CDCI

SUMMARY OF FINDINGS
2020 Annual Outfall Underwater Survey
FINAL

July 2020

Prepared for
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2020 Outfall Survey Summary Report

EXECUTIVE SUMMARY

On July 21, 2020 Crescent Diving & Contracting, Inc (CDCI) carried out the routine interval (annual) underwater survey of the Carmel Ocean Outfall on behalf of the Carmel Area Wastewater District (CAWD).

A general-visual "Level 1" survey of the offshore diffuser section and the lagoon crossing outfall supports, as well as internal physical measurements of to check for sediment and visual observations of discharge flow using dye introduced at the treatment plant. Video recordings with real-time audio narration of each task accompany this report.

The outfall diffuser risers, rubber 'duckbill' style backflow prevention valves, outfall terminus blind flange were found to be in overall "satisfactory" to "good" condition.

Internal sounding measurements were taken at each of the ten (10) diffuser port locations to detect any deposition accumulation within the outfall pipe. When compared to the previous year findings (2019), minimal increase was noted.

Using dye introduced to the stream by CAWD personnel to visually enhance the discharge characteristics, all ten diffusers were observed under normal flow conditions. CDCI observed no signs of obstruction, damage, or significant defects in the rubber check valves during flow.

INTRODUCTION

CAWD retained CDCI under a fixed-sum purchase order agreement to perform the routine (annual) survey of the in and underwater portions of the wastewater conveyance pipeline outfall.

CDCI has performed the annual survey for the past several years, and thus we are sensitive to detecting any subtle changes from previous observations.

SURVEY -- Offshore Diffuser Section:

On July 21, 2020 an OSHA-compliant three (3) person diving crew was mobilized aboard the M/V "BeachHopper II" from the Monterey Municipal Marina in accordance with applicable regulatory and CAWD purchase order requirements.

The surface-supplied diving mode (the standard of the commercial diving industry) has the advantages of two-way communication, real-time video monitoring and directing from the surface, as well as life support redundancies and dive profile controls.

For the offshore portion of the 2020 survey, the surveying diver was CDCI Managing Partner, Ron Null. CDCI Principal and Operations Manager Steve Nicosia managed the dive from the surface. The field operations were coordinated with personnel at the treatment plant through CAWD Project Manager Patrick Treanor.

The scope of work included the following:

“Engineered Solutions for Water in the West”

- A general-visual, “level 1” survey of the ten outfall diffuser ports and outfall terminus blind-flange.
- Check for evidence of material deposition inside the outfall at selected diffuser locations by taking sounding measurements through the duckbill valve and riser
- Visually observe the discharge behavior characteristics of the ten diffusers under normal flow conditions, using added dye to enhance contrast

The offshore outfall is a 24-inch (internal) diameter pipeline, clad with what appears to be a concrete protective and ballast coating.

The survey focus area was the roughly 100LF diffuser section terminating at the end flange at STA 8+99. The diffuser section sits in approximately 40 feet of water depth, and the outfall end flange daylights horizontally out from what appears to be a concrete encasement.

The ten diffusers are identified with letter designations “A” through “J”, starting at the offshore end with “A” at STA 8+89 and moving inshore (upstream) at 10 ft spacing intervals to “J”.

Each of the ten diffusers consists of a riser that extends roughly one (1) foot vertically to a bolted flange connection. This short riser is also concrete clad up to the underside of the flange. Bolted to this flange is an inverted J-tube riser capped by a rubber duckbill check valve.

Each diffuser riser is 53 inches from the center of the bolted flange connection to the centerline elevation of the duckbill.

The reference drawings depict the diffusers as extending vertically out of the crown of the pipe and call out a horizontal offset of 15 degrees of the downstream flow direction for the duckbill valves. This 15-degree offset is shown as alternating with the odd duckbills at +15 and the even duckbills at -15 from the centerline of the pipe (Figure 1).

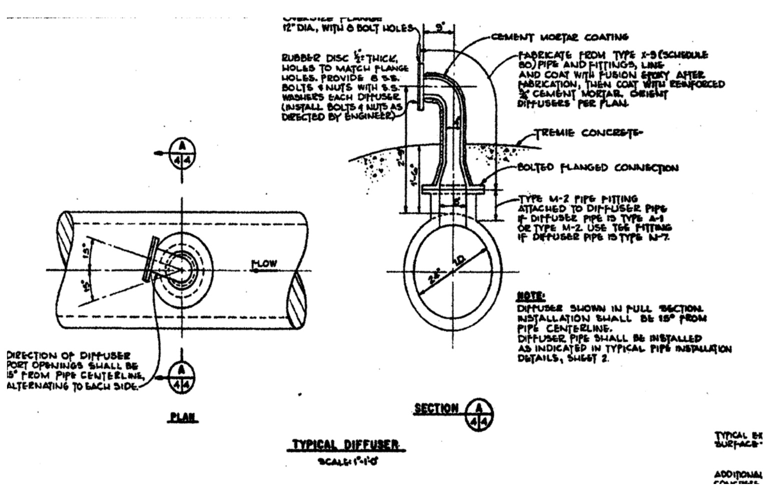

Figure 1 – Diffuser details in reference drawings

FINDINGS -- Offshore Diffuser Section:

The general visual ("level 1") survey of all ten diffusers and backflow valves under almost slack flow was observed and recorded via the helmet-mounted video camera and audio feed. All diffuser/risers were found to be intact with no observable signs of damage or significant deterioration. Each of the duckbill check-valves were pliable.

The actual condition of several of the diffusers at time of the survey were observed to be off vertical by several degrees, or with the impression of "leaning". This lean does not appear to be uniform as if the prevailing ocean swell has acted to influence the risers towards the shoreline. Rather they are "leaning" in what appears to be random directions, both against the swell direction as well as with it.

Rather than the alternating 15-degree offset from the downstream alignment of the pipeline axis, the actual alignment was observed to be (again) almost random with the alignment(s) being in multiple compass directions.

All ten diffuser risers were observed to be solid when physically pushed by the diver. No damage was noted.

A visual flow analysis using red dye introduced into the outflow from the Plant allowed confirmation of what appeared to be equal flows from each of the ten diffusers. The ten duckbill valves appear to be functioning as intended. The interior sealing surface of the rubber valves, or "lips" are clean and free from any marine fouling or observable deposits that would prevent full closure and full sealing contact when under a no-flow condition. With full closure contact, the migration of sediment from the ocean is prevented. Reference survey video file "2020_OutfallSurvey_DiffuserSection" from 10:28:40 to 10:29:05

Image 1 – Duckbill contact sealing surface during no-flow
(Screen capture taken from diver video track)

Observable dye was confined to the diffusers, with no leakage indications betrayed from any other areas of the diffuser section surveyed. No dye was observed at the blind flange at the outfall end, and the flange appears to be solid.

Image 2 – Discharge from Diffuser (typical)

Image 3 – Discharge from Diffuser (typical)

Both hard and soft marine growth fouling was observed on the outfall component exterior up to between 3 and 4 inches over a uniform coverage of approximately 80 percent of the surfaces. This coverage does not allow detailed inspection of the of the pipe and risers, however gross deformities indicating exterior damages should still be discernable.

Marine growth on the rubber duckbill valves was also up to 75% with a maximum thickness of as much as 3 inches. Due to the service flexing of the rubber valve material while under flow, the fouling of the rubber surfaces was almost exclusively soft growth composition. The fouling on the rubber surfaces of the duckbills did not appear to inhibit their function. On the day of the survey, relatively heavy kelp growth was prevalent in the vicinity of the outfall.

All ten of the diffuser ports were measured internally to detect sediment build-up. A 1-inch diameter galvanized steel pipe fitted with a 90-degree elbow at the insertion end was introduced through the duckbill valve to allow vertical sounding measurement using a flexible fiberglass tape measure weighted with a 16-ounce spherical lead weight.

Image 4 – Diffuser sounding device

The distance of travel from the elevation of the duckbill to the contact at the invert of the pipe was measured and recorded. Using lessons learned from previous surveys the diver was able to 'jig' the lead ball up and down and interpret the density of the material contacted. The process is recorded on survey video file "2020_OutfallSurvey_Diffuser Section" from 10:58:10 to 10:59:50 Findings and observations are shown in Table 1.

Diffuser Location	**Sounding (ft)**		
	2020	**2019**	**2018**
A	8.5 / 3-4" of gelatinous material then hard and firm surface	8.1	8.0
B	8.6 / 2-3' of gelatinous material then firm	7.9	N/A
C	8.3 / soft material	8.1	8.0
D	8.0 / firm material	N/A	N/A
E	8.5 / firm material	N/A	8.0
F	8.1 / firm material – riser not vertical (leaning roughly north-south)	N/A	8.0
G	7.8 / firm material – riser not vertical (leaning towards shore)	N/A	N/A
H	7.8 / firm material – riser not vertical (leaning towards shore)	8.1	N/A
I	8.1 / firm material – riser leaning offshore, duckbill oriented pointed upstream	8.0	N/A
J	8.6 / hard contact, riser not vertical (towards shore)	8.6	N/A

Table 1 – 2020 Outfall Soundings and previous comparatives

Note that in previous years a 1-inch hex nut was used as the sounding weight and was considerably lighter in weight than the lead used in 2020. We determined that a heavier (lead) weight would give better tactile feedback into the interior deposited material. This heavier weight accounts for the differences in dimensions from previous soundings. In the 2020 survey, using the heavier spherical lead weight the diver was able to get a much more discernable feeling as to the density and behavior of the interior material.

The diver felt as if the material farther out towards the dead flow area under and beyond the last diffuser "A" was a softer and lighter density material, characterized by the diver as feeling "gelatinous" or "pudding-like" when tapped by the round lead sounding weight. Moving upstream, the material had a feedback consistency described as "softer, but less penetrable after the feeling of initial contact resistance", while the farther upstream material "thudded like wet sand". Finally, the upstream-most diffuser "J" had a distinct clunk livelier and closer to a "ring" that the diver believes was likely the actual invert pipe surface with little or no material over it to deaden the feel.

RECOMMENDATIONS – Offshore Diffuser Section:

Flange Hardware – While the majority of the hardware at the flanges of the a) end blind, b) riser base, and c) duckbill mounting were encrusted in marine fouling and not visibly observable, no indication of loose or missing fasteners were observed.

Replacement of the hardware as part of a preventative maintenance protocol may be readily accomplished. Cleaning and preparation for removal may be done while the outfall is 'live'. The change-out of the hardware can be also be accomplished without disturbing the flow by "hot swapping" as with any live pipeline using temporary clamps to allow a complete or partial exchange.

Rubber Duckbills – Each of the ten duckbill valves appeared to be functioning as intended. Closer examination of the condition of the material will require removal of the marine fouling. A random or selected duckbill could be removed and recovered for examination with only the shortest suspension of flow. A blind flange could be installed at the removal location, and if acceptable that would then reduce diffusing to 9 of 10 diffusers during examination on the surface.

Interior Sediment – While it is assumed by many to be able to use a camera inserted into the pipe through the diffusers to quantify the material, the only way to be certain is to recover samples and physically measure. For the Carmel outfall during a hardware swap a representative J-tube riser could be removed and a hard probe and material sampling could be accomplished at random or designated locations.

Similarly, should it be determined that the flow is realizing backpressure consistent with excessive interior sediment accumulation the removal of the risers at the lower flange will allow access to enable either removal using direct suction methods, or the agitation back into suspension using an eduction recovery method released on to the sea.

In the latter method, a special flange is fabricated with a suction head on the end of a spiral wire reinforced non-collapsable suction hose. A riser is removed and replaced with the special suction flange. The hose is inserted down into the outfall until it touches the invert and lays horizontally extending back roughly halfway to the next diffuser.

Example: Riser "J" is removed and the special suction flange and hose assembly is inserted and bolted to the "J" flange. The suction hose now places the suction headpiece on the bottom of the outfall midway between "J" and "I". The next diffuser ("H") is then removed and replaced with another flanged custom assembly, fitted with a "wye" pipe. One leg of the wye is the releasing discharge, and the second leg of the wye connects to a hose that is then extended back to connect to the suction flange on "J".

The outfall flow is then restored. With the flow running, the wye on "H" harnesses the power of the discharge flow coming out of the "H" to create a venturi effect. This venturi power is brought back to the suction assembly on "J" and the resulting eduction effect then vacuums the material at the end of the suction hose on the floor of the outfall pipe. An additional set of air nozzles is fitted to the suction head to augment the disruption of the material for removal. This vacuumed material ultimately exits out of the open leg of the wye as a percentage of the discharge volume creating the venturi draw. Different length suction hoses allow full coverage of the area needed.

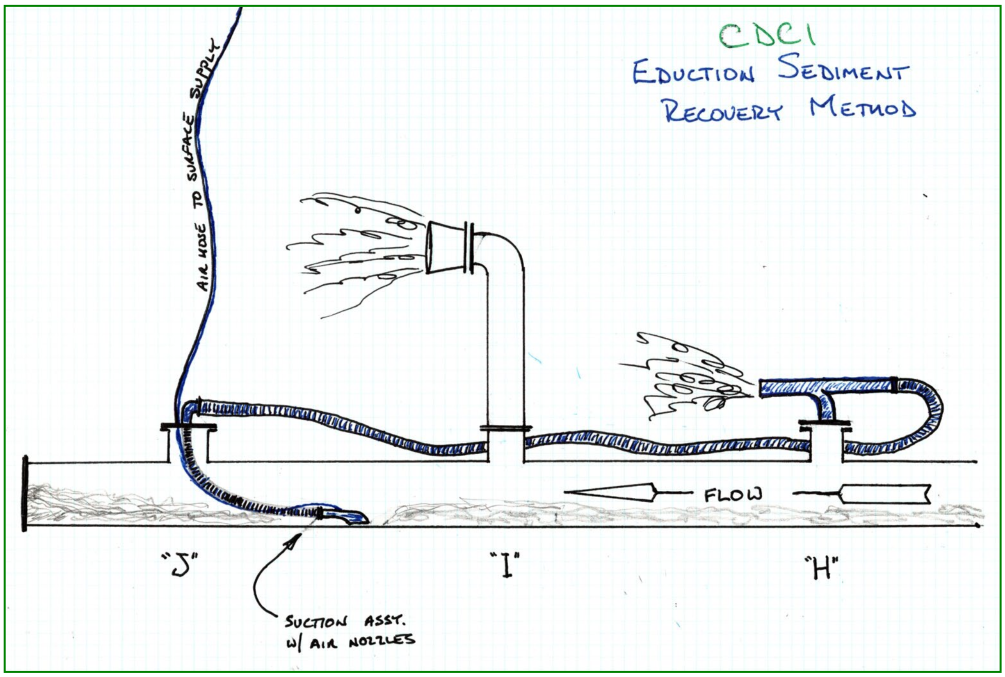

Figure 2 – Eduction Material Recovery Method

Following the conclusion of the offshore diffuser section survey, the vessel dropped out of the mooring and transited back to the marina. The diving equipment and video spread was offloaded from the vessel and onto the worktruck. The CDCI crew then traveled by road to meet CAWD Patrick Treanor at the access gate and setup to carry out the dive survey of the lagoon crossing section from the shore.

SURVEY -- Lagoon Crossing Section:

The outfall crosses the approximate 100LF of lagoon and is supported on three (3) two-pile saddle type supports.

The pipe supports were originally installed each as a pair of steel pipe piles filled with concrete, with steel beams welded on top to create the cradle. In 2019, a repair treatment was prompted by an observed

indication of a possible failure sequence of the steel cradle due to advanced corrosion. An initial response repair to arrest the failure sequence was carried out in January 2019.
The following month in February 2019, CDCI was contracted by the District to encapsulate the repair(s) to mitigate further advancement of corrosion and extend the service life. The pile caps and saddles, augmented with steel as part of the January repair, were formed and encapsulated in reinforced concrete.

Of the three supports, the eastern unit sits at the edge of the lagoon shoreline and has almost no exposed piles. The other two are farther out into the velocity channel and have roughly 10 to 12 feet of exposed pipe pile. The existing steel piles, now extending out from the concrete encapsulations were treated with a structural enhancement epoxy and woven fiber system. Additional soft reaction bracing, comprised of clamps, cables and turnbuckles were installed in an "X" starting under the concrete cap encapsulation and extending down to just above the floor of the lagoon.

The diver for the second part of the survey in the lagoon was experienced CDCI Tier 1 Diver, Marcos Orbegoso.

FINDINGS – Lagoon Crossing Section:

The diver reported the concrete repair encapsulations were in good condition at all three outfall support locations.

The soft reaction bracing is secure, without observable damage, and appears to be functioning as intended. The two-part clamps are all firmly in place, the cable clips are tight, and the turnbuckles remain snug in tension. The visible portions of the epoxy and woven fiber pile wrap appear to be in good condition and without observable damage, indicating that the upper portion(s) under the UV protective second sheathing wrap can be realistically assumed to be in good condition as well.

Image 5 – Upper clamp-to-turnbuckle connection of soft reaction bracing (typical)

Image 6 – Lower epoxy and woven fiber wrap treatment with two-part clamp and rubber liner (typical)

Image 7 – Interface of plastic UV protective wrap under concrete encapsulation (typical)

RECOMMENDATIONS – Lagoon Crossing Section:

No adverse findings were noted in the 2020 survey. It is recommended to continue to add the lagoon crossing section to the annual outfall survey to maintain monitoring of conditions.

REFERENCES:

2020 Outfall Underwater Survey video files, accompanying this report:

1) 2020_OutfallSurvey_DiffuserSection
2) 2020_OutfallSurvey_LagoonSection