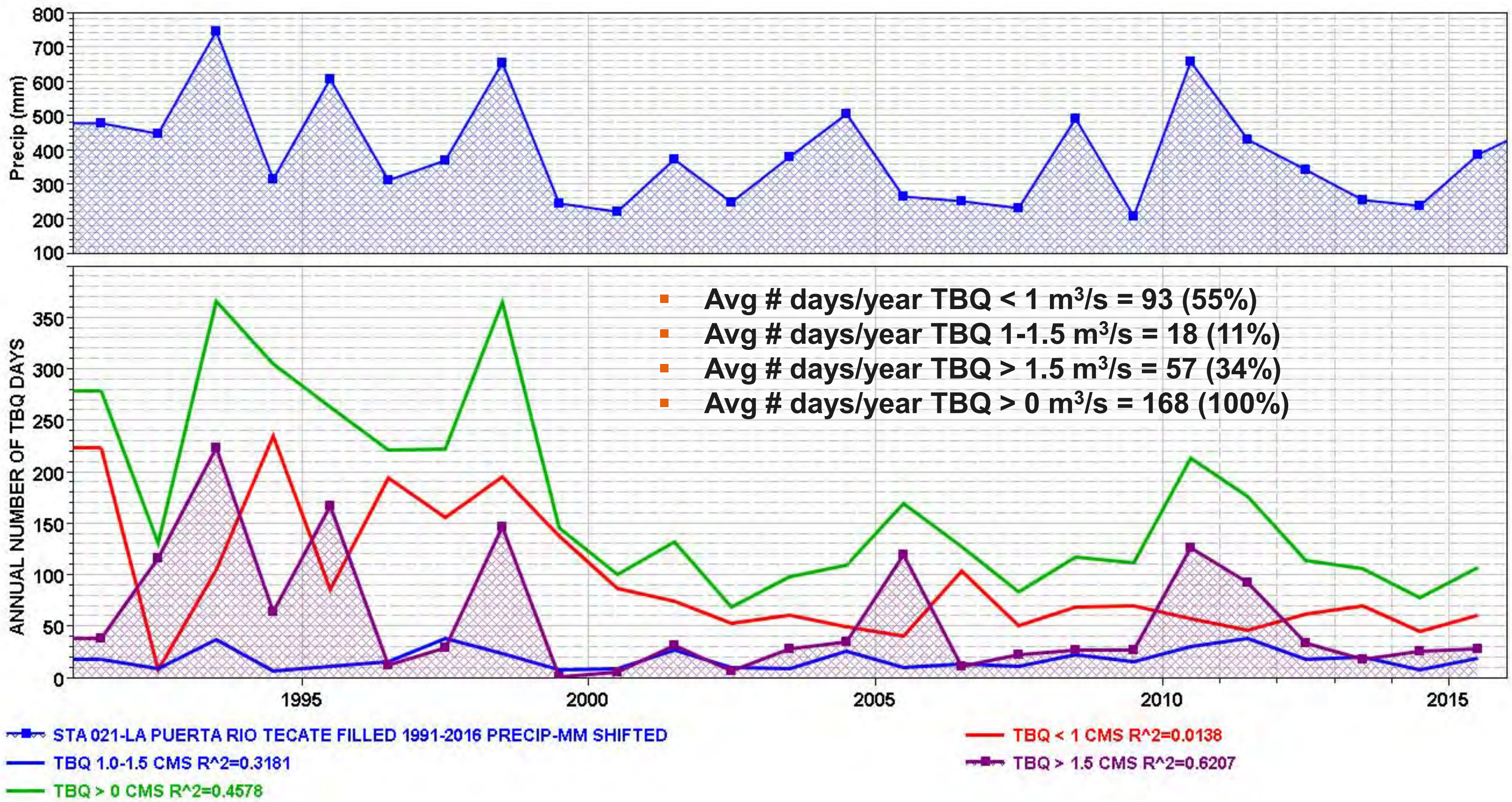








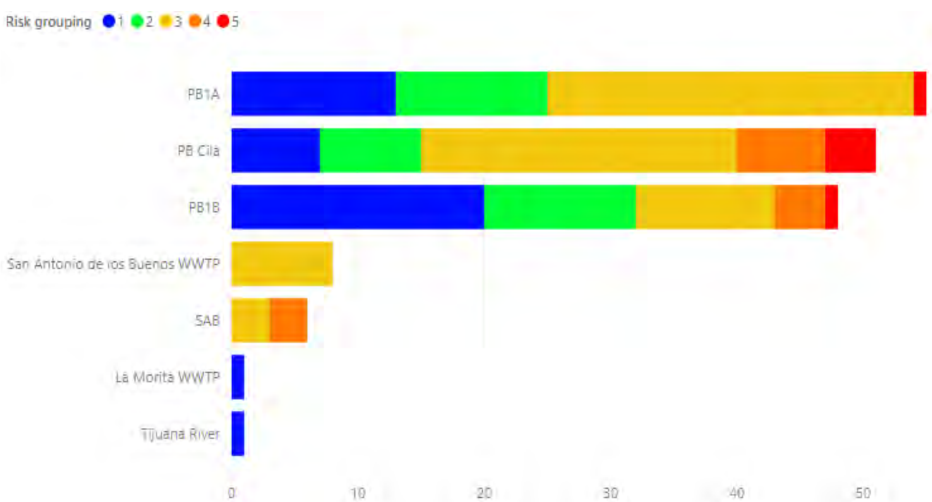
Conclusions – coefficient of determination

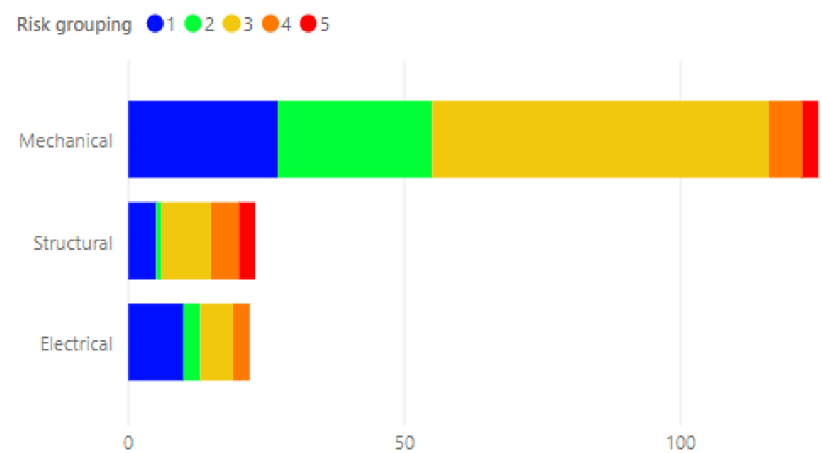


- Avg # days/year TBQ < 1 m^3/s = 93 (55%)
- Avg # days/year TBQ 1-1.5 m^3/s = 18 (11%)
- Avg # days/year TBQ > 1.5 m^3/s = 57 (34%)
- Avg # days/year TBQ > 0 m^3/s = 168 (100%)

- Very good: $0.8 \leq R^2 \leq 1$
- Good: $0.7 \leq R^2 \leq 0.8$
- Fair: $0.6 \leq R^2 \leq 0.7$
- Poor: $R^2 \leq 0.6$

Infrastructure and Operations Diagnostic





5 – High risk (24-25),

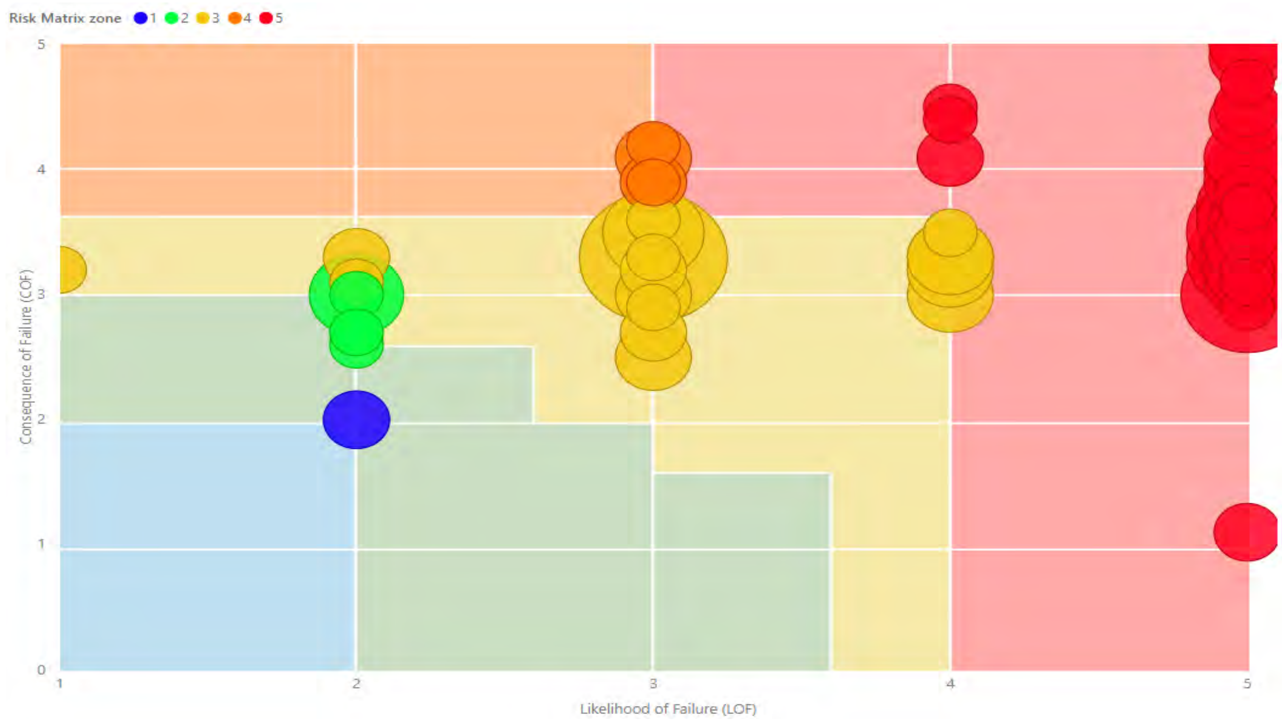
4 - Medium High risk (20-23),

3 – Medium risk (15-19),

2 - Medium Low risk (10-14) and

1 – Low risk (<10)

Infrastructure and Operations Diagnostic



Initial List of Alternatives

No Action	1a	No Action
INFRASTRUCTURE IMPROVEMENTS IN MEXICO	2a	Optimize Existing Facilities: Modifications for dry weather flows
	2b	Optimize Existing Facilities: Modifications for post-storm operations
	2c	Optimize Existing Facilities: Modifications for storm event operations
	3a	Capacity increase: New diversion and conveyance infrastructure in Mexico
INFRASTRUCTURE IMPROVEMENTS IN U.S.	4a	New lift station to discharge directly to SBOO without treatment
	4b	New Lift Station to discharge at SBIWTP for primary treatment only
	4c	New Lift Station to discharge at SBIWTP for full treatment
	4d	New lift station to discharge at Point Loma WWTP
	4e	Gravity flow to the SBOO
COMBINED U.S. - MEXICO INFRASTRUCTURE	5a	Gravity reclaimed water pipeline from WWTP's to SBOO
	5b	Gravity reclaimed water pipeline System from WWTPs to Point Loma WWTP
	5c	Gravity reclaimed water pipeline System from WWTPs to Punta Bandera (ocean discharge)
	5d	New Lift Station to divert Flow in the U.S. with discharge to PERC and treatment at SAB WWTP

Non-Cost Parameters

Jurisdictional Control – Degree of owner influence on the planning, design and operation of Tijuana diversion alternatives. The owner of the project would have much greater control with the new facilities compared to use of facilities owned by others.

Operational Flexibility – Flexibility available for managing the selected TJ diversion alternative. In general, the least number of new operational intensive components along with a larger operations support group is favorable.

Regulatory/Institutional Complexity – Complexity of implementation, including compliance with binational agreements, regulatory standards, number and complexity of new lift stations and treatment facilities, agreements, other agency approvals and support, etc.

Transboundary Flow Reduction– Degree of ability to reduce the transboundary flows with a more efficient diversion system.

Public Perception – General perception of the public of the alternative reducing any potential contact with contaminated water

Phasing Flexibility – Degree of availability the project could be split into phases of construction without compromising daily operation of the existing infrastructure

Weighting Calculations Results

	Evaluating Criteria	Arcadis	NADB	CESPT	EPA	USIBWC	CILA-MX	CONAGUA	AVERAGE
100	Capital Cost	85	90	95	90	80	60	95	85.00
80	O&M Cost	70	90	95	85	95	80	90	86.43
70	Jurisdictional Control	40	40	50	50	50	35	60	46.43
60	Operational Flexibility	10	25	80	60	20	85	75	50.71
50	Regul/Institut Complexity	65	30	50	50	75	45	70	55.00
40	Transboundary flow Reduction	100	100	100	100	95	100	100	99.29
20	Public Perception	50	30	70	45	75	40	85	56.43
10	Phasing Feasibility	30	20	30	30	25	25	64	32.00
		450	425	570	510	515	470	639	511.29

Determining the Weighting Calculations

	AVERAGE	On 100% Scale
Capital Cost	85.00	16.62
O&M Cost	86.43	16.90
Jurisdictional Control	46.43	9.08
Operational Flexibility	50.71	9.92
Regul/Institut Complexity	55.00	10.76
Transboundary flow Reduction	99.29	19.42
Public Perception	56.43	11.04
Phasing Feasibility	32.00	6.26
	511.29	100.00

Evaluation Criteria Scoring

Decision Criteria	Capital Cost	O&M Cost	Jurisdictional Control	Operational Flexibility	Regul/Institut Complexity	Transboundary flow Reduction	Public Perception	Phasing Feasibility	Sum of Scores	Weighted Score
Weight	16.6%	16.9%	9.1%	9.9%	10.8%	19.4%	11.0%	6.3%		
1. No Action	5	1	0	2	0	0	0	5	13	**1.5**
2a. Optimize Existing Facilities: Modifications for dry weather flows	5	4	1	3	4	2	1	5	25	**3.1**
2b. Optimize Existing Facilities: Modifications for post-storm operations	4	4	5	3	4	3	2	4	29	**3.6**
2c. Optimize Existing Facilities: Modifications for storm event operations	4	4	5	3	4	5	4	4	33	**4.2**
3a. Capacity increase: New diversion and conveyance infrastructure in Mexico	2	3	1	4	4	4	4	3	25	**3.2**
3b. Gravity reclaimed water pipeline System from La Morita/Herrera Solis WWTPs to PB1A and infiltration at Valle de las Palmas	2	1	1	3	3	4	5	2	21	**2.7**
4a. New lift station to discharge directly to SBOO without treatment	5	4	5	3	1	3	1	5	27	**3.4**
4b. New lift station to discharge at SBIWTP for primary treatment only	4	2	5	5	2	4	4	5	31	**3.7**
4c. New Lift Station to Discharge at SBIWTP for full plant treatment	1	1	5	3	4	4	4	3	25	**2.9**
4d. New Lift Station to Discharge at Point Loma WWTP	4	1	4	3	1	3	3	4	23	**2.8**
4e. Gravity flow to the SBOO	5	4	5	5	1	1	1	5	27	**3.2**
5a. Gravity reclaimed water pipeline from WWTP's to SBOO	1	1	3	3	3	5	4	3	23	**2.8**
5b. Gravity reclaimed water pipeline System from WWTP's to Point Loma WWTP	0	2	2	2	2	3	4	2	17	**2.1**
5c. WWTP's discharge into the ocean in MX side Alamar WWTP discharges at SBOO	1	3	2	2	3	5	4	2	22	**2.9**
5d. New Lift Station to Divert Flow in the U.S. with discharge to PERC and treatment at SAB WWTP	2	1	2	3	2	4	4	5	23	**2.7**

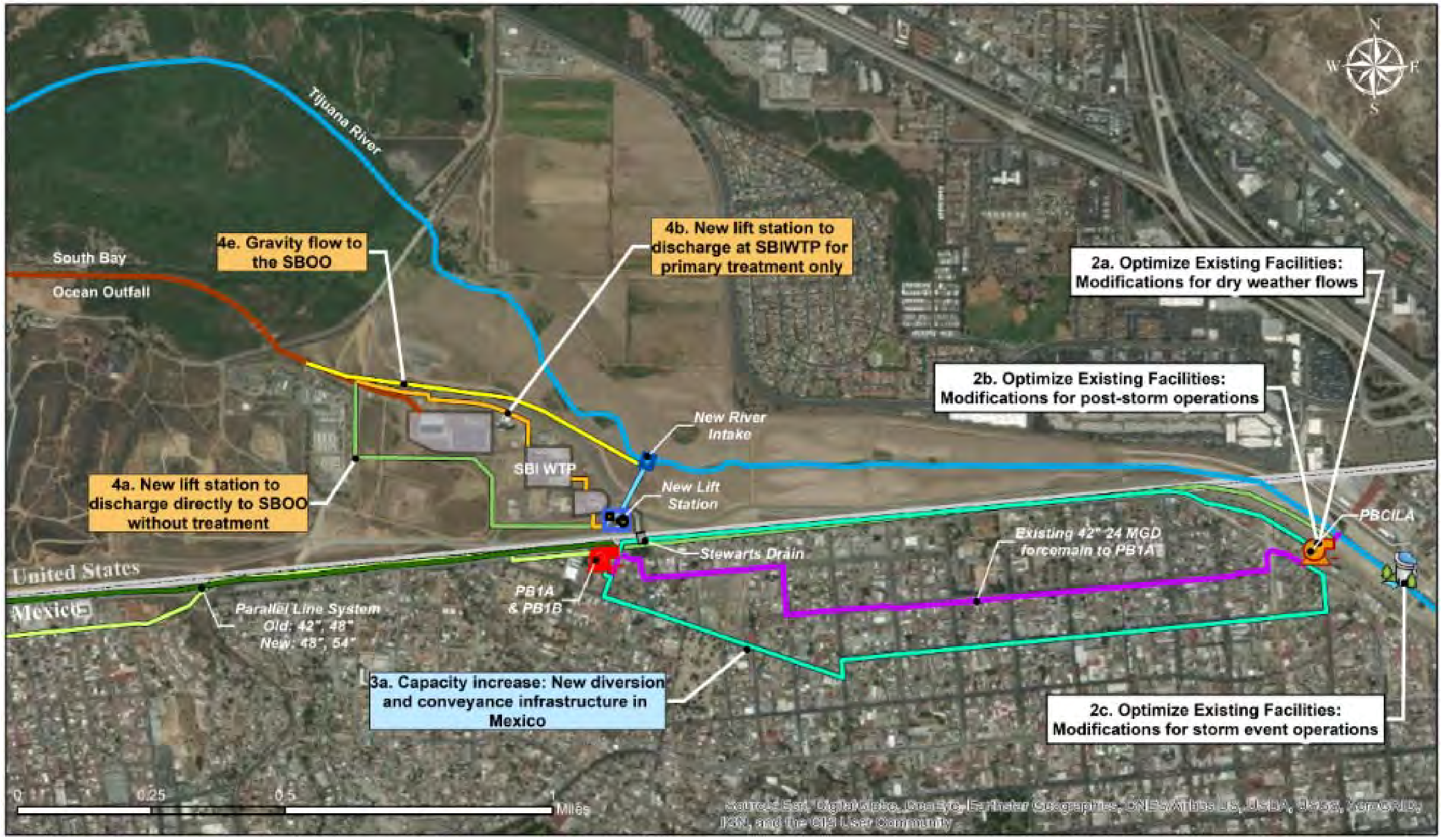
1 - Least Favorable and 5 - Most Favorable

Proposed Alternative for in depth analysis

Refined List of Alternatives:

Group	ID	Name	Description	Cost	O&M Cost (20-yr life cycle)	Estimated days/yr of Trasboudnary Flows
INFRASTRUCTURE IMPROVEMENTS IN MEXICO	2a	Optimize Existing Facilities: Modifications for dry weather flows	Combined diversion facilities in the US and Mexico with new reclaimed water pipeline extending from La Morita/Herrera Solis WWTP's effluent and a proposed WWTP at Alamar to the SBOO.	**$19.6 M**	**$4.35 M/yr**	168-87= **81 days**
	2b	Optimize Existing Facilities: Modifications for post-storm operations	Increase diversion intake, PBCILA Lift Station expansion, PB1A&1B Lift Stations expansion for an additional 30 MGDs of flows for capture of all dry-weather flows and smaller scale storm event (smaller than 1-year flood)	**$28.2 M**	**$4.95 M/yr**	168-87= **81 days**
	2c	Optimize Existing Facilities: Modifications for storm event operations	Improvements from 2b and utilizing inflatable dams to increase detention time and allow for facilities to pump at full flow conditions	**$39.9 M**	**$5.55 M/yr**	168-110= **58 days**
	3a	Capacity increase: New diversion and conveyance infrastructure in Mexico	Increase diversion intake and expansion of PBCILA and PB1A&1B Lift stations	**$109.4 M**	**$6.58 M/yr**	168-88= **80 days**
INFRASTRUCTURE IMPROVEMENTS IN U.S.	4a	New lift station to discharge directly to SBOO without treatment	US based alternative that includes new concrete diversion structure, a 35 MGD lift station to tie into SBOO without additional treatment.	**$22.1 M**	**$7.24 M/yr**	168-88= **80 days**
	4b	New Lift Station to discharge at SBIWTP for primary treatment only	US based alternative that includes concrete new diversion, a 35 MGD lift station to tie into SBOO with additional 1ry treatment at SBIWTP.	**$36.8 M**	**$15.32 M/yr**	168-88= **80 days**
	4e	Gravity flow to the SBOO	U.S. Tijuana River Intake via gravity to SBOO	**$15.2 M**	**$4.5 M/yr**	168-88= **80 days**

Refined List of Alternatives



Alternative 2a - Optimize Existing Facilities: Modifications for dry weather flows

Infrastructure optimization includes improvements to the following:

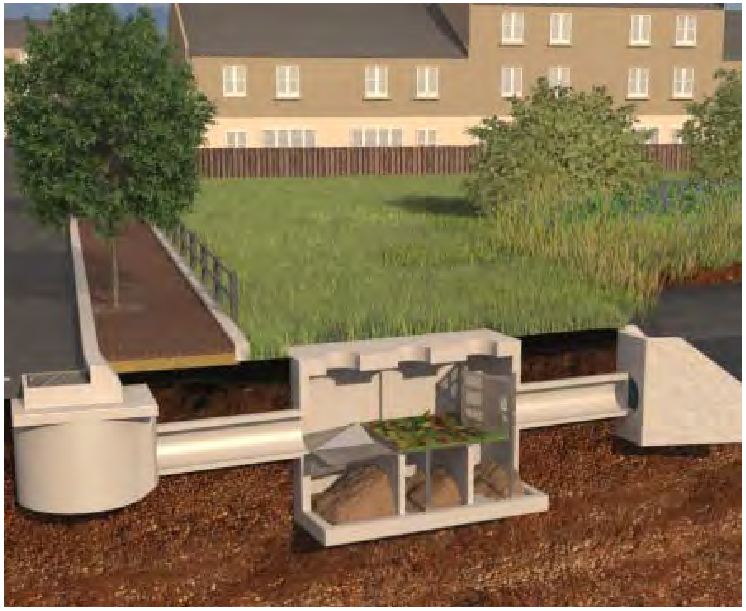
- PBCILA Intake: resize and reconfigure intake system and sedimentation channel, replace racks. Add flow meters
- PBCILA: adding 4 new pumps/motors, replace piping and valves for each system, replace electrical conduits replacement, panel and controls replacement.
- PB1A & PB1B: demolish/rebuilt concrete channels, demolish/rebuilt buildings, 2 new pumps/motors trains in each PS, replace piping and valves for PB1A, electrical conduits replacement, panel and controls replacement in each PS. Add flow meters to all PS
- Replacement of Hoists systems at all PS
- Add SCADA system at all PS

Capital Cost: **$22.7M USD**

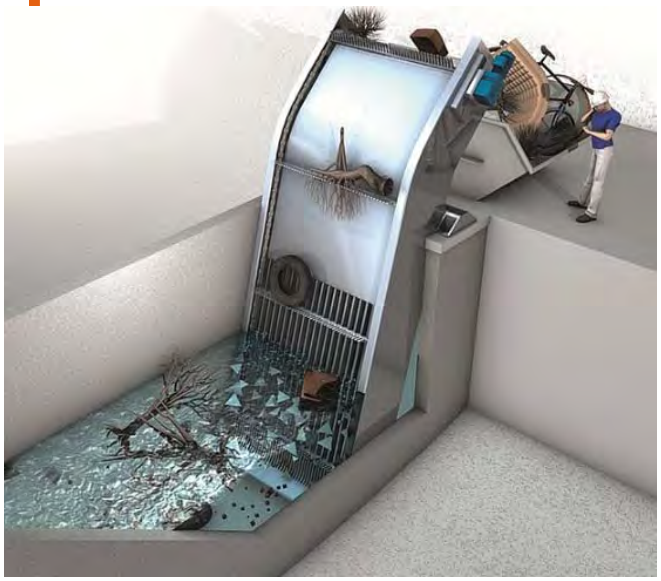
O&M Cost (20 yr LCC): **$4.3M USD**

PBCILA Intake Improvement Examples:

Concrete riser with racks



Baffle box with sediment and trash deposition



Mechanical trash racks

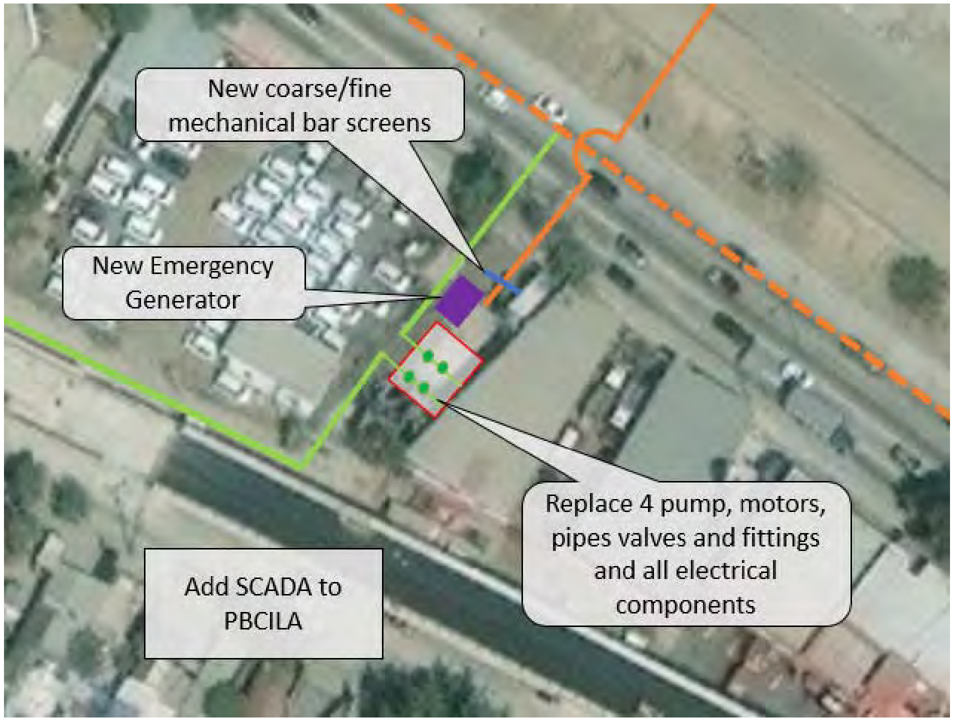
Alternative 2b - Optimize Existing Facilities: Modifications for post-storm operations

Infrastructure optimization includes improvements to the following:

- All improvements from Alternative 2a
- PBCILA Intake: additional sedimentation traps with influent channel re-design
- PBCILA LS: additional bar screens for coarse and fine sediments, emergency generator for a 3 day run period
- PB1A & PB1B: additional bar screens for coarse and fine sediments, automatic trash, debris conveyor belt system, new emergency generator for each PS for a 3 day run period

Capital Cost: **$28.2M USD**

O&M Cost (20 yr LCC): **$4.95M USD**



Alternative 2c - Optimize Existing Facilities: Modifications for storm event operations

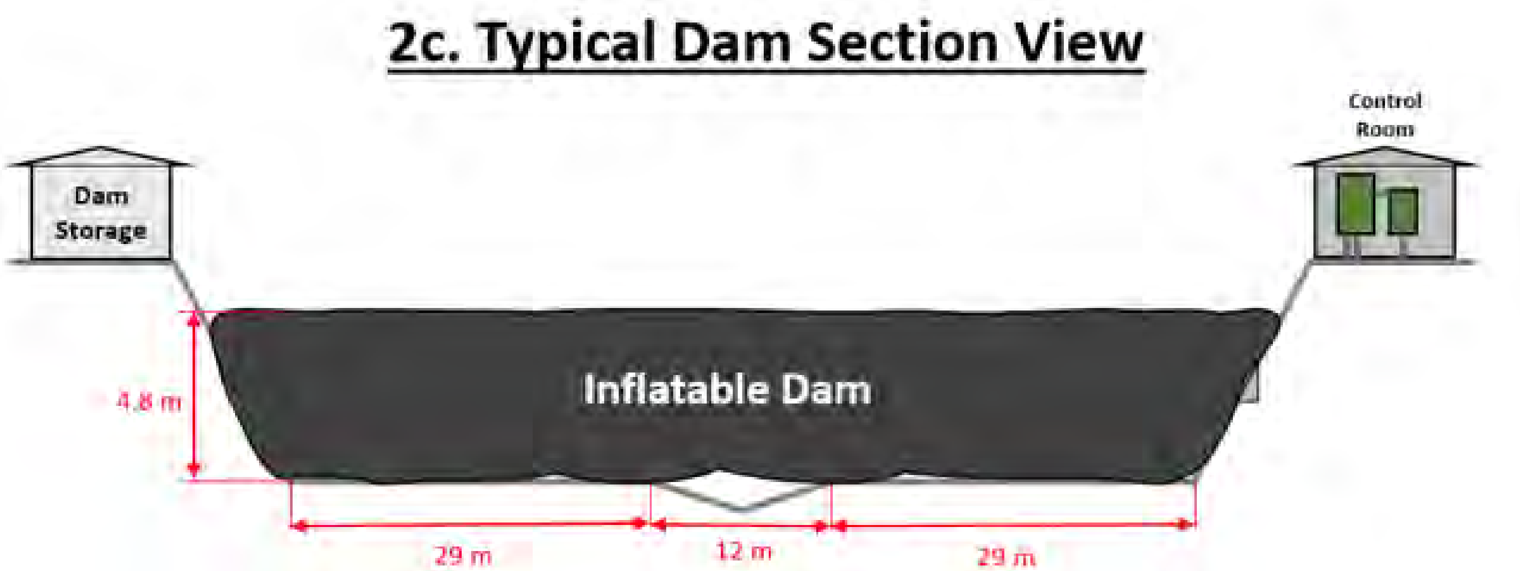
Infrastructure optimization includes improvements to the following:

- All improvements from Alternative 2b
- Addition of four inflatable dams

Capital Cost:
$36.7M USD

O&M Cost (20 yr LCC):
$5.55M USD

Inflatable dam example:



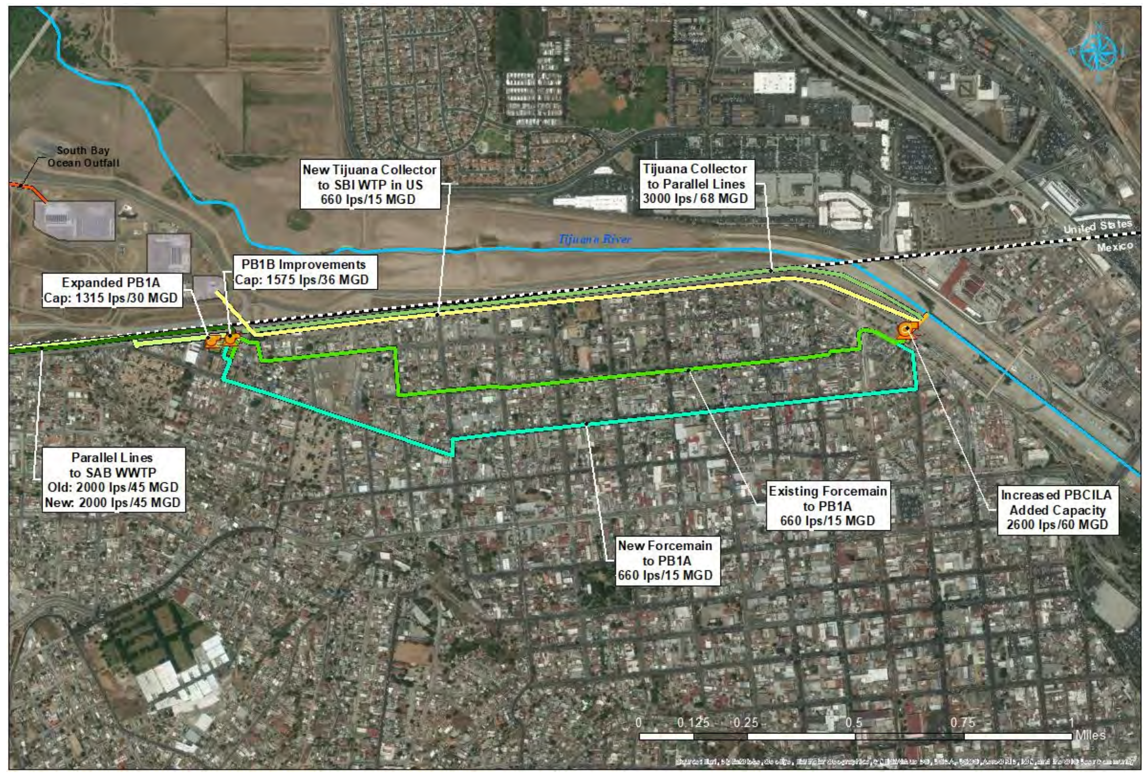
Alternative 3a –Capacity Increase: New Diversion and conveyance infrastructure in Mexico

Infrastructure expansion and optimization includes the following improvements:

- All improvements from Alternative 2b
- PBCILA Intake: expansion to 60 MGD (2,600 lps)
- PBCILA lift station: expansion with additional 30 MGD
- PBCILA to PB1A: forcemain expansion
- PB1A and PB1B PS: add 15 MGD (660 lps) capacity and larger emergency generator –requires additional CFE capacity for additional pumps
- Pipeline addition to Parallel Line system to tie into SAB WWTP

Capital Cost: $109.4M USD

O&M Cost (20 yr LCC): $6.58M USD



Alternative 4a - New Lift Station to discharge directly to South Bay Ocean Outfall (SBOO) without treatment

US based alternatives infrastructure includes the following:

- Concrete river intake box
- 35 MGD (1,500 lps) Lift station
- 5,100 linear feet (1,555 meters) new ductile iron pipelines, (36 and 42 inch diameter)
- Tie in to SBOO

Capital Cost:
$22.1M USD

O&M Cost (20 yr LCC):
$4.24M USD
+
O&M Cost (20 yr LCC):
$3M USD

Alternative 4b - New Lift Station to Discharge at South Bay International Wastewater Treatment Plant (SBIWTP) for primary treatment only

US based alternatives infrastructure includes the following:

- Alternative 4a lift station components
- 3,500 linear foot (1,080 meters) new ductile iron pipeline (36 and 42 inch diameter)
- SBI WTP improvements to have additional 35 MGD treated through primary treatment

Capital Cost: **$36.8 M USD**

O&M Cost (20 yr LCC): **$12M USD**

\+

O&M Cost (20 yr LCC): **$3M USD**

Alternative 4e - New Gravity flow to the SBOO.

US based alternatives infrastructure includes the following:

- Concrete river intake box
- 5,100 linear feet (1,555 meters) new ductile iron pipelines, (42 inch diameter)
- Tie in to SBOO
- Not technically feasible: not meeting minimum slope requirements

Capital Cost:
$15.2 M USD

O&M Cost (20 yr LCC):
$1.5M USD

+

O&M Cost (20 yr LCC):
$3M USD

Additional Components

Replacing International Interceptor with a new 84 and 96 in diameter WW pipeline (HDPE or Reinforced Polyester

Capital Cost:
$15.4 M USD

No. de tramo	ÁREA TRIBUTARIA LOCAL	POBLACIÓN LOCAL DE LA CUENCA	PUNTOS QUE DESCARGAN EN EL TRAMO	POBLACIÓN LOCAL QUE SE INCORPORA AL TRAMO	POBLACION ACUMULADA	APORTACION	Qmedio	Qmin	Qmin	M	Qmax	Qmaxprevisto	Qmax previsto	diametro	diametro	RUGOSIDAD	CADENAMIENTO	LONGITUD DEL TRAMO
		hab			hab	L/hab/DIA	L/seg	L/seg	m3/seg		L/seg	l/seg	m3/seg	pulgadas	m			m
1-2	PARALELO A CANAL	1665756.98	1.00	1665756.98	1665756.98	176.00	3393.21	1696.60	1.6966043	1.80	6107.78	9161.66	9.161663	84.00	2.13	0.010	400.000	400.000
2-3	LÍNEA INTERNACIONAL	0.00	1.00	0.00	1665756.98	176.00	3393.21	1696.60	1.6966043	1.80	6107.78	9161.66	9.161663	96.00	2.44	0.010	3000.000	2600.000

Additional Components

Stewart's Drain Diversion Box Improvements with a new diversion box discharging to the SBIWTP

Capital Cost:
$1.4 M USD

Additional Components

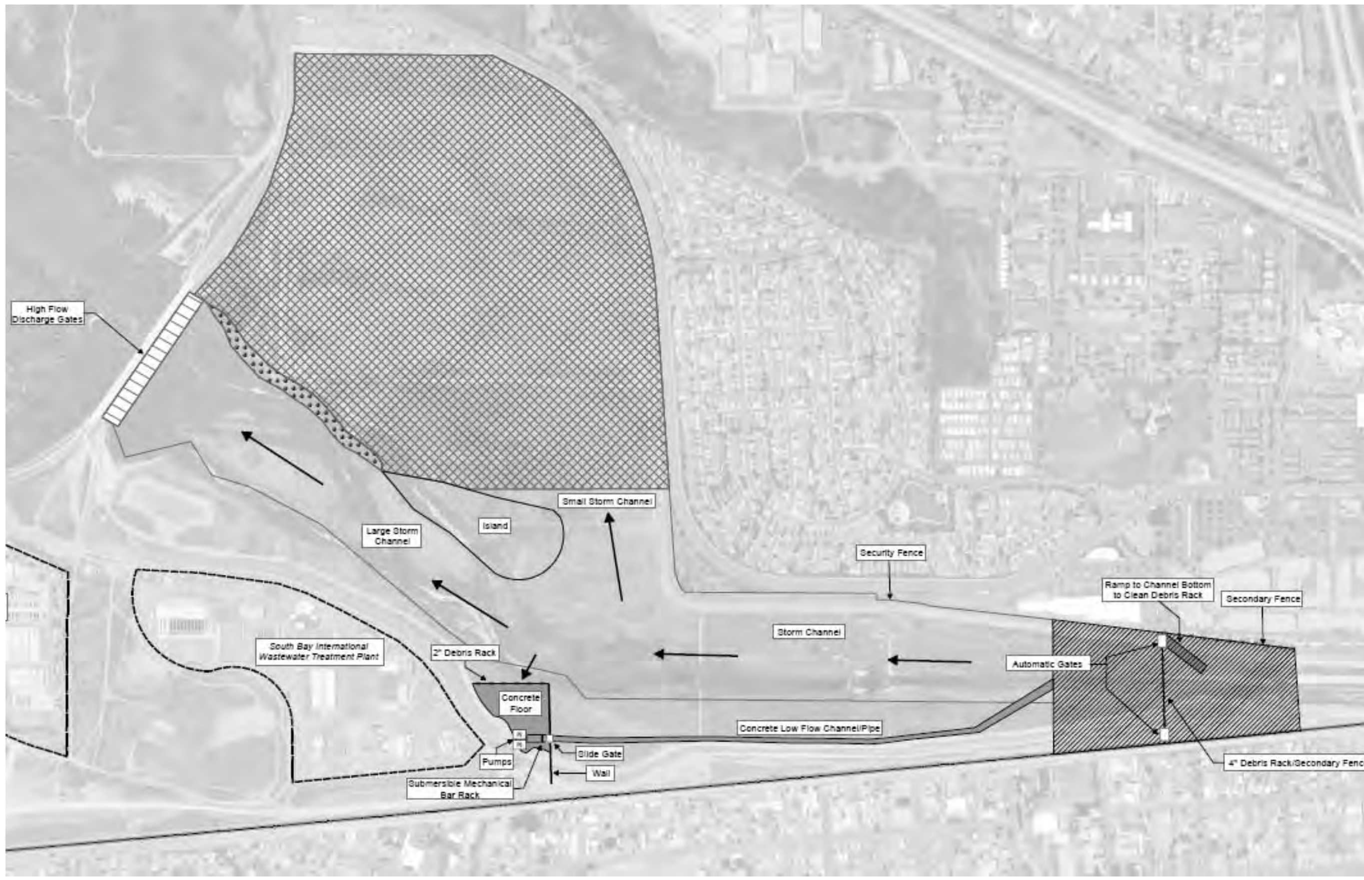
Single inflatable at the U.S. side of the Tijuana River Channel

Capital Cost:
$6.5 M USD

Additional Components

U.S. solution from Surfrider:

Capital Cost:
N/A



Project Schedule

Tasks & Deliverable	Date
Kick off meeting	05/09/18
30% Progress deliverable	08/24/18
30% Review and presentation	08/28/18
60% Progress deliverable	11/30/18
60% Review and presentation	**12/20/18**
60% Revised Progress deliverable to NADB	*Early January*
Draft report review and presentation	*Late January*
Final report	*February*

Next Steps

- Finalizing Task 1 & Task 2
- Updating alternatives from meeting's input
- Finalize evaluation of refined list of alternatives
- Deliver a revised 60 percent report

Questions/Discussion

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- About Arcadis and Project Team
- Project Background and Objectives
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Health and Safety Moment

Spring cleaning every year can be a real chore but by choosing the right tools and products, it can be done safely and efficiently:

- **Get prepped:**

1. Steam clean carpets to kill mold, fungi and bacteria that has built up over the winter.
2. Use bleach to target mold in and around the shower/tub areas. 1 cup bleach for each gallon of water.
3. Replace filters in the furnace, AC and vacuum.

- **Read the labels:**

1. If using cleaners with “Poison or Warning”, the can be toxic to you and pets. Air out those areas as you clean and after for at least 30 minutes.
2. Use the proper PPE as you clean and do not wear your contact lenses while you clean, vapors, dust and particles from the cleaners are easily absorbed by the lenses.

About Arcadis

#13 Top 500 Design Firms

Top 20 by Sector

- #4 General Building
- #7 Water
- #2 Hazardous Waste

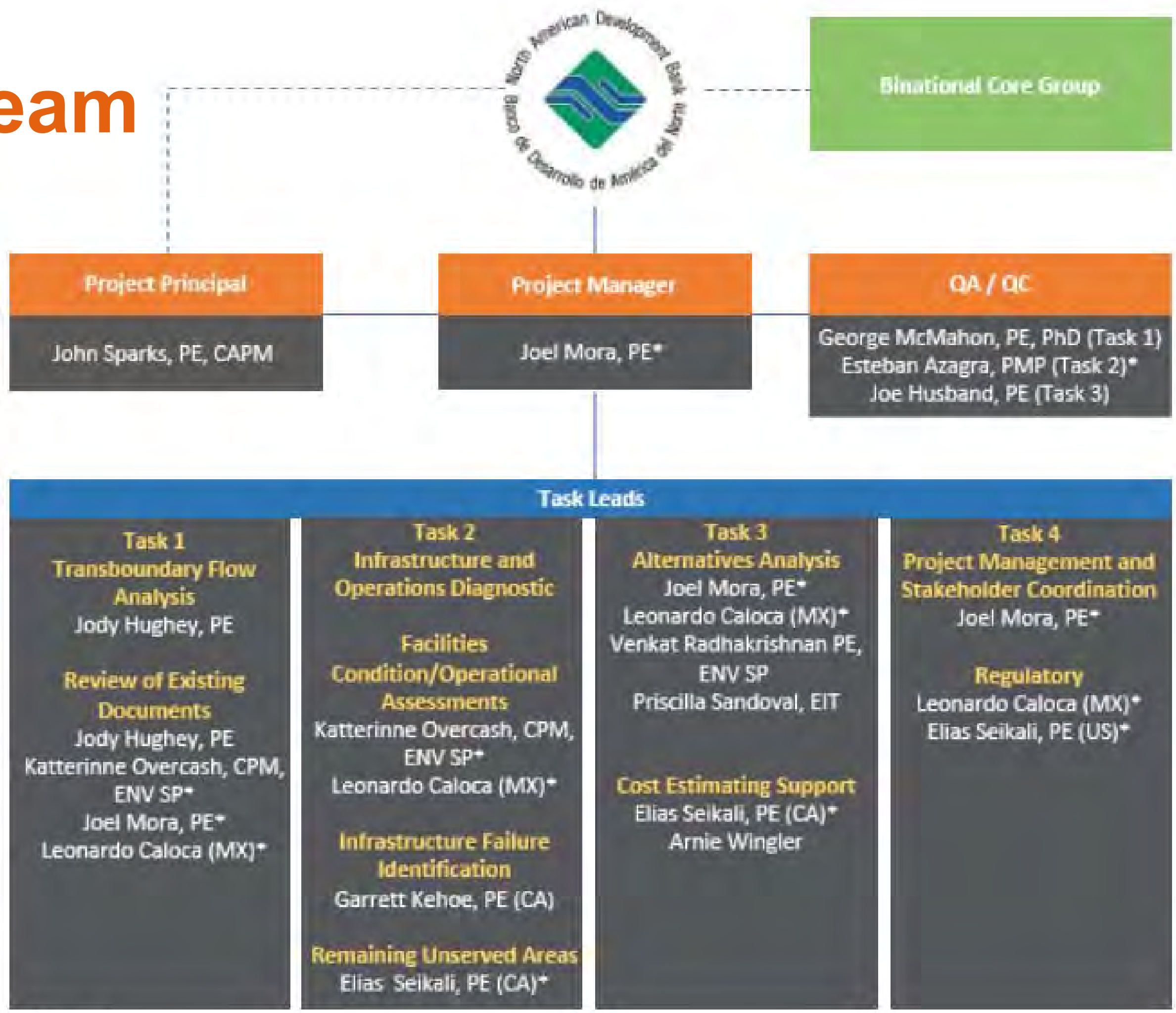
Engineering & Manufacturing

- #2 Pure Engineering
- Top 50% Overall

U.S. Stats

- 6,200 employees
- 160+ offices in U.S.

Project Team



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Project Background

- Occurrence of transboundary flows in the Tijuana River watershed that result in discharge of pollutants to the ocean and beach closures in San Diego County.
- Existing infrastructure design for dry-weather flows. Insufficient capacity, failures, shut downs permit storm events to carry combined flows to the ocean.
- Working with multiple stakeholders such as NADB and Minute 320 Binational Work Group to understand the existing problem
- Evaluate transboundary flows, assess existing infrastructure and develop viable alternatives to prevent or significantly reduce transboundary flows

Project Objectives

- Transboundary flow analysis
- Evaluation of existing conditions at the wastewater infrastructure: PBCILA, PB1A, PB1B, Junction boxes, Tijuana River and conveyance pipeline systems
- Optimization of flow diversion and pumping
- Alternative evaluation: 15 total alternatives
  - WWTP discharging into the PBCILA
  - Diversion options in Mexico
  - Diversion and pumping options in US
  - Evaluate return flow to Mexico
  - Discharge through PERC
  - Discharge though SBOO with or without additional treatment
- Alternatives to be evaluated against effect on transboundary flows, beach closure days, and cost-benefit ratio

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- Task 1 – Review of Existing Information and Transboundary Flow Analysis
  - Identify previous problems and solutions from completed studies
  - Gather existing data on Tijuana River flows, border flows, water quality, beach closure reports, rainfall events
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  - Alternative evaluation of 15 total alternatives
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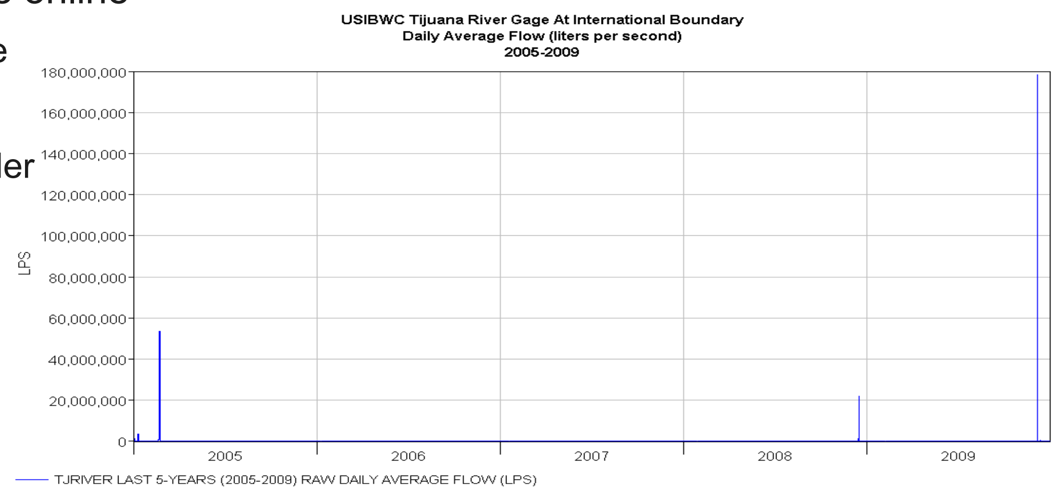
  - Meetings, stakeholder interviews, draft and final reporting

Task 1 – Review of Existing Documents and Transboundary Flow Analysis

- Understanding transboundary flows (magnitude, frequency, duration, potential causes)
- Compile and review existing information, studies, flow data, available rainfall data
- Work with NADB and stakeholders to determine what additional flow data exist beyond the USIBWC TJ River gage data available online
  - Data set for entire period of record for TG River gage
  - Diverted or captured flow data?
  - Flow data for TJ River upstream of international border
  - Flow data for Stewart's Drain
  - WW dischargers

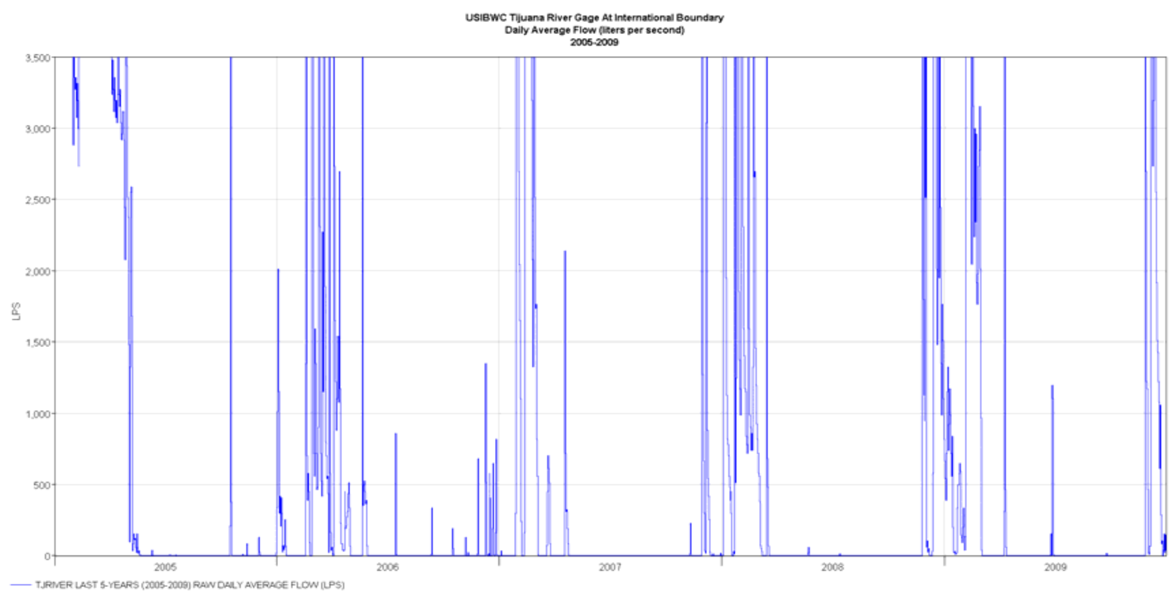


Task 1 – Review of Existing Documents and Transboundary Flow Analysis

- Submit questionnaire to stakeholders to develop estimate of number of undocumented operational failures
  - System operators
  - USEPA
  - USIBWC
  - CILA
  - CONAGUA
  - CESPT

Task 1 – Review of Existing Documents and Transboundary Flow Analysis

- Evaluate flow data and develop flow frequency curve for most recent 5-year period of record using HEC-DSSVue 2.0.1
- Develop relationships between river flow, total volume of uncontrolled transboundary river flows, and precipitation time series and known diversion operational failures
- Identify if any transboundary flows occurred under low-flow (under 1,000 l/s) conditions and no identified operational failure. May indicate unaccounted for operational failures.
- Apply relationships to estimate annual probability of occurrence and number of days of transboundary flows under low-flow (under 1,000 l/s) and higher-flow (up to 3,000 l/s) conditions due to operational failure, including non-operation

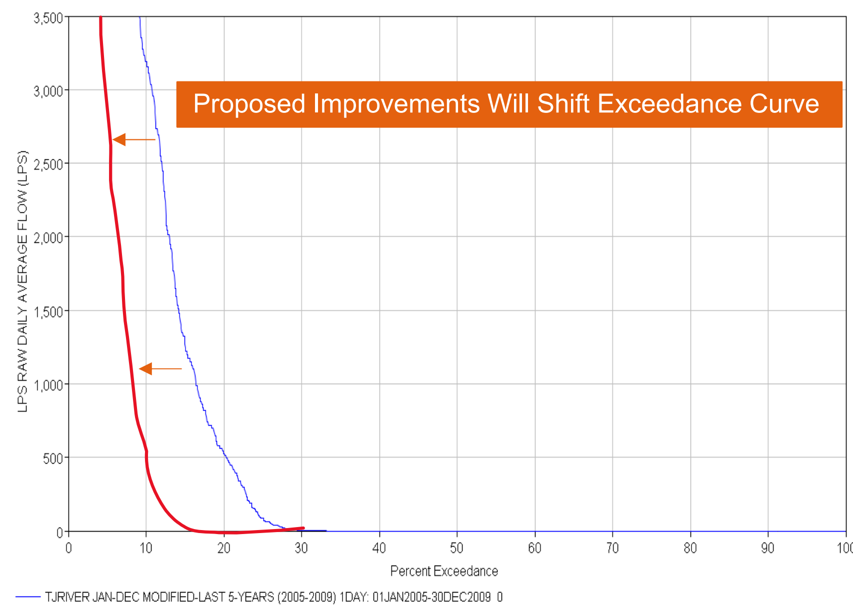


Task 1 – Review of Existing Documents and Transboundary Flow Analysis

- Examine documentation of diversion operational failures to:
  - Develop distributions of causes of failure
  - Determine annual probabilities of failure by cause and by flow rate
  - Determine the reliability of different system components of the diversion system and dependable capacity relative to nominal or "theoretical" capacity
- Apply operational failure relationships to estimate number of expected failure events under baseline (no action) conditions over a 20-year planning period assuming either
  - Historical Tijuana River flows for a 20-year or longer period of record
  - Stochastically-generated flows over a 20-year planning period

Task 1 – Review of Existing Documents and Transboundary Flow Analysis

- Develop baseline statistical relationships to develop similar statistical relationships of transboundary flows that would have occurred over a 5-year period under the following hypothetical scenarios.
  - If the existing infrastructure had no failures
  - If the existing infrastructure were operated at the full capacity of 1,300 l/s
  - If the existing infrastructure were expanded to 1,500 l/s
  - If the existing infrastructure were expanded to 2,000 l/s
  - If the existing infrastructure were expanded to 3,000 l/s
- Determine frequency and source of dry weather flows in Stewart's Drain



ARCADIS Design & Consultancy for natural and built assets

Task 2 – Infrastructure and Operations Diagnostic

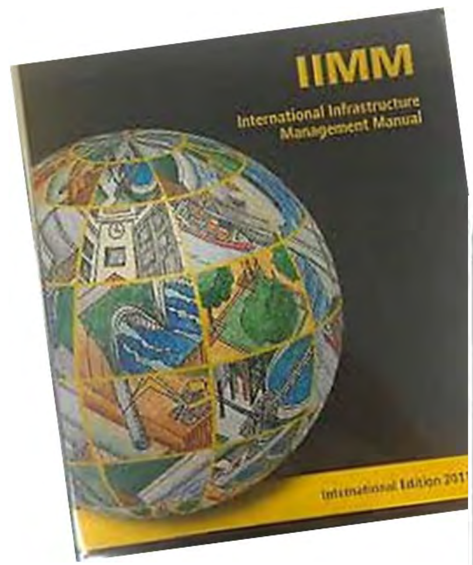
Determining Condition

- What is Condition?

  “The state of something, especially with regard to its appearance, quality or working order” – Oxford Dictionary

- For Capital Planning Purposes, condition is evaluated in two parts:
  - Physical Condition – current state of repair
  - Performance Condition – ability to deliver required service
- Physical and Performance Field Assessments
  - Utilizing AssetHound on supplied tablets
  - Through site visits and data review
  - Assessors will establish condition scores in accordance with the established guideline document: the International Infrastructure Management Manual (IIMM).

Diagnostic Methodology



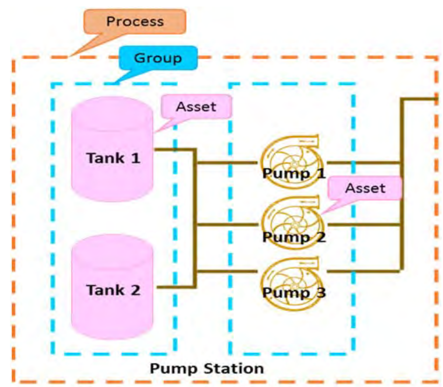
Rank	Description of Condition
1	**Very Good Condition** Only normal maintenance required
2	**Minor Defects Only** Minor maintenance required (5%)
3	**Maintenance Required to Return to Accepted Level of Service** Significant maintenance required (10-20%)
4	**Requires Renewal** Significant renewal/upgrade required (20-40%)
5	**Asset Unserviceable** Over 50% of asset requires replacement

Figure 3.3.4: Condition Rating Model

Task 2 – Infrastructure and Operations Diagnostic

Visual Diagnostic Criteria and Scoring Approach

Example Diagnostic Approach



Examples of Asset to receive and Asset Level Diagnostic include:

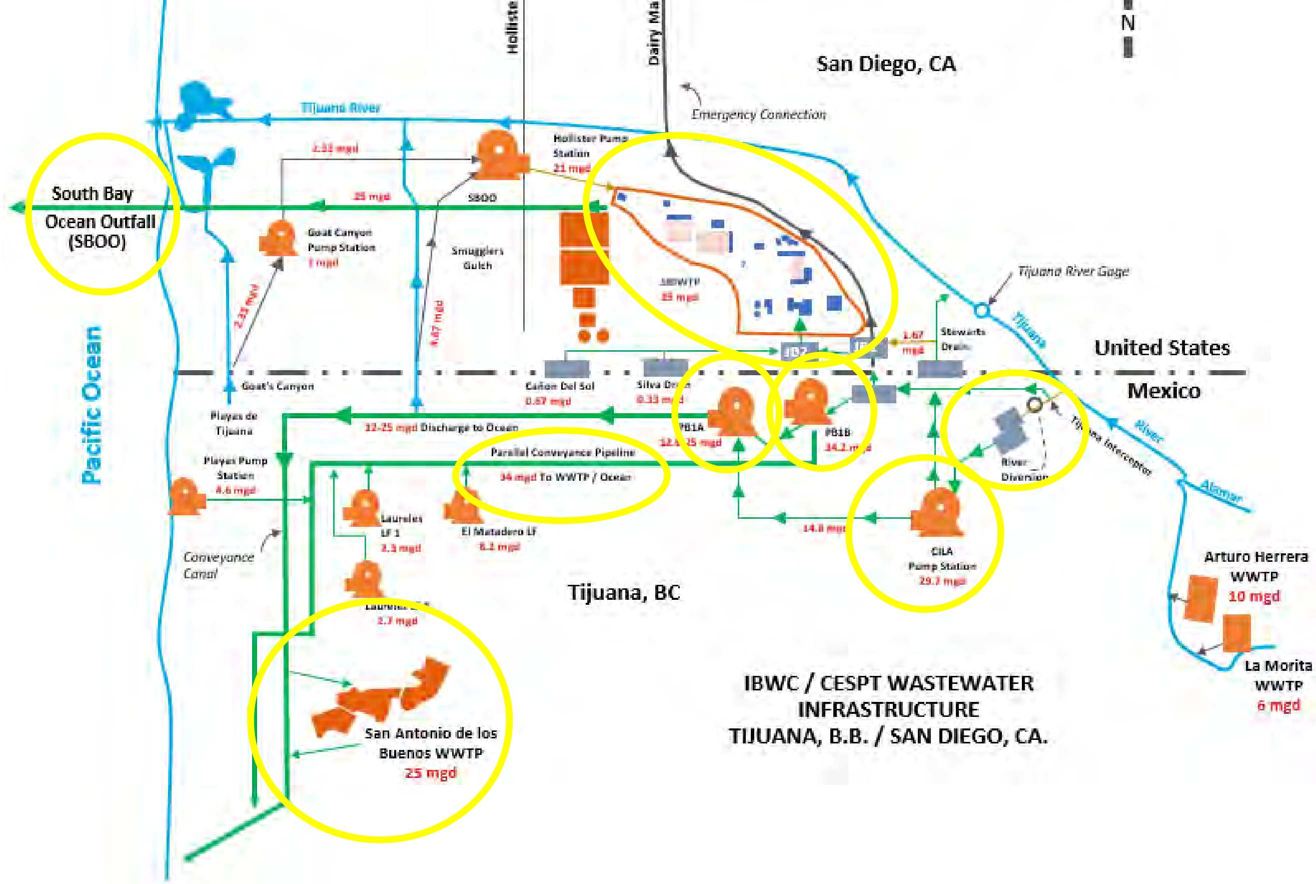
- Valves = > 18”, and all actuated valves
- Motors/Drives > 50 HP
- Pumps, process equipment
- Buildings, tanks, process structures.

Items Not Assessed

- Architectural items
- Building lighting & plumbing
- Computer equipment
- Elevators
- Employee facilities
- Fleet vehicles
- Furnishings and Furniture
- Laboratory equipment
- Maintenance equipment
- Portable equipment
- Spare parts
- Underground & Buried items

Task 2 – Infrastructure and Operations Diagnostic

Conducting Condition Diagnostics



Sites:

1. SBIWTP
2. South Bay Ocean Outfall
3. Primary Effluent Return Connection (PERC)
4. PBCILA
5. PBCILA intake
6. PB1A
7. PB1B
8. International Collector (Gravity Line)
9. PBCILA force main
10. SAB WWTP
11. Parallel Ocean Outfall system (MX)
12. River Diversion

Task 2 – Infrastructure and Operations Diagnostic

Evaluating Consequence of Failure (CoF)

- What is Consequence?

  "The result or effect of an action or event" – Oxford Dictionary

- For Capital Planning Purposes, the CoF is expressed in Triple Bottom Line (TBL) terms and evaluated in 3 parts:

  Economic
  - Direct cost to repair
  - Additional O&M impacts

  Social
  - Level of Service Delivery (loss of capacity, odors, etc.)
  - Health & Safety (employee and public)

  Environmental
  - Regulatory compliance
  - Impacts to environmentally sensitive areas

Analysis in support of Task 3

- Based on the results of the diagnostics, a risk assessment will evaluate the asset's impact and a prioritized list of recommendations will be developed in a decision matrix to support the overall effort.

			Condition Data							Data Analysis/Asset Valuation									Condition Scoring from Tablets (AssetHound)												
Process	Asset Group	Install Year	Asset Description	Capacity	Manufacturer	Model Number	Serial Number	Motor Details	Photo Number	Age	EUL	RUL	Adjust Facor	Updated EUL	RY 1ST CYCLE	RY 13-17	Replacement Cost	Replacement Cost Source	Damage	Foundation Settling	Appurtenances	Roofs	Doors/ Hatches	Heat	Corrosion	Electrical Damage	Environment	Support / Anchors	Corrosion	Leakage	Vibration/Noise
Electrical	HVAC	2001	Heater	208/240V /	Dayton	3UF79			5841	12	17	5	1.2	17	2018		$500.00	Grainger													
Electrical	HVAC	2001	Exhaust Fa	1750RPM	McMillen	BDGE12			5838	12	17	5	1.2	17	2018		$200.00	Grainger													
Electrical	Electric	2001	Transforme	15KVA/H.V.	Square D	15540F			5835	12	25	13	1	25	2026		$2,750.00	TOHO						1	2	1	1	1			
Electrical	Instrum	2001	Control Panel 8		Systems East				5840	12	16	4	1.3	16	2017	$27,300.00	$13,650.00	TOHO						1	1	1	1	1			
Electrical	Instrum	2012	SCADA Panel		Allen Bradley	Micro Logix			5839	1	15	14	1	15	2027		$13,950.00	TOHO						1	1	1	1	1			
Electrical	Electric	2001	Breaker Pa	100A, 480/2	Square D	NF	12-141838	CAT 12-148	5836	12	17	5	1.3	17	2018		$6,850.00	TOHO						1	1	1	1	1			
Electrical	Electric	2001	Low Voltag	120/240V /	Square D			CAT NQOD	5837	12	17	5	1.2	20	2021		$13,950.00	TOHO						1	2	1	1	1			
Electrical	Electric	2001	Manual Tra	60A/600VA	SEIMENS				5834	12	25	13	1.2	30	2031		$15,000.00	TOHO						1	1	1	1	1			
Electrical	Electric	2005	Main Power Disconnec		Siemens					8	17	9	1.2	17	2022		$13,950.00	TOHO						1	1	1	1	1			
Electrical	HVAC	2005	Exhaust Fa	1550RPM,	Dayton	2C713B	926876		5825	8	17	9	1	17	2022		$200.00	Grainger													
Electrical	HVAC	2000	Exhaust Fa	1700RPM	BREIDERT	MODBDGE16		MARITHON	5777	13	17	4	1.3	17	2017	$400.00	$200.00	Grainger													
Electrical	HVAC	2000	Heater		Dayton				5776	13	17	4	1.3	22	2022		$500.00	Grainger													
Electrical	Electric	2002	Transforme	25KVA, 240	Square D	25S3H			5789	11	25	14	1.2	25	2027		$2,750.00	TOHO						1	1	1	1	1			
Electrical	Instrum	2011	Scada Panel						5783	2	15	13	1	15	2026		$13,950.00	TOHO						1	2	1	1	1			
Electrical	Electric	2000	Disconnect	480V/100A	Square D				5812	13	17	4	1.3	17	2017	$10,300.00	$5,150.00	TOHO						1	1	1	1	-			
Electrical	Electric	2002	Auto Transf	50KW/100A	Cummins/	OTPCA-556	F020380518		5787	11	20	9	1.3	20	2022		$6,100.00	TOHO						1	1	1	1	1			

Task 3 – Alternatives Analysis

1. No action

2. **(2a)** Optimize existing facilities with minor physical improvements or operational modifications for dry-weather flows, reducing the number of flow events (1,000 to 1,300 L/s)
3. **(2b)** Optimize of existing facilities with physical improvements or operational modifications to have PBCILA with minimum down time, including silt removal, wet well clean-up and equipment protection
4. **(2c)** Optimize of existing facilities with improvements or operational modifications for PBCILA reach a 2,000 L/S capacity, no capacity increase and consideration of higher volumes of silt and grit for removal

Optimize existing facilities

5. **(3a-i)** A new diversion box and conveyance infrastructure in Mexico, including expanding intake structure and pump capacity expansion at PBCILA
6. **(3a-ii)** Expansion of the forcemain from PBCILA to PB1A
7. **(3a-iii)** Expansion of PB1A and or PB1B with emergency backup power

New capacity to capture Tijuana River flows in US

Increase capacity to capture Tijuana River flows in MX

8. **(3b-i)** New diversion box upstream of the border and conveyance/pumping systems
9. **(3b-ii)** Reducing the volumes of flows currently reaching the river by reuse or infiltration of WWTP effluent

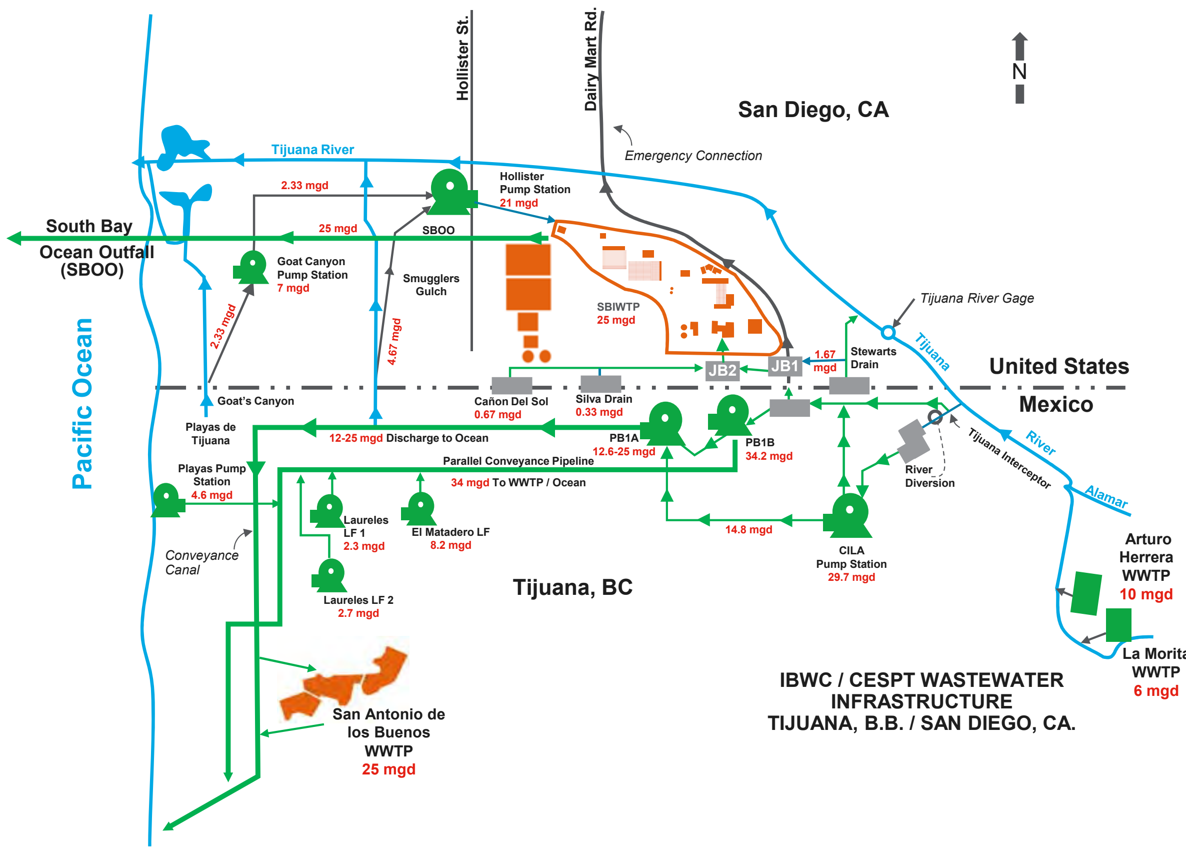
10. **(4a)** New infrastructure to convey transboundary flows to the SBOO without treatment
11. **(4b)** New infrastructure to convey transboundary flows to the SBOO with primary level treatment at SBIWTP
12. **(4c)** New infrastructure to convey transboundary flows to the SBOO with secondary level treatment at SBIWTP
13. **(4d)** New infrastructure to convey transboundary flows for treatment at Point Loma WWTP
14. **(4e)** New or existing infrastructure (usage of the PERC) to convey transboundary flows back to Tijuana without additional treatment, including any necessary upgrades to PB1A

15. **(5)** Combined Alternative in both or either US and Mexico

No Action

No infrastructure improvements

Rain events will continue to bring a mix of storm and wastewater as transboundary flows which continue to discharge to the Pacific Ocean, beach closure will continue to occur as a result from the rain events.

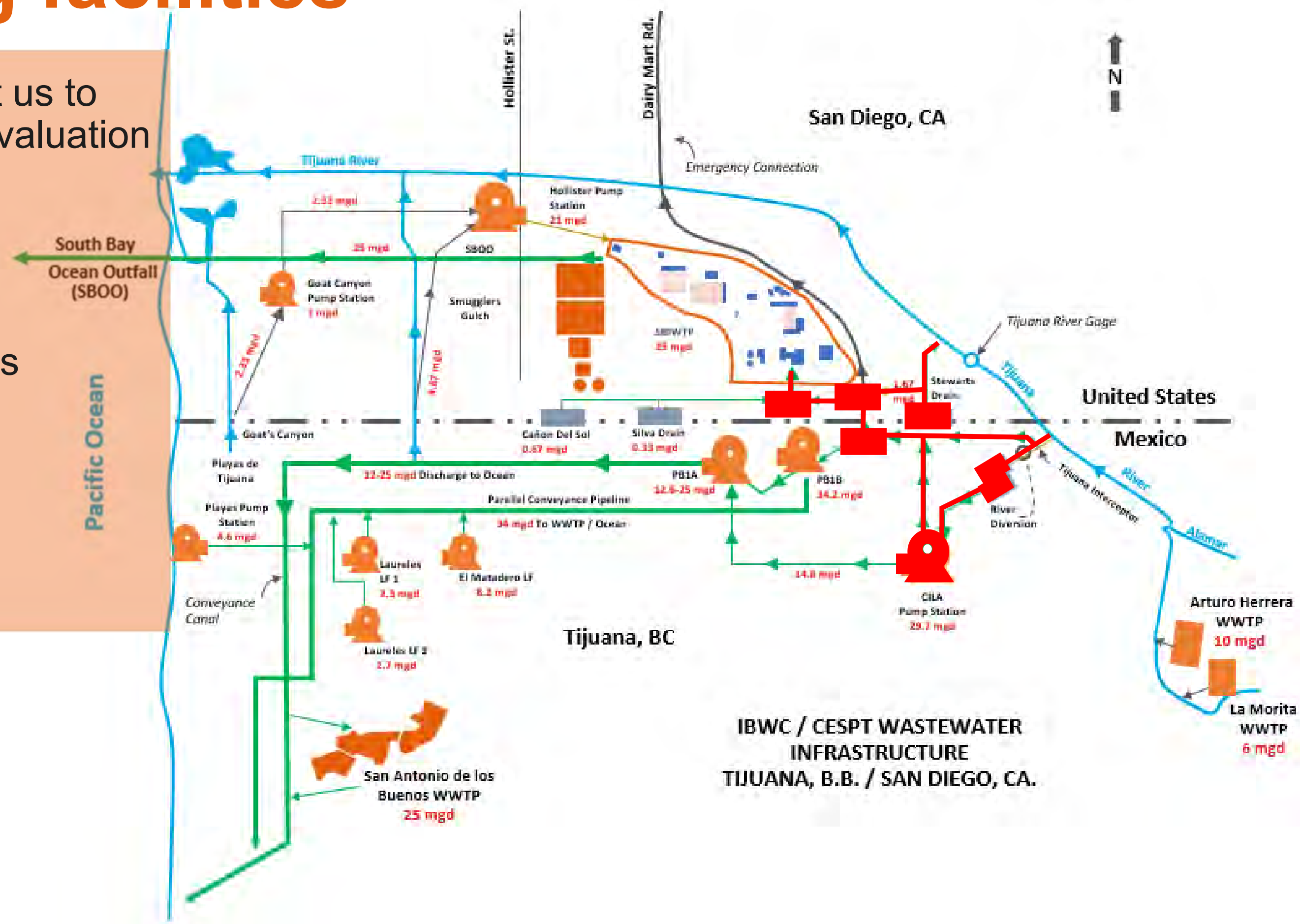


Notes:
1. Pump station flows are maximum pumping capacities.
2. Pipeline and WWTP flows are average daily flows.
3. U.S. Canyon connector flows are average design flows.

Optimize existing facilities

Transboundary flow analysis will permit us to understand flow captures by PBCILA, evaluation includes:

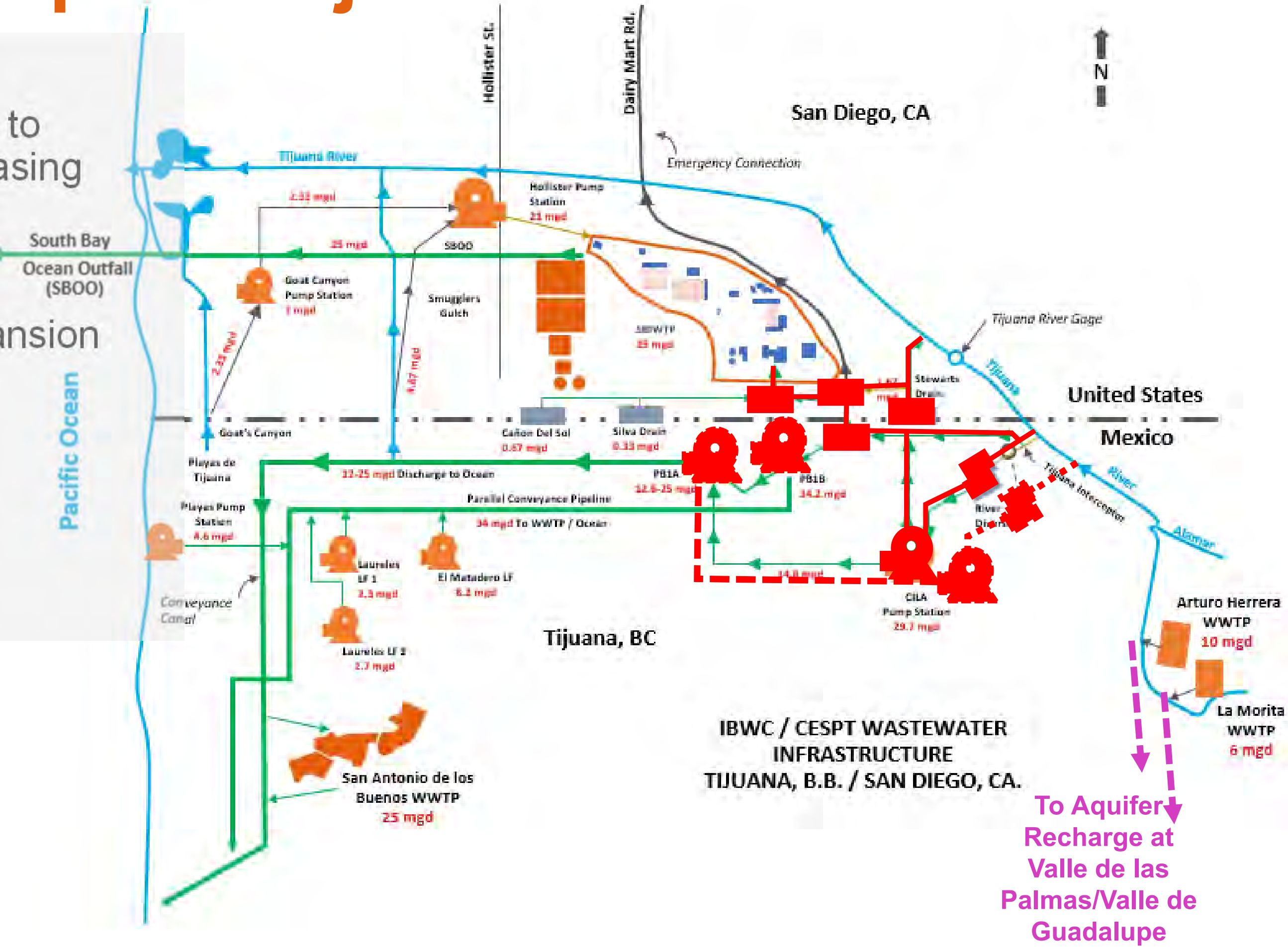
- TJ Interceptor
- PBCILA1
- JB1 and JB2 and associated pipelines
- Intakes to TJ Interceptor
- Intake at Stewards Drain
- Flow events (1,000 to 1,300 lps)
- 2,000 lps capacity at PBCILA



Increase capacity: capture Tijuana River flows in MX

Transboundary flow analysis will permit us to understand flow captures by PBCILA increasing the system's capacity, evaluation includes:

- Gravity pipeline discharging to PBCILA
- Intake structure and pump capacity expansion at PBCILA
- Forcemain from PBCILA to PB1A
- Expansion of PB1A and or PB1B with emergency backup power



Increase capacity: capture Tijuana River flows in MX

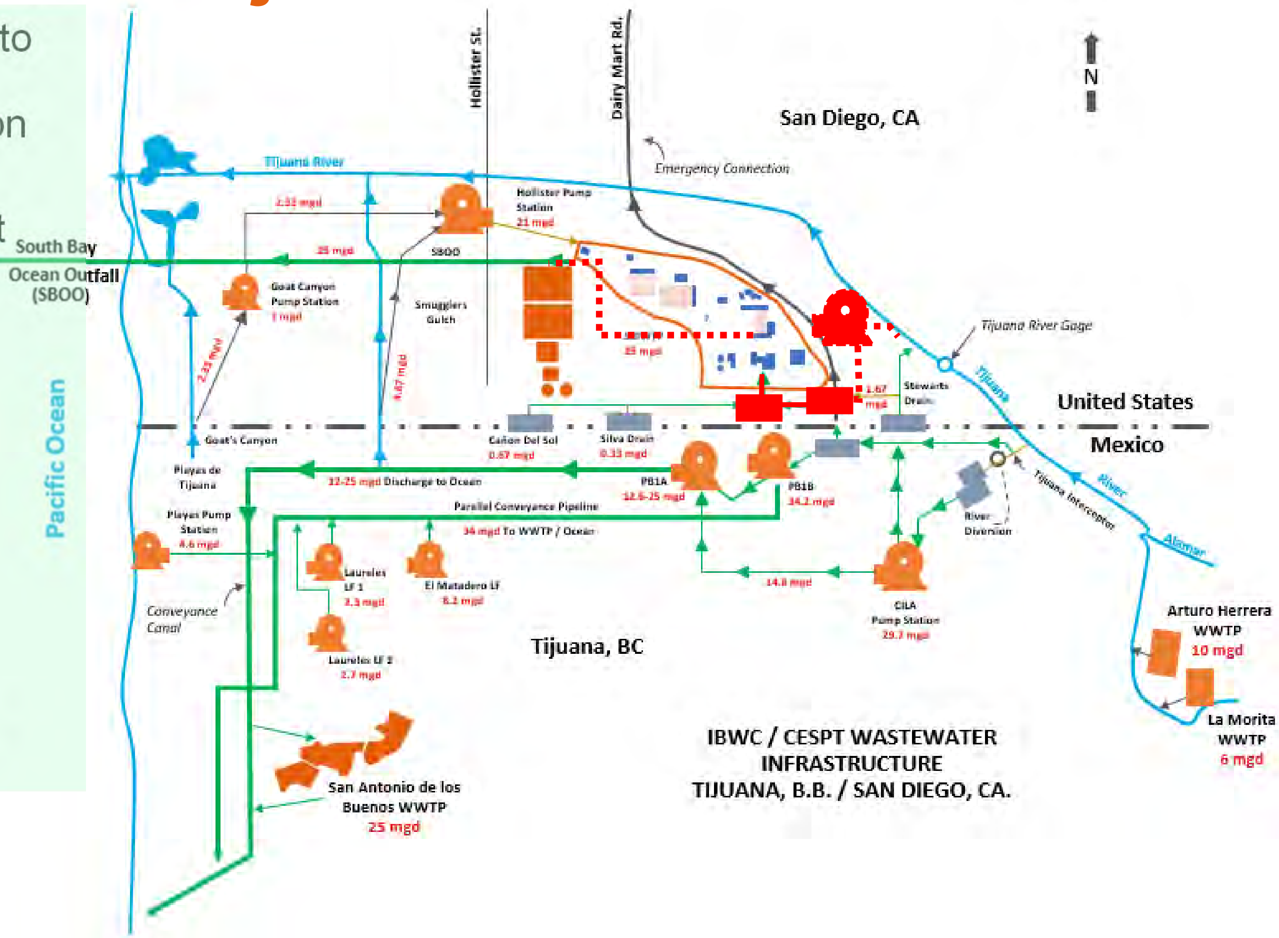
Options will also be evaluating:

- Inflatable Rubber Dam in one or more locations of the Tijuana River lining, upstream of the border crossing:
  - Temporarily store collected small stormwater flows to diminish the peaks
  - PBCILA will pump the flows with more time, requiring small physical improvements or modifications

New capacity: capture Tijuana River flows in US

Transboundary flow analysis will permit us to understand flow to be captured by a new pumping and conveyance system, evaluation includes:

- Gravity pipeline discharging to a new Lift Station in the US side
- Intake structure
- New Forcemain to JB1
- New tie-in to JB1
- Improvements to JB1 and JB2
- PERC rehabilitation
- New junction box JB3
- Improvements of PB1A with emergency backup power

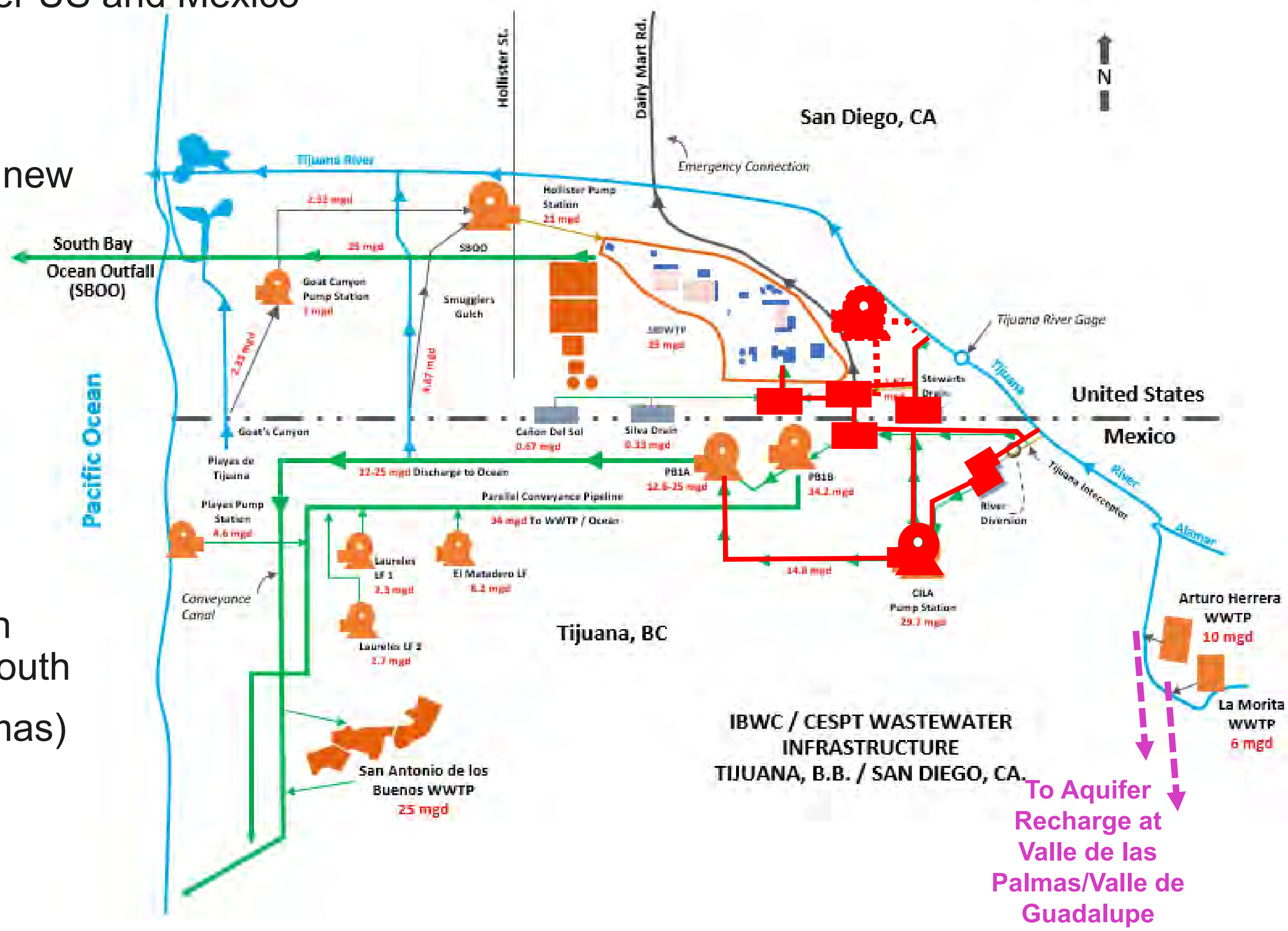


Combined Alternative

Combined Alternative in both or either US and Mexico

New Infrastructure includes:

- Gravity pipeline discharging to a new Lift Station in the US side
- Intake structure
- New Forcemain to JB1
- New tie-in to JB1
- Improvements to JB1 and JB2
- New reclaim pipeline system, Approximately 80 kms (50 miles)
- New Lift Station at low a elevation point to carry WWTP discharge south
- Infiltration zone (Valle de las Palmas)



Task 3 – Decision Matrix

- Defining the Parameters:
  - Reduction of beach day closure
  - Jurisdictional Control
  - Cost
  - Operational flexibility
  - Regulatory/Institutional Complexity
  - Public Perception
- Prioritize the Decision Criteria
- Scoring the alternatives relative to Decision Criteria
- Ranking Alternatives

Task 3 – Decision Matrix

Decision Criteria	Cost		Jurisdictional Control		Water Credits		Operational Flexibility		Regulatory/ Institutional Complexity		Water Supply Flexibility		Public Perception	
1A: Spreading Basin Recharge by SPA	Always lowest cost	5	• All City-owned	5	• No loss of credits • 3% evaporation loss	4	• Most recharge facilities • Most WRFs	3	• Surface recharge permitting is routine • Most facilities to permit	3	• All water recharged can be recovered as potable	5	• Recharge of aquifer may be viewed as more sustainable • Public contact with reclaimed water is minimized	5
1B: "Injection" Recharge by SPA	Always highest cost, except if no additional treatment needed	3	• All City-owned	5	• No loss of credits	5	• Most recharge facilities • Most WRFs	3	• May be difficult to permit if injecting into the aquifer • Most facilities to permit	1	• All water recharged can be recovered as potable	5	• Recharge of aquifer may be viewed as more sustainable • Public contact with reclaimed water is minimized	5
1C: Spreading Basin Recharge by Combining SPAs	Always lowest cost	5	• All City-owned	5	• No loss of credits • 3% evaporation loss	4	• Fewer recharge facilities	2	• Surface recharge permitting is routine • Fewer facilities to permit	4	• All water recharged can be recovered as potable	5	• Recharge of aquifer may be viewed as more sustainable • Public contact with reclaimed water is minimized	5
1D: "Injection" Recharge by Combining SPAs	Always highest cost, except if no additional treatment needed	3	• All City-owned	5	• No loss of credits	5	• Fewer recharge facilities	2	• May be difficult to permit if injecting into the aquifer • Fewer facilities to permit	2	• All water recharged can be recovered as potable	5	• Recharge of aquifer may be viewed as more sustainable • Public contact with reclaimed water is minimized	5
2A: Regional Recharge at Hieroglyphics and Agua Fria Linear Recharge Facilities	Always in lowest cost group	5	• All recharge conducted at facilities owned by others • Need to deal with two owners	2	• Portion of recharge outside of service area (less wet water) • Potential for loss of credits to CAGRD	2	• Fewer recharge facilities • Combined conveyance	2	• City not responsible for permitting • Cost/credit sharing agreement needed • Agreement with SROG needed	5	• All water recharged can be recovered as potable	5	• Recharge of aquifer may be viewed as more sustainable • Public contact with reclaimed water is minimized	5
2B: Regional Recharge at Hieroglyphics Recharge Facility	Always in lowest cost group	5	• All recharge conducted at facilities owned by others • Facility located in service area	3	• All recharge inside service area (more wet water) • Potential for greater loss of credits to CAGRD	1	• Least recharge facilities • Most Combined conveyance	1	• City not responsible for permitting • Cost/credit sharing agreement needed	5	• All water recharged can be recovered as potable	5	• Recharge of aquifer may be viewed as more sustainable • Public contact with reclaimed water is minimized	5
3: Serve Largest Reuse Customers by SPA	Always at mid-cost range	3	• All City-owned	5	• No loss of credits	5	• Most WRFs • Can't move water between SPAs	2	• Water reuse permit and administration needed • Most recharge facilities to permit • Permitting dependent on recharge technology used	3	• Water recharged can be recovered as potable	3	• Public could question turf irrigation • Additional public outreach may be necessary to overcome potential negative perceptions • Less potential for public contact with reclaimed water	3
4: Maximize Direct Reuse by SPA	Always in lowest cost group	5	• All City-owned	5	• No loss of credits	5	• Most WRFs • Can't move water between SPAs • More customers to accept water	2	• Water reuse permit and more administration needed • Most recharge facilities to permit • Lower recharge volumes may facilitate permitting process • Permitting dependent on recharge technology used	3	• Less water recharged that can be recovered as potable	1	• Public could question turf irrigation • Additional public outreach may be necessary to overcome potential negative perceptions • More potential for public contact with reclaimed water	2

Task 4 – Project Management and Stakeholder Coordination

Effective Project Management Arrangements

To Program	To Quality	To Budget
Experienced National + Local Team	National Experienced TAs	Efficient use of Experienced Team and Local Resources + TJ Partner
Development of detailed brief	Development of a detailed work breakdown	Rigorous change control procedures
Implement Binational Core Group Scope of Services	4-eye review of external document	Monthly reporting against Scope of Services

Project Schedule

Tasks & Deliverable	Date
Kick off meeting	05/09/18
30% Progress deliverable	***07/05/18***
30% Review and presentation	07/12/18
60% Progress deliverable	09/06/18
60% Review and presentation	09/13/2018
First draft report	10/26/2018
First draft report review and presentation	11/08/2018
Final report	11/29/2018
Final report review and presentation	12/12/18

Next Steps

- Request for information to each entity point of contact
- Stakeholders Coordination Meeting: May 17th
- Interview Stakeholders – setup time and date with each
- Begin Task 1 and Task 2
- Task 4 ongoing from today on
- Perform site visits and condition assessments

Next Steps

Anticipated Deliverables for Each Delivery Level				
Deliverables	**30% Delivery**	**60% Delivery**	**Draft Report**	**Final Report**
Meeting Coordination	•	•	•	•
Progress Presentation	•	•	•	•
Document Review & Data collection Findings	•	•	•	•
Draft Results of Task 1 – Task 2	•			
Proposed Decision-Making Criteria/Methodology	•		•	•
Applied Decision-Making Criteria Matrix/Methodology		•	•	•
Alternatives Identification & Initial Analysis	•	•	•	•
Final Results of Task 1 – Task 2		•	•	•
Alternative In-depth Analysis		•	•	•
Cost (capital, O&M) Estimates		•	•	•
Progress Summary	•	•	•	•
Draft Diagnostic Results and Recommendations			•	•
Final Diagnostic Results and Recommendations				•

Questions/Discussion

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