WorleyParsons
resources & energy

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08 June 2018

Proj. No.: 308010-00159

Gregory Harris
Herwit Engineering
6200 Center Street
Suite 310,
Clayton, CA 945117

Dear Mr. Harris:

Re: Sanitary Outfall Assessment for the Town of Discovery Bay

1. Introduction

Herwit Engineering (Herwit), on behalf of the Town of Discovery Bay California (TDBC), has requested WorleyParsons Group Inc. (WorleyParsons) to complete an assessment of their sanitary outfall (outfall). The outfall is used to discharge treated effluent from the TDBC wastewater treatment plant into the Old River and in past years has experienced diminishing discharge capacity. In addition, concerns have been raised that discharge pumping capacity of the plant has been reduced; this may be due to plugged sections of the outfall and/or reduced capacity of the pumps.

The following assessment includes an evaluation of the outfall existing conditions, a review of the system hydraulics, site investigations including closed circuit television (CCTV) camera inspection, a review of underwater surveys, and recommendations for upgrades/repair measures.

2. Background Information

2.1 Project Site

The project sanitary outfall is located in eastern Contra Costa County, California about 60 miles from San Francisco, in a section of the Old River flanked by earthen levees. The site is located adjacent to the west levee (left river bank) and south of the Contra Costa Water District (CCWD) Los Vaqueros Pump Station. Based on the Kleinfelder Inc. geotechnical report (2004), the Old River at the site location has the following tidal water level fluctuations and information:

- 100-year Flood Elevation – 7.5 feet (ft.)
- Mean High Water Elevation – 2.4 ft.
- Mean Higher High-Water Elevation – 3.5 ft.

- Mean Lower Low Water Elevation – -0.5 ft.
- Extreme Low Water Elevation – -2.0 ft.
- Flow velocity – 3 to 4 ft./s

2.2 Original Design Specifications

The existing outfall diffuser is comprised of a multi-port diffuser system developed by Flow Science Inc., as noted in their Dye Study (December 2002).

The outfall concept (Komex 2004a, Komex 2004b) approved by the Regional Water Quality Control Board (RWQCB), consisted of the following:

- Total outfall length 228.5 feet (actual pipe length from the levee connection point);
- HDPE Pipe Diffuser length 123 ft. including concentric reducer length;
- Outfall diameter 18 inches (in.), 10 in., and 6 in.;
- Number of diffuser ports 36;
- Port spacing average of 3 feet between ports; and
- Port diameter 2 in. Series 35 Longneck Tideflex Valve

2.3 Previous Site Investigations - 2013 Underwater Survey

On May 15, 2013, Bishop Diving & Salvage completed an underwater visual inspection of the outfall including 123 ft. of HDPE pipe comprised of 18 in., 10 in. and 6 in. pipeline segments. The result of the inspection revealed that, out of the 36 diffuser ports, 2 of them were missing and no flow (except for one port) was observed in the 6-in. pipeline segment (16.5 ft. long).

3. Site visit

On December 7, 2017, WorleyParsons representatives visited the site to inspect the outfall condition. The site activities included visual inspection of the outfall (above water) and a CCTV camera inspection completed by Subtronic Corporation.

From the visual inspection, no damage of the outfall was observed above water, and no erosion along the bank slope existed. Good vegetation growth was observed next to the outfall along the bank slope as shown in Photo A.

Photo A **Old River West Bank (looking NW)**

Due to reduced clearance at the entrance point (opening at the removed Harris syphon breaker) (Photo A) the CCTV camera inspection was completed and televised using a push/rod reel with self leveling color camera and footage counter. The inspection did not reveal significant obstruction of the 18 in HDPE segment (70 ft.), except for algae growth along the walls of the pipe. Similar to the 18 in segment, algae growth was observed in the 10 in HDPE segment (30.5 ft.). At approximately 152 ft. (station 0+190 ft., C2 diffuser design drawing, Komex 2004a) the CCTV camera experienced a blockage in the 10" segment and was not able to proceed further into the pipe. As a result, no footage was recorded beyond this point. No details of the 6 in HDPE segment were obtained. It is assumed that this segment may be partially or fully obstructed (with reduced flow capacity) as described in the 2013 and 2017 (section below) underwater survey. Video files CCTV camera inspection were mailed to TDBC and Herwit.

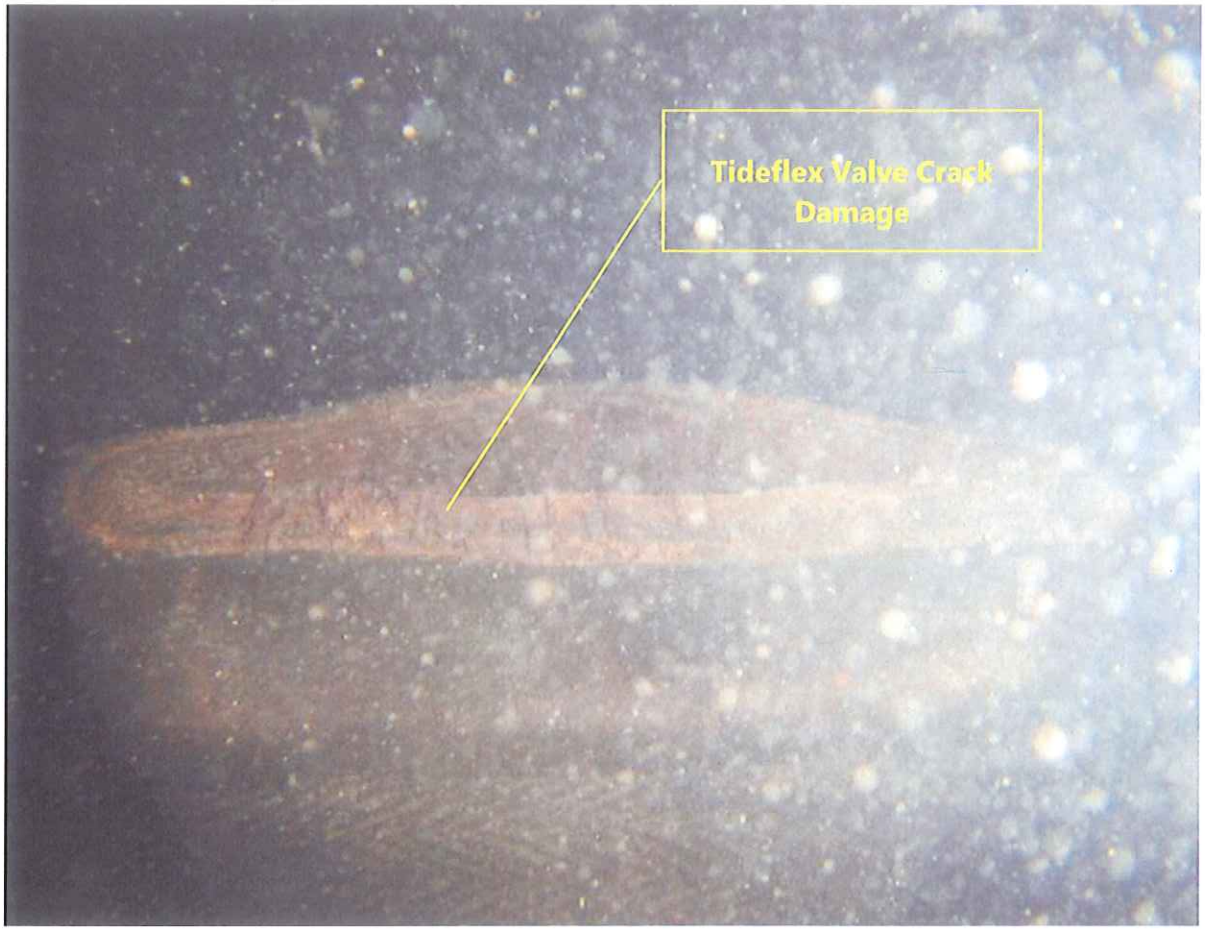
Also, as part of the site visit, a pump test was completed for all of the five vertical turbine pumps (Photo B) at the wastewater treatment plant. The test procedure was to allow the lift station sump to fill to its volume capacity and then activate the pumps to its maximum flow. Recordings were made for approximately 5 to 10 minutes obtaining reading from the flow meter and pressure head for the pump gauges. It is important to note that one of the pump gauges (first pump from north to south) was not operating, so readings were obtained for 4 out of the 5 lift station pumps. The result of the pump test indicated an average flow of 3.11 MGPD for an approximate pumping head of 20 psi gauge (psig).

Photo B **Discovery Bay Community Service District Sewage Treatment Plant Export Pump Station**

4. 2017 Underwater Inspection

On December 2, 2017, Bishop Diving & Salvage completed an updated underwater survey of the outfall including 123 ft. of HDPE pipe (comprised of 18 in., 10 in. and 6 in. pipeline segments). The inspection showed similar outcomes to the 2013 survey, with 2 out of the 36 ports missing and no flow observed in the 6 in pipeline segment (16.5 ft. long). Also, some of the Tideflex valves appeared to have cracks and may not be sealing properly, therefore allowing for outside sediments into the diffuser (see Photo C). These results confirmed the observations of the CCTV camera inspection, which inferred a partial blockage at the downstream end of the 10-in. segment (weak flow out of port 28) and a complete blockage of the 6-in. segment (with no flow observed out of port 31-36).

Photo C Discovery Bay Outfall Diffuser - Tideflex Valve Showing Crack Damage at its Opening



5. Review of the Hydraulics of the Outfall and Pumping System

A hydraulics assessment of the TDBC pressurized effluent system has been completed. This assessment included the lift station (five vertical turbine pumps), 4079 ft. of conveyance pipe (Steel 16 in. Pipe Schedule 40) and the Old River outfall diffuser (36 discharge ports). The configuration of the system was based on the Herwit Engineering design drawings (2004a) for the Sewage Treatment Plan Export Pump Station, the Herwit Engineering Sewage Treatment Plant Export Pipeline Project design drawings (2004b) and the Komex 18 in. Sanitary Sewer Outfall Old River design drawings (2004a).

The hydraulic assessment was based on industry standard calculation methods, using a derivation of the Colebrook-White equation to define the Darcy Weisbach friction factors of the system relative roughness and associated Reynold's number. Head loss and fitting losses were calculated based on the derived friction factors and fitting loss coefficients. The system hydraulics were based on an aged pipeline system with a roughness of 3mm and river water EL 1.00 ft.

To simulate the results of the pumping test, the recorded flow of 3.11 MGPD (Mega Gallons per day) was used though the system and compared to recorded pumping head of approximately 19.9 psig (45.9 ft.). The assessment indicated that for a flow of 3.11 MGPD, the head losses though the system would require a pumping head of 14.6 psi (33.6 ft.). These results indicate that the current system has increased head losses and therefore the lift station has to operate at a higher pumping head to convey the flow through the system. The higher-pressure head required is a result of additional losses encountered by flow being channeled through a lower number of diffusers which increases the jet velocity and the loss at each Tideflex valve. As expected, these head losses may be attributed to the obstruction observed in the outfall diffuser.

6. Proposed Outfall Upgrade/Repair Options

Four proposed upgrade/repair options are presented for the TDBC outfall. These options include removal/replacement and abandoning/replacement of the existing HDPE sections of the diffuser. These options also include using the existing diffuser concept of 36 ports or using a new design of 3-5 ports. In addition, all options may include a flush system for periodic cleaning of the diffuser, with either a return line for disposal of flushed material onshore or with direct discharge into the river (no return line). The flush system will involve the installation of ball valves equipped with pneumatic actuators at each of the diffuser ports, and an air line to activate them. Also, the system will include a downstream discharge ball valve (6 in.) equipped with a pneumatic actuator (with a separate air line for activation) and an alternative 6 in. return line for discharge onshore. A portable air compressor can be connected to the air manifold (installed onshore) to supply air and activate the various valves for periodic maintenance cleaning. Actuators for the valves would be specified as normally open (NO) for the diffuser port valves and normally closed (NC) for the flush valve in absence of pressurized air.

It is important to note that since all options presented will include some level of disturbance of the site during the implementation of the repairs/upgrades, some regulatory requirements may be triggered as presented in Section 7.

Details for the proposed options are provided below.

6.1 Option 1

Option 1 includes removal of the diffuser HDPE segments (123 ft. of pipeline comprised of 18 in., 10 in., and 6 in. diameter sections) and replacement with a similar HDPE diffuser design with 36 ports. Installation work may include the following:

- removal of the HDPE pipeline;
- new pipe installation;
- trench excavation;
- grading of the river bed (fill trench with granular material) per original design. An alternative option to the trench installation is to install of an articulated concrete block matt ACBM).

Pros

- Will not require additional dispersion modelling or a new diffuser design;
- Since no design is required, the interim approved NPDES permit may not involve an update or review from the Regional Water Quality Control Board, Region 5, Central Valley (RWQCB5); and
- the California State Lands Commission Lease (CSLC) would not be affected because the new project footprint can be accommodated in the existing lease. However, if the ACBM is used in lieu of grading and backfilling the riverbed, the CLSC lease may need to be renegotiated.

Cons

- this option will involve disturbance of the outfall area and may require additional work to install as the current outfall will need to be removed;
- also, this option may involve similar obstruction damage as the current outfall due to its numerous port/different pipe diameters. However, if a periodic maintenance program is incorporated and flushing system installed, obstruction for this design can be reduced; and
- may require a more frequent maintenance program compared to options 2 and 3.

6.2 Option 2

Option 2 will involve removal of the HDPE segments (123 ft.) of the diffuser and replacement with a single HDPE pipe diameter (e.g. 18 in.) and 3-5 discharge ports. Tasks associated with this option will include the following:

- preparation of a dispersion model and the design of a new diffuser with reduced discharge ports.
- removal of the HDPE pipeline;
- trench excavation;
- new pipe installation
- grading of the river bed (fill trench with granular material) per original design (an alternative option to the trench installation is to install an ACBM).

Pros

- Due to its reduced ports and single pipe diameter this option may require less maintenance and may lower the chances of obstruction damage; and

- the CSLC lease would not be affected because the new project footprint can be accommodated in the existing lease. However, if the ACBM is used in lieu of grading and backfilling the riverbed, the CLSC lease may need to be renegotiated.

Cons

- this option will involve disturbance of the outfall area and may require additional work to install as the current outfall will need to be removed;
- will require additional dispersion modelling and a new diffuser design.

6.3 Option 3

Option 3 involves abandonment of the diffuser HDPE segments (123 ft.) and replacement with a new diffuser design installed on top of it (at river bed level). Tasks associated with this option will include the following:

- preparation of a dispersion model and the design of a new diffuser with reduced discharge ports;
- abandonment of the HDPE pipeline;
- removal of existing ports;
- grading of the river bed;
- installation of an articulated concrete block matt;
- installation of new diffuser with reduce ports; and
- removal of a section of steel pipe, and anchoring.

Pros

- due to its reduced ports and single pipe diameter this option may require less maintenance and may lower the chances of obstruction damage;
- this option will require less disturbance of the outfall area and may result in easier installation; and
- this option will involve shorter ports compared to the original design therefore, allowing for sufficient water depth above it without restricting boating activities in the river.

Cons

- will require additional dispersion modelling and a new diffuser design; and
- use of the ACBM on the riverbed, may require the CLSC lease to be renegotiated.

6.4 Option 4

Option 4 includes removing the 10-inch and 6-inch HDPE segments and replacing them with an 18-inch spool of the same combined length. This will result in a structure with a constant 18-inch diameter throughout the entire length of the diffuser pipe body and with 36 ports similar to Option 1. Tasks associated with this option will include the following:

- preparation of a dispersion model;
- removal of the 10 in and 6 in sections of the HDPE pipeline;
- trench excavation
- new pipe installation; and
- grading of the river bed (fill trench with granular material) per original design. An alternative option to the trench installation is to install of an articulated concrete block matt ACBM).

Pros

- might have better longevity compared to Option 1; and
- the CSLC lease would not be affected because the new project footprint can be accommodated in the existing lease. However, if the ACBM is used in lieu of grading and backfilling the riverbed, the CLSC lease may need to be renegotiated.

Cons

- will require additional dispersion modelling and may require a new diffuser design;
- flow discharge along the 36 ports may not be uniform, unless it is calibrated at the upstream ports. Therefore, this option may not meet the design dilution requirements for copper and temperature as establish in the current NPDS permit approval.
- this option will involve disturbance of the outfall area and may require additional work to install as the current outfall will need to be removed;
- also, this option may involve similar obstruction damage as the current outfall due to its numerous ports. However, if a periodic maintenance program is incorporated and flushing system installed, obstruction for this design can be reduced;
- use of the ACBM on the riverbed, may require the CLSC lease to be renegotiated.
- may require a more frequent maintenance program compared to options 2 and 3; and
- this option will trigger several regulatory requirements, including approval by RWQCB5 as a condition of the NPDES permit.

6.5 Maintenance and Proposed Additional Upgrades

Improvements can be made to the outfall diffuser pipe that would facilitate maintenance and improve the operability of the diffuser between maintenance cycles. A periodic maintenance plan should be developed and implemented to prevent failure and reduce the need for extensive future repairs.

Maintenance-related upgrades should include a means of flushing sediment trapped within the diffuser as it impedes hydraulic performance and reduces dilution effectiveness. WorleyParsons recommends the installation of flushing valves at the upstream and downstream ends of the diffuser to facilitate flushing in one of two ways noted below. An upstream valve (or flange that can be blinded during maintenance) should be installed at the shoreline downstream of the existing Harris syphon breaker to isolate the conveyance pipeline to the plant.

1. **Flushing the system using pressurized treated effluent from the export pump station** – In this case the onshore valve would remain open to allow the typical flow through the diffuser from the export pipeline. Valves installed on the diffuser ports would be closed while the flush valve on the downstream end of the diffuser would be opened.

2. **Flushing the system using supplied compressed air or water from the Old River** – In this case the valve isolating the export pipeline would be closed. A small 2" valved connection to the pipeline downstream of the valve would be used to introduce air or water into the diffuser section. Port valves and downstream flushing valve would be operated similarly to case 1 above.

Depending on the option selected for upgrade / repair of the diffuser, the outlet flush valve would be installed on the downstream end of the diffuser and would include a 18x6 in. concentric reducer to connect to a proposed 6 in. ball valve with a pneumatic actuator as described in Section 6. The flush valve would be used to flush directly into the river, or be connected to a 6 in return line that would run parallel to the diffuser and bring the flushed water back on shore where it can be managed. The return line would be terminated onshore near the Harris syphon breaker and fitted with a locked camlock cap. When maintenance is being conducted, this will be removed to attach a temporary hose to discharge the flushed water to an acceptable location or attached to a tank for storage.

TDBC indicated that some of the tideflex riser pipes are being broken off or damaged. The damage may be attributable to recreational fishing boats that drop anchor near the diffuser to fish. Anchor lines may be snagging the tideflex risers and since the riser pipes contain a break-off groove, the risers are easily lost. Another source could be the large amount of submerged debris moving through the Old River which collides with the risers and break them off during periods of high flows. The debris flow contains logs, lumber, steel propane tanks, pieces of shipwrecks, as well as mats of semi-submerged vegetation, which easily snag the riser pipes and break them off. To prevent this damage a metal cage with small openings, could be used to protect the outfall diffuser along its entire length. The cage could be held in place by using concrete weights.

7. Regulatory Considerations for Proposed Upgrade/Repair Options

7.1 Existing Approvals

TDBC received the following regulatory approvals during initial construction of the outfall diffuser structure:

7.1.1 Mitigated Negative Declaration

Authority: California Environmental Quality Act.

TDBC filed a Mitigated Negative Declaration (MND), State Clearinghouse No. 2003072160, in support of their Discovery Bay Wastewater Treatment Plant Upgrade Project, which included completing two components of the system on land adjacent to the site: solar drying facilities, an export pump station, emergency storage lagoon, pipeline and outfall. The California State Lands Commission and the California Department of Fish & Wildlife reviewed the MND as responsible agencies and filed Notices of Determination indicating that the project will not have a significant effect on the environment and that mitigation measures were made as a condition to the project.

7.1.2 California State Lands Commission Lease

Authority: California Code of Regulations, Title 2, Chapter 1 State Lands Commission.

A CSLC lease is required whenever a project is built upon the State's natural, navigable waterways, and tide and submerged lands, including those adjacent to the coast and offshore islands of the State from the ordinary high-water mark to three geographic miles offshore. Since the outfall diffuser rests on the riverbed below the ordinary high-water mark, a land lease application was prepared concurrently with the filing of the MND. TDBC received a CSLC land lease for the construction of the structure on the riverbed of the Old River.

7.1.3 US Army Corps of Engineers Regulatory Division, Nationwide Permits (NWPs)

Authorities:

- Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)
- Section 404 of the Clean Water Act (33 U.S.C. 1344)

TDBC applied for a NWP but USACE never responded to the application. By statute, the permittee may presume that the project qualifies for the NWP unless otherwise notified by USACE's District Engineer within 45-days after filing the application. Although an NWP was not received, TDBC proceeded to construct the facility since USACE's District Engineer expressed no objection to the project within the statutory 45-day response period.

7.1.4 Lake and Streambed Alteration Permit (LSA Permit)

Authority: California Fish and Game Code section 1602

Section 1602 requires an entity to notify the California Department of Fish and Wildlife (CDFW) prior to commencing any activity that may:

- Substantially divert or obstruct the natural flow of any river, stream or lake;
- Substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or
- Deposit debris, waste or other materials that could pass into any river, stream or lake.

A Lake or Streambed Alteration (LSA) permit application was prepared and submitted to CDFW concurrently with the filing of the Mitigated Negative Declaration (MND). TDBC received the LSA permit from CDFW prior to construction of the outfall diffuser.

7.1.5 National Pollution Discharge Elimination System (NPDES) Permit

Authority: The National Pollutant Discharge Elimination System (NPDES) program is a federal program, under the Clean Water Act, that has been delegated to the State of California for implementation through the State Water Resources Control Board and the nine Regional Water Quality Control Boards. TDBC received NPDES Permit # 2003072160 prior to construction of the outfall diffuser. The permit describes the basic configuration of the facility as it discharges to Old River via an outfall diffuser that ensures rapid mixing in the receiving water. The diffuser is 123 feet long with 36 ports (2-inch diameter ports, spaced 3 feet on center)." TDBC's NPDES permit was initially approved by the Regional Water Quality Control Board, Region 5, Central Valley (RWQCB5) and was renewed in 2014.

7.2 Effect of regulatory approvals on upgrade/repair options – general comments

7.2.1 NPDES Permit - Regional Water Quality Control Board, Region 5

The NPDES permit includes a basic description of the configuration of the outfall diffuser. The diffuser is designed to achieve dilution goals for copper and temperature specific to the Basin Plan. The outfall is located approximately two miles upstream of Clifton Court, where the California Department of Water Resources and the United States Bureau of Reclamation each operate large export pumping plants for the State Water Project and the Central Valley Project, respectively. Some of the exported water is diverted and treated for drinking water by State and federal water contractors. RWQCB5 is very much aware of the outfall's proximity to the export pumping stations and requires strict monitoring and reporting of water quality parameters in order to maintain the NPDES permit. A significant alteration to the as-permitted diffuser configuration will trigger a permit review by the RWQCB5 and compel TDBC to undertake hydraulic model studies of the new diffuser configuration to ensure that dilution requirements are in compliance with the Basin Plan.

7.2.2 Nationwide Permits (NWP) – US Army Corps of Engineers

Projects constructed in waters of the United States involving minor dredging (less than 25 cubic yards) require an NWP19-Minor Dredging. Outfall construction for effluent discharges in waters of the USA requires an NWP7-Outfall Structures. Maintenance of previously authorized structures installed in waters of the USA requires an NWP3-Maintenance. Periodic maintenance to the outfall diffuser structure involving flushing of sediment, trench excavation, and backfill with granular material would fall under NWP3 and NWP19. Construction of a new outfall pipe resting on the riverbed would require a NWP7. Since TDBC did not receive written acknowledgement of their previous NWP application, WorleyParsons recommends consultation with USACE for guidance on the NWP application most appropriate for the preferred option. The USACE Regulatory Division permit process takes approximately one year from date of application to permit issuance.

7.2.3 Land Lease – California State Lands Commission

Project options having a footprint on the riverbed greater than the existing footprint will trigger consultation with CSLC. The original land lease would need to be modified to accommodate a larger structure or additional structure, such as the ACBM, which has a footprint extending outside of the leased area. WorleyParsons recommends consultation with the CSLC to determine how the existing land lease would need to be modified for the options involving the ACBM or an enlarged structure.

7.2.4 Lake and Streambed Alteration Permit – California Dept. of Fish & Wildlife

The LSA permit would need to be re-visited if the selected option involves excavation trenching, placement of granular backfill material in the trench, and/or placement of a new structure, such as the ACBM, upon the riverbed. In consultation with CDFW, it may be required to refresh the Mitigated Negative Declaration if the agency deems the project significantly different from the previous CEQA document. Most likely an Initial Study would be conducted in conjunction with a Mitigated Negative Declaration.

7.2.5 Periodic Maintenance

Maintenance work on the structure would be required to keep the system operating as intended in the permits. The regulatory agencies expect TDBC to perform periodic maintenance in order to ensure optimal hydraulic performance of the diffuser system. Maintenance involving little or no changes to the diffuser's structural configuration would be covered under the USACE's NWP3 and CDFW's LSA permit if maintenance was limited repairing broken tideflex risers and sediment flushing into the receiving water body. No new permits would be needed If the flushing operation included capturing and diverting the flush effluent into an onshore holding tank where it could be properly disposed.

7.3 Effect of regulatory approvals on upgrade/repair options – by Option

7.3.1 Option 1

Excavating the trench and placement of granular backfill material will trigger the need to review CDFW's LSA permit, especially if the footprint of the new trench is broader than the existing trench. Addition of the ACBM would trigger an amended LSA permit application, because a new structure is going into the riverbed. WorleyParsons recommends consultation with CDFW to determine the extent of the amendment required to the existing LSA permit if this option is selected.

WorleyParsons recommends contacting USACE regarding submittal of NWP applications for NWP 3-Maintenance for rehabilitation of previously authorized structures or fills and discharge of accumulated sediment, NWP-7 Outfall Structures, and NWP19-Minor Dredging, if less than 25 cu yd. of material is contemplated for trench excavation. These NWPs will cover periodic maintenance including discharge of sediment into the river, trench excavation, and placement of trench backfill. Note that the USACE permitting process may take up to one year.

Installation of the ACBM involves placement of another structure in the river and TDBC would need to amend the CSLC lease to extend the limits of the lease if the ACBM dimensions are significantly larger than the existing lease footprint. WorleyParsons recommends consultation with CSLC to determine how the existing land lease would need to be modified.

A downstream flush ball valve equipped with pneumatic actuator will be added to the diffuser pipe to allow sediment flushing as part of a periodic maintenance program. No additional permits would be needed if the maintenance procedure included capturing the flushed effluent in an onshore holding tank rather than discharging it into the river. WorleyParsons recommends the installation of a 6-in. return line on the downstream side of the flush valve to discharge the flush effluent onshore for proper disposal.

7.3.2 Option 2

This option represents a significant design change from the existing NPDES permitted design. In addition to the inclusion of NWP3, NWP7, and NWP19 from USACE as stated in Option 1, RWQCB5 would require hydraulic modeling to ensure that the new design, with fewer ports and larger diameter pipe, would achieve minimum dilution goals required in the Basin Plan. Note that the USACE permitting process may take up to one year.

The CSLC lease would not be affected because the replacement pipe structure would occupy the same or smaller footprint on the riverbed. The original land lease would need to be modified to accommodate a larger structure or additional structure, such as the ACBM, which has a footprint extending outside of the leased area. If TDBC chooses to use the ACBM in this option, WorleyParsons recommends consultation with CSLC to determine how the existing land lease would need to be modified to accommodate the ACBM.

As stated in Option 1, a downstream flush ball valve equipped with pneumatic actuator will be added to the diffuser pipe to allow sediment flushing as part of a periodic maintenance program. No additional permits

would be needed if the maintenance procedure included capturing the flush effluent in an onshore holding tank rather than discharging it into the river.

7.3.3 Option 3

This option minimizes the in-river work and eliminates the need for trench excavation. Hydraulic modeling would be required to prove that the revised diffuser design can achieve minimum dilution goals required in the NPDES permit. RWQCB5 would need to approve hydraulic model results for the new design. Presumably, the structure would occupy the same footprint on the riverbed as the previous design, so no CLSC lease modification would be required. Since a new structure is being placed upon the riverbed, CDFW should be contacted to determine if they will require an amendment to the existing LSA permit. WorleyParsons recommends applying for a USACE NWP7, due to the fact that this option includes a new outfall pipe resting on the riverbed and that no previous written documentation was received from USACE for the existing structure. Note that the USACE permitting process may take up to one year.

As stated in Options 1 and 2, a downstream flush ball equipped with pneumatic actuator will be added to the diffuser pipe to allow sediment flushing as part of a periodic maintenance program. No additional permits would be needed if the maintenance procedure included capturing the flush effluent in an onshore holding tank rather than discharging it into the river. WorleyParsons recommends installation of a 6-in. return line on the downstream side of the flush valve to discharge the flushed effluent onshore for proper disposal.

7.3.4 Option 4

Option 4 includes removing the 10-inch and 6-inch spools and replacing them with an 18-inch spool of the same combined length. This will result in a structure with a constant 18-inch diameter throughout the entire length of the diffuser pipe body. As in Option 3, hydraulic modeling will be required and the model would need to be approved by RWQCB5 as a condition of the NPDES permit.

This option calls for removal of the existing diffuser pipe and installation of an improved design of the same overall length and width. The CSLC lease would not be affected because the new project footprint can be accommodated in the existing lease.

A small amount of fill material will need to be removed from the trench in order to excavate the old pipe. Backfill would be placed over the new pipe after it is installed. The CDFW LSA permit will need to be amended to cover this work.

As stated in the previous options, USACE NWP19 and NWP7 would be needed to cover minor dredging and installation of the new outfall pipe. Concurrent with these permit applications, WorleyParsons recommends securing the NWP3 to facilitate future periodic maintenance. Note that the USACE permitting process may take up to one year.

As stated in Options 1, 2, and 3, a downstream flush ball equipped with pneumatic actuator will be added to the diffuser pipe to allow sediment flushing as part of a periodic maintenance program. No additional permits would be needed if the maintenance procedure included capturing the flush effluent in an onshore holding tank rather than discharging it into the river. WorleyParsons recommends installation of a 6-in. return line on the downstream side of the flush valve to discharge the flushed effluent onshore for proper disposal.

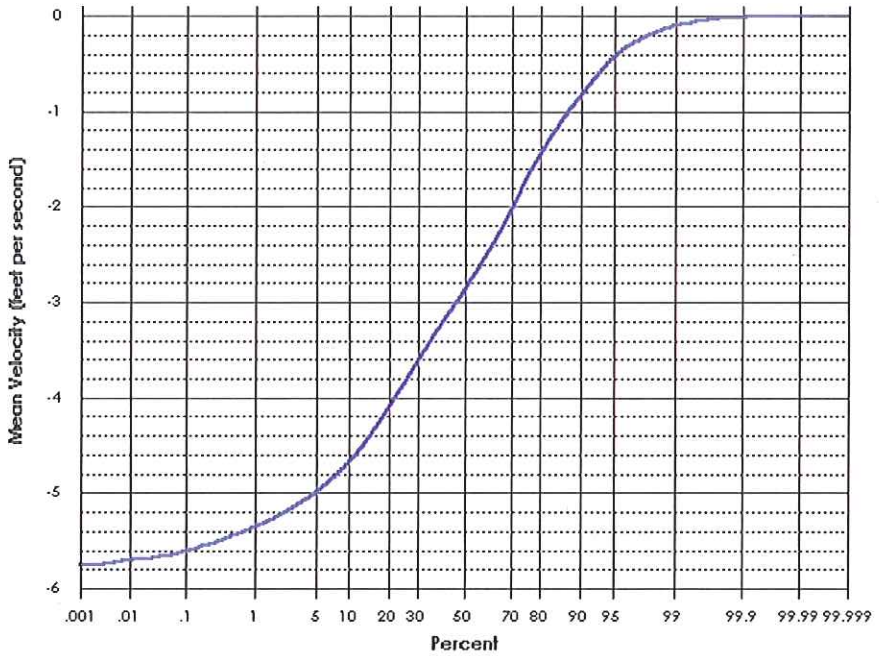
8. Review of Site Conditions, River Flow, and Proposed Scour Protection

8.1 Diffuser Scour

The geotechnical investigation (Kleinfelder 2004) indicated that the general soil profile on the river bottom consists of 1.5 to 2 feet of very loose silty sand and silty clay underlain by 2.5 to 5 feet of medium dense silty sand underlain by over 50 feet of medium stiff to stiff silty clay and sandy clay. Based upon the reported blow counts, the medium stiff to stiff silty clay and sandy clay layer provides firm bearing. The top of the medium dense silty sand layer is interpreted to represent the depth of general scour in the river, as the density of the medium dense sand layer exceeds that of river sand re-deposited on the bottom after a scour event.

Per the Komex report (Komex 2004b), The United States Geological Service (USGS) river flow data for the Old River at the Highway 4 Bridge was analyzed to determine the probability distribution of the mean velocity in the river channel. Due to limitations in how much data could be analyzed at that time (65,536 rows); the probability distribution is based upon data collected from October 13, 2001 through September 22, 2003 (data collected at 15-minute intervals). As the Old River is strongly tidal, the data were analyzed for the direction that had the highest mean velocities (the "negative" velocity direction towards the south meaning tidal inflow). Based upon an analysis of that data, the probability distribution of mean river velocity is presented in Figure A.

Figure A **Old River at Highway 4 Bridge – Probability Distribution of Mean Velocity**



The probability distribution of mean river velocity indicates that scour is an important criterion that must be considered in the riverbed diffuser support design. Therefore, it is recommended that for Options 1, 2 and 4 the diffuser be placed in an excavated trench below the depth of scour,

approximately 2.5 feet below the existing riverbed, and for all four options, an articulated concrete block matt (ACBM) should be installed above the header at the level of the existing bed to prevent scour in the region of the diffuser. Since the ACBM is porous, it would be important to incorporate a geotextile into the design to prevent bed material loss through the interstitial spaces.

9. Cost Estimate

A preliminary cost estimate was prepared for the upgrade/repair of the four diffuser options described above. The cost for each option is presented in Table A and includes supply and installation of the material, on-site disposal of stripped and excavated material, mobilization and de-mobilization to and from the Site. Details pertaining to the construction cost include: 2% insurance, 20% contractor overhead and profit (OH+P), a contingency of 15% and excludes tax. Costs in Table A do not include Engineering and Construction inspection costs for WorleyParsons as outlined below.

WorleyParsons estimated cost to support the regulatory applications support (dispersion modeling for NPDS permit Application) and preparation (except NPDS permit application), design, dispersion modeling, water quality monitoring, bathymetric survey and construction support is $164,000. Items included in this cost are as follow:

- design of the selected diffuser option and dispersion modeling for Options 2, Option 3 and Option 4;
- water quality monitoring and bathymetric survey (9- 12 hr. days, 4 – 8hr. days mob/demob);
- construction support (9- 12 hr. days, 4 – 8hr. days mob/demob);
- specifications and issued for construction drawings;
- Regulatory Applications Preparation;
- construction completion report (including daily field activities, water quality monitoring and as-built drawings); and
- Tax excluded.

Table A Cost Estimate for TDBC Diffuser Upgrade/Repair Options

Activity/Material	Estimated Cost
Option 1 – Removal and Replacement of Similar Diffuser Design	$298,500
Option 2 – Removal and Replacement of Diffuser with New Design	$296,900
Option 3 – Abandonment and Replacement of Diffuser with New Design	$334,000
Option 4 – Repair/ Removal and Replacement of the 10 and 6 in HDPE spools	$183,000

10. Conclusions and Recommendation

10.1 Conclusions

Based on the results of this assessment, the following conclusions were made:

- Sections of the diffuser appear to be damage, either partially operating (downstream end of the 10-in. segment) or non-operating (6 in. segment). Based on the 2017 underwater survey prepared by Bishop Diving & Salvage, the 6-in. segment of the diffuser is non-operational with no flow observed in any of its ports. Also, per the underwater survey the 10-in. segment appears to have weak flow at the downstream end. The CCTV camera inspection completed by Subtronic Corporation indicated that a blockage was present at the downstream end of 10 in. segment, verifying the flow observations made by the underwater survey.

- The hydraulic assessment completed for the TDBC sanitary system (from the lift station to the outfall) indicated that the current system is operating with higher head loss compared to its original design. Therefore, the lift station has to deliver a higher pumping head to convey flow through the system. The results showed that to deliver a flow of 3.11 MGPD the lift station required a pumping head of 19.9 psi, while under normal conditions the expected pumping head should be of approximately 15 psi. The higher-pressure head required is a result of additional losses encountered by flow being channeled through a lower number of diffusers which increases the jet velocity and the loss at each Tideflex valve. These increased head losses are in agreement with 2017 results of the underwater and the CCTV camera inspection.

- To improve the overall system performance, the existing diffuser should be repaired or upgraded. To this point four repair /upgrade options have been prepared as described in Section 6.

10.2 Recommendations

- Based on the results of this assessment, the following recommendations were made:
- To verify that there are no significant issues with the performance of the Lift Station (5 pumps), it is recommended to complete a pumping test using the lift station recirculation system. The result of this pump test should be then compared to the original performance result of the system to confirm no loss in original pumping performance.
- To assist the outfall repair/upgrade design, a bathymetric survey of the outfall area is recommended. This survey will provide details of the river bed, and indicate if scour or sedimentation has occurred near the outfall area and inform the bed preparation design for the selected option.
- The probability distribution of mean river velocity indicates that scour is an important criterion that must be considered in the riverbed diffuser support design. Therefore, it is recommended that for Options 1, 2, and 4 the diffuser be placed in an excavated trench below the depth of scour, approximately 2.5 feet below the existing riverbed, and for all four options, an articulated concrete block matt (ACBM) should be installed above the header at the level of the existing bed to prevent scour in the region of the diffuser. Since the ACBM is porous, it would be important to incorporate a geotextile into the design to prevent bed material loss through the interstitial spaces.
- Out of the four repair/upgrades presented in this document, WorleyParsons recommends Option 3, as it will require less disturbance of the outfall area and may require an easier installation. This option will also use reduced number of ports, which will reduce maintenance and lower the chances of obstruction damage. In addition, this option will involve shorter ports compared to the original design therefore, allowing for sufficient water depth above it without restricting boating activities in the river.
- It is recommended that for all design options a protection (e.g. metal cage) be considered to prevent damage from boating activities (e.g. vessel anchors).
- As part of the construction activities and per the State of California requirements it is recommended to implement a turbidity monitoring program for the duration of the construction activities.
- It is recommended to develop and implement a periodic (e.g. annual) maintenance plan to repair any damages, prevent failure and reduce the need for extensive future repairs.
- As part of the upgrade/repair options WorleyParsons recommends installing valves equipped with pneumatic actuator for both the diffuser ports and the downstream end of it. A 6-in. return line could be installed for discharge onshore.
- It is important to note that for all these options the diffuser will be out of commission while replacement is completed. Alternative discharge options should be considered for treated effluent including its regulatory implications.

11. Closure

We trust that this letter proposal satisfies your current requirements and provides suitable documentation for your record. If you have any questions or require further details, please contact the undersigned at any time.

Sincerely,

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Senior Consultant

Senior Reviewed by

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