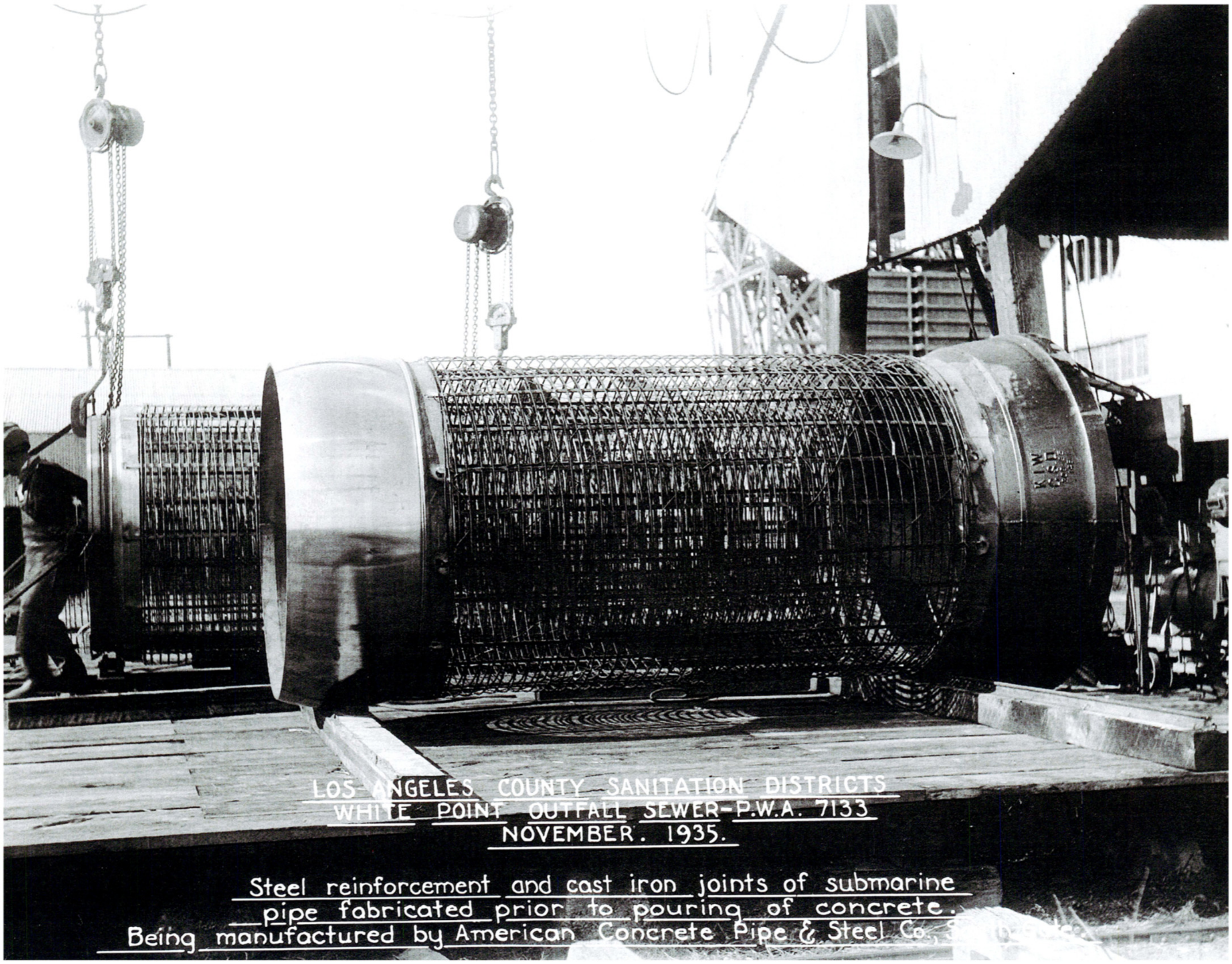
ANNUAL REPORT, 2023

WHITE POINT OUTFALL SYSTEM INSPECTION



LOS ANGELES COUNTY
SANITATION DISTRICTS
Converting Waste Into Resources

Cover Photo: A photo from 1935 showing sections of the 60 inch outfall being manufactured.

LOS ANGELES COUNTY
SANITATION DISTRICTS
Converting Waste Into Resources

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August 1, 2024

VIA CIWQS
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A.K. Warren Water Resource Facility
White Point Outfall System Inspection Annual Report, 2023
Order No. R4-2023-0181, NPDES No. CA0053813, CI-1758

Enclosed please find the 2023 White Point Outfall System Inspection Annual Report. All inspections were conducted as specified in the Monitoring Program.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Very truly yours,

Joshua Westfall
Senior Environmental Scientist
Reuse and Compliance Section

JW:CT
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cc: Environmental Protection Agency, Region IX

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EXECUTIVE SUMMARY

Approximately 247 million gallons per day of treated wastewater from the A.K. Warren Water Resource Facility (WWRF) are discharged to the Pacific Ocean offshore of White Point on the Palos Verdes Peninsula. The effluent is conveyed through two continuously operated outfall pipes (120 and 90 inch pipe diameters) extending 1.5 miles offshore to a water depth of approximately 200 feet (**Figure 1**). A third outfall (72 inch pipe diameter) is used only during times of heavy rains to provide hydraulic relief for flow in the outfall system. The fourth outfall (60 inch pipe diameter) serves as a standby outfall to provide additional hydraulic relief during the very heaviest flows.

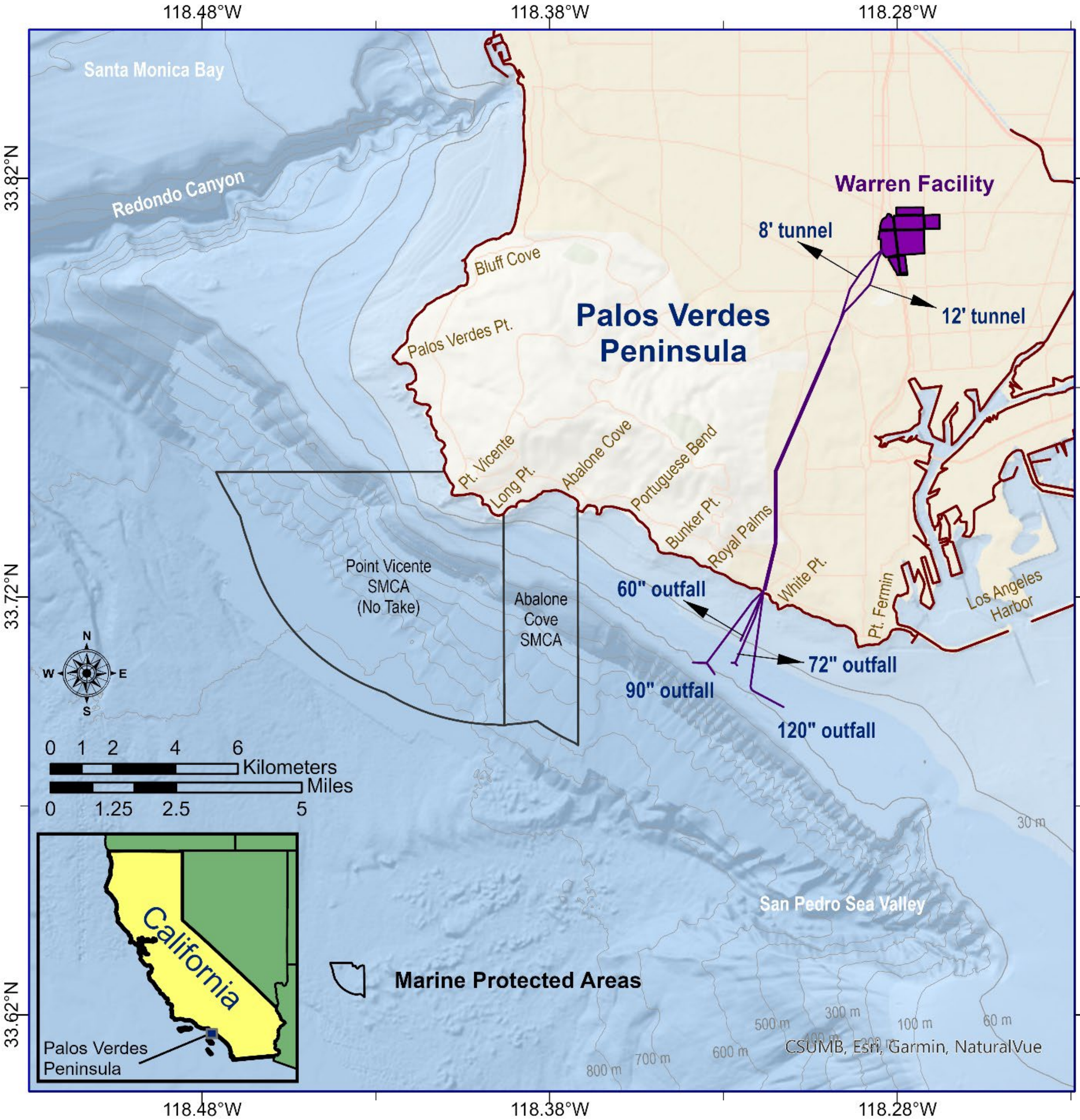

Figure 1: Ocean outfall system located offshore of White Point on the Palos Verdes Peninsula.

The Los Angeles County Sanitation Districts (Sanitation Districts) inspected the four outfalls during 2023 using a remotely operated vehicle (ROV) and divers using a self-contained underwater breathing apparatus (SCUBA) in compliance with WWRF's National Pollutant Discharge Elimination System (NPDES) permit. The concrete pipes, joints, termini/end structures, and ballast rock on the 120-, 90-, and 72-inch outfalls appeared to be in good operational condition with little or no change since the 2022 surveys. The concrete pipe of the 60-inch outfall has considerable deterioration as evidenced by frequent spalls and exposed rebar. The cast iron joints of this outfall were typically corroded, the support girder that braces the three jets at the end structure has detached, and much of the original ballast rock has been lost, particularly near the end structure. Most of these conditions have been evident since the mid 1980s. However, the 60-inch outfall appears to be adequate for its designated use as a standby outfall to provide additional hydraulic relief during the very heaviest flows.

To extend the life expectancies of the three largest outfalls, 634 aluminum anodes were attached to the cast iron components of the joints and manhole covers of the 72- and 90-inch outfalls and the cast iron component of the manhole covers of the 120-inch outfall to provide cathodic protection. Based on conservative assumptions, the anodes are expected to last for 50 years, at which point, they could be replaced. During this time and when functioning properly (approximately 22% of the cable connections have detached), there should be little to no corrosion occurring on the cast iron joints or manhole covers.

Electronic copies of the 2023 White Point Outfall System Inspection Annual Report can be obtained through the Sanitation Districts' website (www.lacsd.org).

ACKNOWLEDGEMENTS

WHITE POINT OUTFALL SYSTEM INSPECTION REPORT, 2023

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WHITE POINT OUTFALL SYSTEM INSPECTION

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WHITE POINT OUTFALL SYSTEM INSPECTION

INTRODUCTION

The Sanitation Districts operate eleven wastewater treatment plants serving approximately 5.5 million people. The WWRF, located in the city of Carson, is the largest of these plants and serves nearly 3.5 million people and hundreds of industries. In 2023, the WWRF wastewater flow averaged 247 million gallons per day of disinfected, secondary treated effluent (LACSD 2024). The WWRF treats the solids from this flow as well as the solids from six upstream water reclamation plants. Treated wastewater from WWRF flows through two tunnels, six miles in length, under the Palos Verdes Peninsula to a shoreline manifold station at White Point.

The effluent flow is carried by gravity from White Point approximately 1.5 miles offshore through two outfall pipes lying on the ocean floor (Figure 1). These outfalls measure 120 and 90 inches (inside pipe diameter) and continuously discharge from multi-port diffusers that terminate in water depths of approximately 200 and 220 feet, respectively. The 120-inch outfall was placed into full-time operation in 1967 and the 90-inch outfall in 1957. A third outfall that measures 72 inches, taken out of regular service in 1966, is available during times of heavy rains to provide hydraulic relief for flow in the outfall system. Originally placed in operation in 1947, the 72-inch outfall was extended from a water depth of 110 feet to a depth of 160 feet in 1953. In 2023, this outfall was used for hydraulic relief for approximately 6 hours during a period of heavy rain. The fourth outfall that measures 60 inches, was taken out of regular service in 1958, and serves as a standby outfall to provide additional hydraulic relief during the very heaviest flows. This smallest and oldest of the outfalls terminates in 110 feet of water and began operation in 1937. The last time this outfall was used for hydraulic relief was during a major storm event in 2005 (LACSD 2006).

Each outfall is blanketed by a concrete cover prior to emerging from the ocean floor. The 90-, 72-, and 60-inch outfalls have cast iron pipe joints while the 120-inch outfall has concrete joints. All four outfall pipes are made of reinforced concrete. Detailed descriptions of each outfall are provided below.

The Sanitation Districts' external visual inspections determine if the outfall structures appear in serviceable condition to ensure their continued safe operation. In the 1990s, outfall repair projects requiring extensive reballasting were completed with the intent to maintain the outfall system integrity. Based on a life expectancy analysis of the three largest outfalls, cathodic protection was added to extend the life of existing cast iron joints and manhole covers on the 72- and 90-inch outfalls and manhole covers of the 120-inch outfall in 2015. Cathodic protection, an aluminum anode approximately four feet in length connected to the cast iron component with a cable, was installed on 634 joints and manhole covers (**Figure 2**). Based on conservative assumptions, the anodes are expected to last for 50 years, at which point, they could be replaced. During this time and when functioning properly, there should be little to no corrosion occurring on the cast iron joints or manhole covers. These former projects and a history of the outfall system inspections are discussed in **Appendix A**.

Figure 2: Overview of joint and flush manhole cover to cable connections and aluminum anodes to cable connections with anodes located within the ballast rock.

120-inch Outfall Description

The 120-inch outfall, including the doglegged diffuser, is 11,880 feet long. Individual pipe sections are 24 feet long. The bell and spigot joints (**Figure 3**) are made of concrete and sealed with internal neoprene gaskets. Twenty-eight flush manhole covers are located on various pipe sections along the outfall (**Figure 4**) and are intended to allow divers entry access to the outfall for maintenance or repairs. The diffuser leg is comprised of 185 sections of pipe. To maintain internal velocity as the effluent flows through the diffuser toward the end structure, the diffuser pipe decreases in diameter from 120 to 102 to 72 inches and the discharge port (**Figure 5**) diameters increase from 2.0 to 3.6 inches. There are four ports per pipe section (two on each side), except on the south side of four pipe sections in the diffuser leg that have three ports each and one vertical port located at the bend of the diffuser leg (**Figure 6**). The block shaped end structure has an internal bulkhead with two 6.0-inch diffuser ports followed by two external self-closing gravity doors, each with a centralized port cut-out (**Figure 7**). When the outfall was cleaned in 1978, ballast rock slipped into the doorframe and prevented the gravity doors from completely shutting. Removal of the ballast rock from the self-closing doors by divers has been deemed too dangerous, but this condition is irrelevant as the bulkhead diffuser ports maintain the design flow rates. There is a total of 747 ports along the outfall.

Figure 3: A concrete bell and spigot joint on the 120-inch outfall.

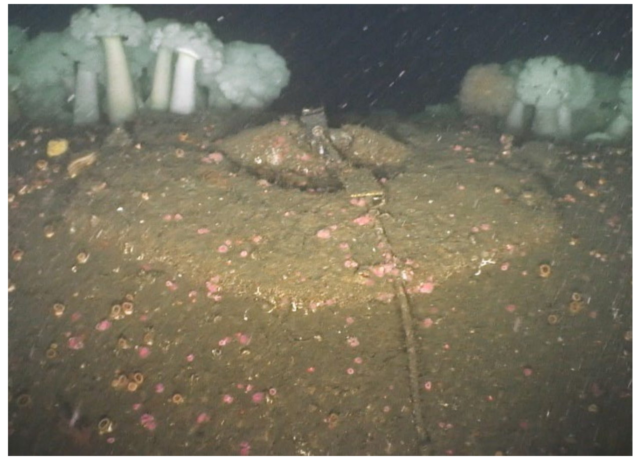

Figure 4: A flush manhole cover on the 120-inch outfall. This type of manhole cover is also on the 90- and 72-inch outfalls.

Figure 5: A flowing port on the 120-inch outfall.

Figure 6: Vertical port on the 120-inch outfall. This port is located on a section reducing the diameter of the diffuser pipe from 120 to 102 inches.

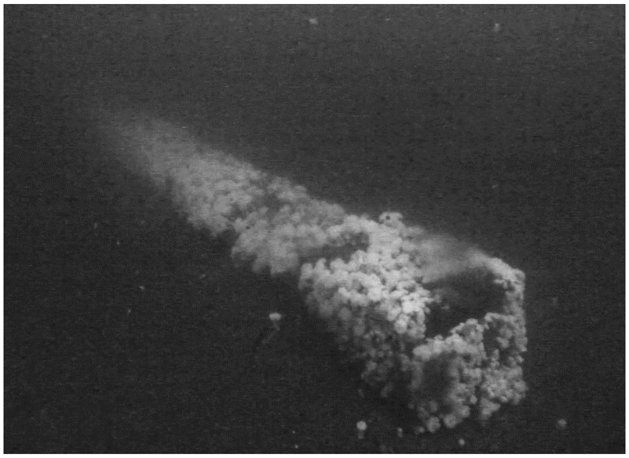

Figure 7: The end structure with two gravity doors each with a centralized port cut-out on the 120-inch outfall.

Figure 8: A cast iron joint wrapped with a hard rubber gasket and attached anode cable on the 90-inch outfall.

90-inch Outfall Description

The 90-inch outfall, including its wye-shaped diffuser, is 10,398 feet long. Individual pipe sections are 24 feet in length. The cast iron joints are wrapped with a hard rubber gasket (**Figure 8**) and sealed internally with rubber and lead gaskets. Twenty-five flush manhole covers are located on various pipe sections along the outfall (Figure 4). They are intended to allow divers entry access to the outfall for maintenance or repairs. The main barrel includes an inshore wye structure (j-box) in approximately 35 feet of water (**Figure 9**). This structure was designed to provide an option for adding a second main barrel to the 90-inch outfall (**Figure 10**). It is unique to this outfall and has never been utilized. Following minor vandalism by recreational divers in the early 1970s, the Sanitation Districts' divers made repairs to the metallic fasteners on the concrete cover plate. The plate has been free of leaks since those repairs were made.

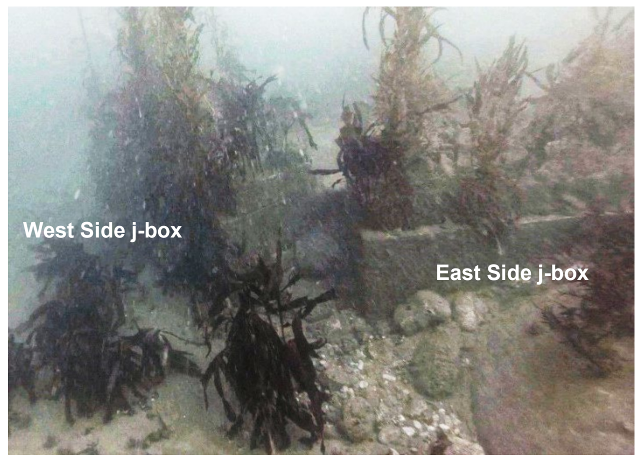

Figure 9: Inshore wye structure (j-box) located on the main barrel of the 90-inch outfall.

Figure 10: West side of j-box designed to provide an option for adding a second main barrel to the 90-inch outfall.

The 90-inch outfall main barrel terminates at the offshore wye structure where the flow splits into two 60-inch diameter diffuser legs. The wye structure has a vertical port encrusted with barnacles and other fouling animals (**Figure 11**). Each diffuser leg is composed of fifty 24-foot long pipe sections. There is a single discharge port, with diameters of 6.5 to 7.5 inches, per pipe section on alternating sides with each subsequent section (**Figure 12**), except for two pipe sections on the east diffuser leg that have two ports each. Each end structure has a visible bulkhead with a single 15-inch port. There is a total of 105 ports along the outfall.

Figure 11: Vertical port with barnacle collar on the 90-inch outfall.

Figure 12: A flowing port on the 90-inch outfall.

72-inch Outfall Description

The 72-inch outfall, including its wye-shaped diffuser, is 6,900 feet long. Individual pipe sections are 24 feet in length. The cast iron joint connections (**Figure 13**) are internally sealed with lead gaskets and overlaid with a concrete collar. In the early 1990s, thirteen joints on the older section of the outfall were observed to have cracks in the concrete collars. These joints were encapsulated with concrete in 1994 to protect the joints and prevent further corrosion **(Figure 14**). The outfall has both flush (Figure 4) and raised (**Figure 15**) manhole covers located on various pipe sections and are intended to allow divers entry access for maintenance or repairs. The raised manhole covers on the older section of the outfall are held in place with wedged clamps. The 72-inch outfall main barrel has 18 diffuser ports inshore of the wye structure. The flow splits at the wye into two 48-inch diameter diffuser legs, each composed of nine 24-foot long pipe sections. Each diffuser pipe section has two opposing ports with diameters of 8 or 9 inches. Each end structure has a visible bulkhead with a single 9-inch port. There is a total of 56 ports along the outfall.

Figure 13: A cast iron joint with a concrete collar on the 72-inch outfall.

Figure 14: Encapsulated joint on the 72-inch outfall.

Figure 15: A raised manhole cover on the 72-inch outfall. This type of manhole cover is also on the 60-inch outfall.

60-inch Outfall Description

The 60-inch outfall, including its main barrel diffuser, is 5,000 feet long. Individual pipe sections are 18 feet in length. The cast iron joints (**Figure 16**) are sealed internally with lead gaskets. This outfall has raised manhole covers (Figure 15) that are held in place with wedged clamps. The last 21 pipe sections leading to the offshore end structure were retrofitted in 1954 with 42 opposing 9-inch diffuser ports (**Figure 17**). Prior to this retrofit, effluent was discharged through three very large ports (>2 feet in diameter) forming a tri-jet end structure (**Figure 18**). As part of the 1954 retrofit, steel cover plates were installed over the original tri-jet ports to divert flow to the new ports. These steel plates are now in various states of corrosion. During the 2001 diver survey, it was discovered that the middle steel plate had fallen off. That same year, a stainless steel crossbar was installed inside the middle jet to prevent diver access into the outfall. During the 2015 diver survey, it was discovered that the support girder that braces the jets had detached (LACSD 2016). Although the support girder is detached, the end structure appears to be structurally sound.

Figure 16: Cast iron joints on the 60-inch outfall.

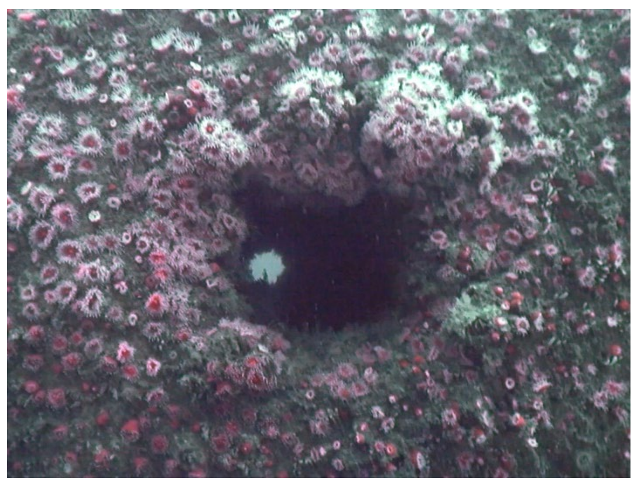

Figure 17: Diffuser port looking through to other side of the pipe section on the 60-inch outfall.

Figure 18: The tri-jet end structure of the 60-inch outfall with detached support girder.

During the 1950s, United States Army personnel disposing of ordinance at sea set off explosions near the 60-inch outfall that accidentally caused minor superficial cracks in the concrete overlying nine of the cast iron joints. To reinforce the damaged areas, concrete was poured into a form around the nine joints forming a large block over each of them (**Figure 19**). The blocks have since deteriorated and are now in various stages of collapse. However, the underlying joints appear to be in a similar condition as the other joints on this outfall. The end structure has been undercut over the last 60 years. Small sized ballast rock material was added to this section in 1966 to help stabilize the pipe.

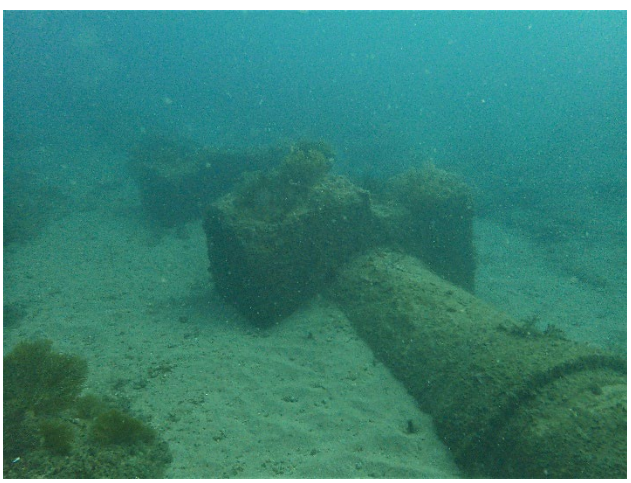

Figure 19: Joint block repairs on the 60-inch outfall.

The 60-inch outfall is over 80 years old and exhibits external deterioration of the concrete pipe and loss of ballast rock that has been observed at least as far back as the 1980s. In addition to joint and pipe section concrete spalling, these surveys have detected corrosion of cast iron joints, the steel plates of the end structure, and exposed rebar. In the 1990s, the Sanitation Districts determined that further repairs to extend the useful life of the 60-inch outfall posed unacceptable risks to the structure.

METHODS

ROV and diver surveys are conducted on each of the four outfalls annually. The ROV surveys took six days of field time to complete and diver surveys required an additional day.

2023 ROV Surveys

The Sanitation Districts conducted the ROV based outfall surveys in October of 2023 using a Saab Seaeye Falcon (**Figure 20**) piloted from aboard the Sanitation Districts' research vessel, *Ocean Sentinel*. A neutrally buoyant fiber optic umbilical, 450 meters in length, provided electrical power and command signals down to the vehicle and various data streams back to the boat. The ROV was outfitted with two forward facing cameras, a high definition (HD) color zoom and a low light monochrome, a rear-facing color camera, and three LED dimmable video lights. Five vectored thrusters and a 300 meter operational depth provided sufficient power and capabilities to conduct inspections at outfall termini depths. ROV positions were determined by an Applied Acoustics' Ultra-Short Base Line (USBL) positioning system and *Ocean Sentinel*'s Global Positioning System (GPS) interfacing with HYPACK Navigation software. Doppler Velocity Log (DVL) and altimeter readings aided in station keeping and fine scale navigation. The vehicle's sonar was equipped with gyro-stabilization and aided with the initial navigation to the outfalls.

Figure 20: Saab Seaeye Falcon used during the outfall survey.

The ROV surveys for the 120-, 90-, and 60-inch outfalls started with an inspection of an outfall terminus or wye structure. The ROV survey for the 72-inch outfall started on the west side of the main barrel in 107 feet of water before proceeding to the wye structure. The pilot and observer(s) monitored video and other data streams in real time. The vehicle was flown inshore along the east or north side of the outfall maintaining an altitude several feet above the ballast rock and/or pipe, observing all diffuser ports and anode attachments, when applicable. The survey continued along the main barrel of the outfall to within a reasonable diver depth then proceeded until the structure went below grade or conditions made piloting the vehicle impractical. The vehicle was then flown to the opposite side of the outfall and surveyed along the west or south side of the pipe back offshore to the where the survey began.

Any changed or unusual conditions encountered, including reduced ballast rock height, undercutting, concrete or joint deterioration, blocked diffuser ports, or particularly unusual biota, were given additional attention. Observed anomalies were recorded along with appropriate metadata. Typically, the black and white camera was used for most of the outfall survey. This camera has a greater field of view and allows for a better perspective of the outfall-ballast interface in low light or poor visibility conditions. The HD color camera was used whenever a more detailed view of a particular area was needed or visibility improved. Continuous video of the entire survey was recorded and analyzed several times during the creation of this report.

2023 Diver Surveys

The Sanitation Districts' divers conducted the SCUBA based outfall surveys from the *Ocean Sentinel* in December 2023. The dives started at depths ranging from 56 to 67 feet depending on the outfall. Surveys were conducted in an inshore direction by a team of two to three divers. Start locations were selected to ensure an overlap with the inshore portion of the ROV inspection track. For each diver survey, the team descended to the main barrel of the outfall with one person positioned on each side of the outfall two to three feet above the ballast rock and a third diver, when available, directly above the outfall. From the start point, the divers headed inshore and surveyed their respective portion of the above grade length of the outfall. Divers were propelled along the outfall by use of battery powered electric scooters (**Figure 21**).

Figure 21: Divers inspecting an outfall.

Underwater video and digital cameras were used by the divers to capture video of the survey and images of areas of interest. The captured video was analyzed several times during the creation of this report. Divers looked for conditions that might have changed markedly since the previous survey or might require future repair by outside contractors.

RESULTS & DISCUSSION

The following observational comments regarding the condition of the outfalls surveyed in 2023 were drawn from the ROV and diver surveys. Findings from these surveys are noted below and can be obtained through the Sanitation Districts' website (www.lacsd.org).

120-inch Outfall

The ROV survey of the 120-inch outfall was performed on 20 and 24 October 2023, inspecting the end structure in 200 feet of water and inshore to 63 feet of water. The diver survey of the 120-inch outfall was performed on 14 December 2023 beginning at the point where the ROV survey ended and terminating in 41 feet of water, where the outfall went below grade.

All 747 ports were inspected, of which nine had no flow, reduced flow, or another anomalous condition (**Table 1, Figures 22-30**). Both termini ports located within the gravity doors of the end structure were unobstructed (**Figure 31**). Several of the ports had various sized barnacle collars (ports encrusted with barnacles and other fouling animals forming a collar around the port; **Figure 32**). The barnacle collars on the west side of the outfall were more numerous and robust than those on the east side of the outfall. Effluent flow out of these ports did not appear altered by the collars. The vertical port (**Figure 33**), with barnacle collar, was encountered in 179 feet of water and the shallowest ports were observed in 165 feet of water.

Table 1. Anomalous ports on the 120-inch outfall
Port numbering begins at the terminus.

Side of Diffuser Leg	Port Number	Figure Number	Description * new observation during this survey. ǂ last observed with blockage in 2016
North	10	22	buried, no flow
North	15	23	buried, reduced flow (weeping)
South	7	24	blocked (internal obstruction), reduced flow
South	8	25	partially blocked (internal obstruction) ǂ, normal flow
South	11	26	partially blocked (internal obstruction), reduced flow
South	12	27	partially buried, reduced flow
South	13	28	buried, reduced flow (weeping)
South	20	29	partially blocked (internal obstruction)*, normal flow
South	21	30	buried, no flow


Figure 22: A buried port with no flow, 10th from the terminus, on the north side of the 120-inch outfall.


Figure 23: A buried port with reduced flow (weeping), 15th from the terminus, on the north side of the 120-inch outfall.


Figure 24: An internally blocked port with reduced flow, 7th from the terminus, on the south side of the 120-inch outfall.


Figure 25: A partially blocked port, 8th from the terminus, on the south side of the 120-inch outfall.


Figure 26: A partially blocked port with reduced flow, 11th from the terminus, on the south side of the 120-inch outfall.


Figure 27: A partially buried port with reduced flow, 12th from the terminus, on the south side of the 120-inch outfall.

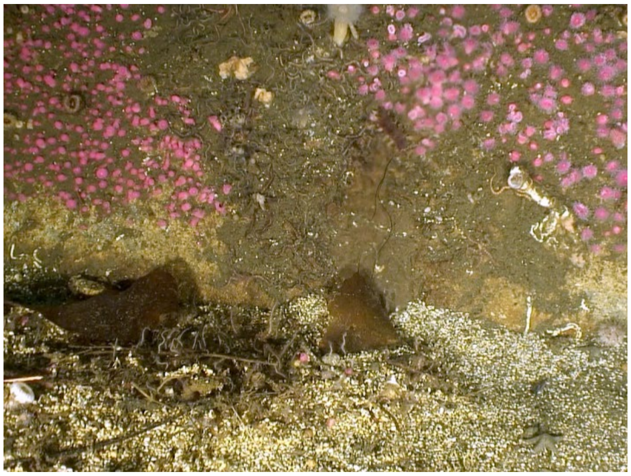

Figure 28: A buried port with reduced flow (weeping), 13th from the terminus, on the south side of the 120-inch outfall.

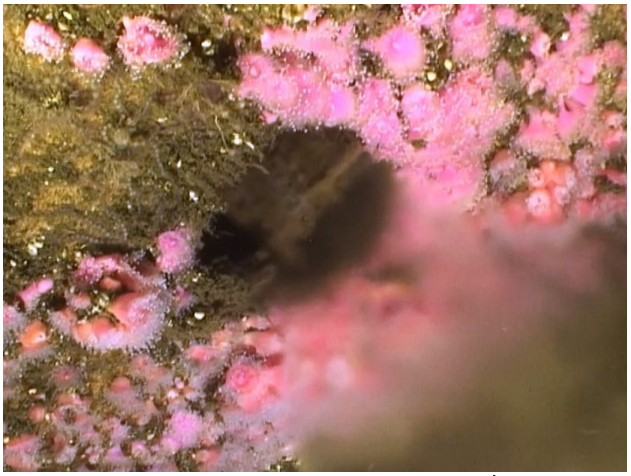

Figure 29: A partially blocked port, 20th from the terminus, on the south side of the 120-inch outfall.

Figure 30: A buried port with no flow, 21st from the terminus, on the south side of the 120-inch outfall.

Figure 31: Terminus ports located within the gravity door of the end structure on the 120-inch outfall.

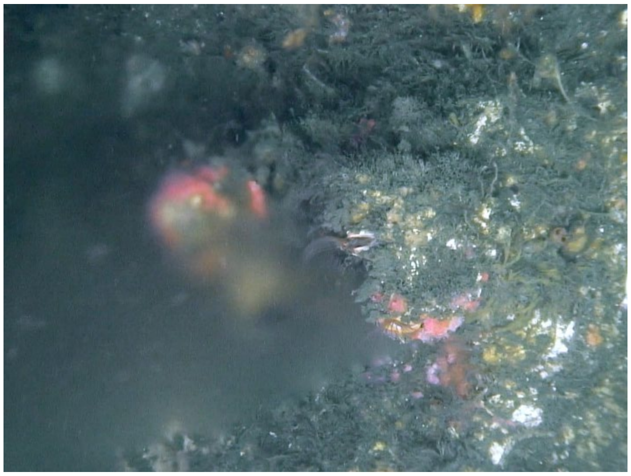

Figure 32: Barnacle collar formed around a port on the 120-inch outfall. Effluent flow does not appear to be altered by these collars.

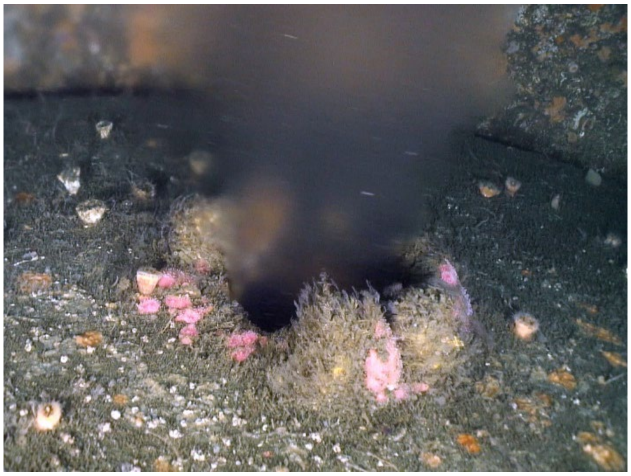

Figure 33: Vertical port encrusted with barnacles and other fouling animals on the 120-inch outfall.

A grit mound (sediments overlaying ballast material) was located on the north side of the diffuser leg between the fifth and thirteenth pipe sections. On the south side of the diffuser leg, a grit mound was located between the fourth and twelfth pipe sections. Even though the ballast rock levels along both sides of the diffuser leg and main barrel varied, there was no evidence of undercutting. The large 12-inch minus rock from the 1999 reballasting terminated at a depth of 50 feet (Appendix A).

The flush manhole covers and joints appeared to be in good condition with no evidence of corrosion. Of the 28 cast iron manhole covers, ranging in water depth from 194 to 48 feet, that were outfitted with aluminum anodes in 2015 (**Figure 34**), 23 were observed having detached cable connections (**Appendix B, Figure 35**). Three of those occurrences were new observations made during this survey.

Figure 34: Attached anode on the 120-inch outfall.

Figure 35: Detached anode on the 120-inch outfall.

Fishing nets were observed on and draped over the outfall at three locations. Several pieces of rope were seen at various locations on the outfall and within the ballast rock.

Vermilion Rockfish (*Sebastes miniatus*), various other rockfish species (*Sebastes spp*), Jack Mackerel (*Trachurus symmetricus*), Giant plumose anemones (*Metridium farcimen*), Strawberry anemones (*Corynactis californica*), Sea pens (Pennatuloidea), Painted urchins (*Lytechinus pictus*), Spiny brittle stars (*Ophiothrix spiculata*), Sheep crab (*Loxorhynchus grandis*), and California sea cucumbers (*Apostichopus californicus*) were seen within the diffuser section of the outfall. Schools of Blacksmith (*Chromis punctipinnis*) and high abundances of Gorgonians (*Muricea* spp), Brown cup corals (*Paracyathus stearnsii*), and Bat stars (*Patiria miniata*) were seen along the entire outfall. Within the inshore waters, high abundances of Kelp Bass (*Paralabrax clathratus*), California Sheephead (*Bodianus pulcher*), Red sea urchins (*Mesocentrotus franciscanus*), Purple sea urchins (*Strongylocentrotus purpuratus*), and Wavy turban snails (*Megastraea undosa*) were observed.

Based upon the 2023 surveys of the 120-inch outfall and comparisons with previous inspections, the outfall continues to function as designed. It is ballasted to the springline or above in all areas, including the grit mound areas. Within these areas, the original ballast is presumed buried under sediments but still stabilizes the outfall. Some areas of the outfall, including offshore and inshore portions, were completely buried under ballast rock. A total of nine diffuser ports, located near the offshore end structure, were buried or had some degree of blockage (1% of the total ports). All remaining diffuser ports appeared to be working as intended. Of the anodes installed to provide cathodic protection to the manholes, 82% have become detached. The outfall shows no signs of abnormal wear or deterioration.

90-inch Outfall

The ROV survey of the 90-inch outfall was performed on 17 and 18 October 2023, inspecting the wye structure (**Figure 36**), the west diffuser leg to the terminus in 224 feet of water, the east diffuser leg to the terminus in 217 feet of water, and the main barrel inshore to 64 feet of water. The diver survey of the 90-inch outfall was performed on 14 December 2023 beginning at the point where the ROV survey ended and terminating in 35 feet of water, where the pipe went below grade.

Figure 36: Wye structure on the 90-inch outfall.

All 105 ports were inspected, of which one had reduced flow caused by an internal obstruction (**Table 2, Figure 37**). Both termini ports located at the end of the diffuser legs were unobstructed (**Figures 38** and **39**). Several of the ports, including the vertical port located on the top of the wye structure, had various sized barnacle collars (**Figure 40**). Effluent flow out of these ports did not appear to be altered by the collars.

Table 2. Anomalous ports on the 90-inch outfall

Port numbering begins at the terminus.

Diffuser Leg and Side	Port Number	Figure Number	Description
East Leg North Side	3	37	partially blocked (internal obstruction), substantially reduced flow

Figure 37: A partially blocked port with substantially reduced flow, 3rd from the terminus, on the north side of the east diffuser leg of the 90-inch outfall.

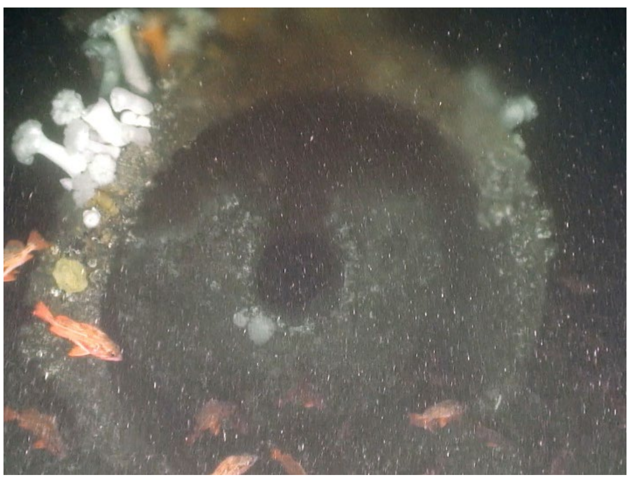

Figure 38: Terminus port with flow on the west diffuser leg of the 90-inch outfall.

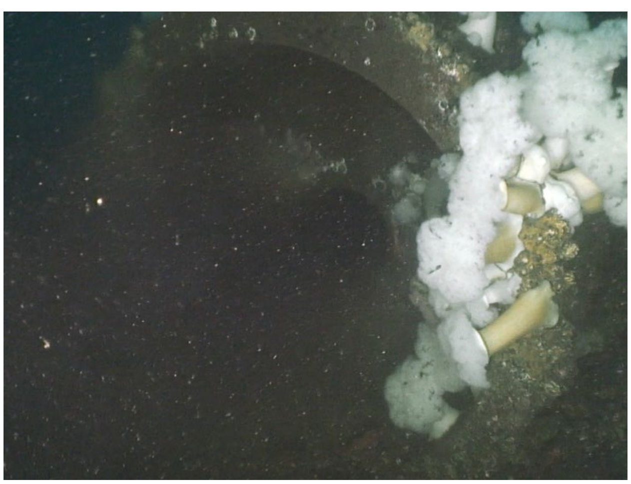

Figure 39: Terminus port with flow on the east diffuser leg of the 90-inch outfall.

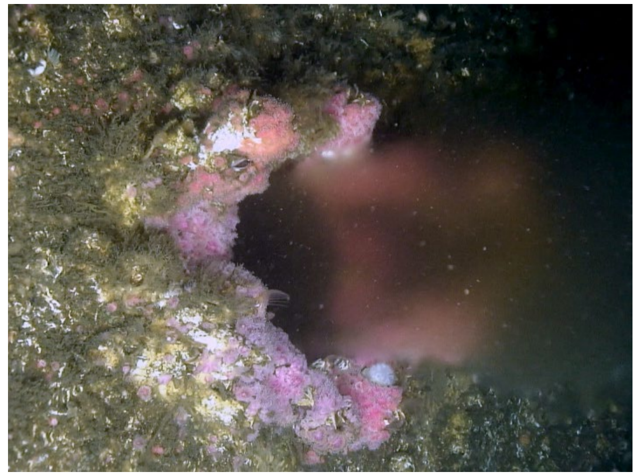

Figure 40: Barnacle collar formed around a port on the 90-inch outfall.

A grit mound area was located on the north side of the east diffuser leg between the third and eleventh pipe sections. On the south side of the east diffuser leg, a grit mound was located between the second and thirteenth pipe sections. Movement and shifting of the sediments has been observed in the grit mound area (LACSD 2023). Small areas of undercutting were observed in the grit mound area of the east diffuser leg (**Table 3, Figures 41-49**). These areas of undercutting are typically observed in pipe sections where ports are located. The observed undercutting does not appear to be affecting the stability of the outfall. Future surveys will continue to document any changes to these areas. Elsewhere, ballast rock levels varied along the diffuser legs and main barrel with some areas of the outfall completely buried under ballast rock. The large 12-inch minus rock from the 1999 reballasting terminated at a depth of 38 feet (Appendix A).

Table 3. Areas of Partial Undercutting on the 90-inch outfall

Pipe section numbering begins at the terminus.

Diffuser Leg and Side	Pipe Section Number	Figure Number	Description
East Leg North Side	2	41	length ~3 feet, depth 6-12 inches
East Leg South Side	2	42	length ~2 feet, depth 6-8 inches
East Leg South Side	3	43	length ~3 feet, depth 6-8 inches
East Leg North Side	4	44	length 2-3 feet, depth 6-8 inches
East Leg South Side	5	45	length 3-4 feet, depth 6-8 inches, similar undercutting observed on either side of the port in this section
East Leg North Side	10	46	length ~3 feet, depth 6-8 inches, similar undercutting observed on either side of the port in this section
East Leg South Side	11	47	length ~2 feet, depth 6-8 inches, similar undercutting observed on either side of the port in this section
East Leg North Side	12	48	length ~2 feet, depth 6-8 inches, similar undercutting observed on either side of the port in this section
East Leg South Side	12	49	length ~3 feet, depth 6-8 inches

Figure 41: Area of partial undercutting, 2nd pipe section from the terminus, on the north side of the east diffuser leg of the 90-inch outfall.

Figure 42: Area of partial undercutting, 2nd pipe section from the terminus, on the south side of the east diffuser leg of the 90-inch outfall.

Figure 43: Area of partial undercutting, 3rd pipe section from the terminus, on the south side of the east diffuser leg of the 90-inch outfall.

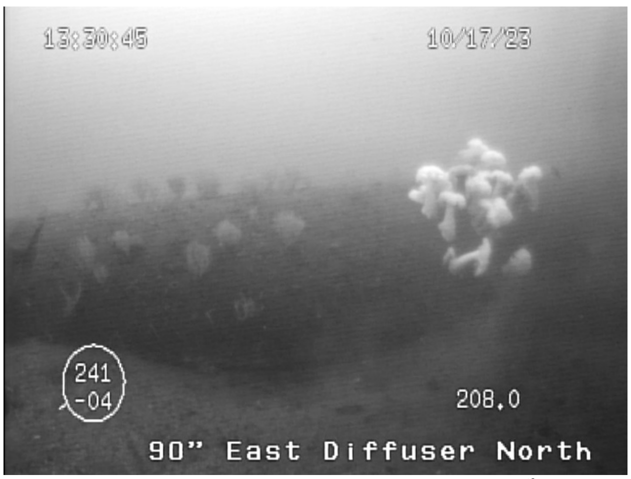

Figure 44: Area of partial undercutting, 4th pipe section from the terminus, on the north side of the east diffuser leg of the 90-inch outfall.

Figure 45: Area of partial undercutting, 5th pipe section from the terminus, on the south side of the east diffuser leg of the 90-inch outfall.

Figure 46: Area of partial undercutting, 10th pipe section from the terminus, on the north side of the east diffuser leg of the 90-inch outfall.

Figure 47: Area of partial undercutting, 11th pipe section from the terminus, on the south side of the east diffuser leg of the 90-inch outfall.

Figure 48: Area of partial undercutting, 12th pipe section from the terminus, on the north side of the east diffuser leg of the 90-inch outfall.

Figure 49: Area of partial undercutting, 12th pipe section from the terminus, on the south side of the east diffuser leg of the 90-inch outfall.

The flush manhole covers and joints appear to be in good condition with no evidence of corrosion. The majority of the hard rubber gaskets that wrap the exterior of the joints have been removed or partially unwrapped to expose the center of the joint during installation of the anodes in 2015. Of the 365 cast iron joints and 17 cast iron manhole covers, ranging in water depth from 215 to 40 feet, that were outfitted with aluminum anodes, 50 joints and 6 manhole covers were observed having detached cable connections (**Appendix C**). Eight detachments from joints and one detachment from a manhole cover were new observations for this survey. Seven manhole covers not listed in Appendix C were observed as not having anodes installed, one inshore of MH-90-0A, four between MH-90-0A and MH-90-001, and two between MH-90-001 and MH-90-002. The inshore wye structure (j-box) was encountered in 37 feet of water and appeared to be in good condition (Figure 9).

Fishing nets were observed draped over the outfall at two locations. Abandoned lobster traps were seen near the outfall at two locations. Several pieces of hard rubber gasket debris, anode cable debris, and rope were seen at various locations on the outfall and within the ballast rock. Two large tires, which have been encountered for several years, were again located at the edge of the ballast rock-sand interface, one in 108 feet of water and the other in 168 feet of water. A boat anchor was observed several feet from the outfall entangled with an anode that was previously reported as missing (**Figure 50).**

Figure 50: An anode that was previous reported missing entangled with a boat anchor several feet off of the 90-inch outfall.

High abundances of Giant plumose anemones, Strawberry anemones, and California sea cucumbers were seen within the diffuser leg sections of the outfall. Large schools of Blacksmith and high abundances of Bat stars, Gorgonians, and Brown cup corals were seen along the entire outfall. Congregating near the deeper tire and the terminus ends of the outfall were high abundances of Vermilion Rockfish. Within the inshore waters, high abundances of Kelp Bass, California Sheephead, and Wavy turban snails were observed.

Based upon the results of the 2023 surveys of the 90-inch outfall and comparisons with previous inspections, the outfall continues to function as designed. It is ballasted to the springline or above, except for the small areas of partial undercutting that were observed along the east diffuser leg. Within the grit mound areas, the original ballast is presumed buried under sediments but still stabilizes the outfall. Some areas of the outfall were completely buried under ballast rock. A single diffuser port on the east diffuser leg had an internal obstruction with reduced flow (< 1% of the total ports). All remaining diffuser ports appeared to be working as intended. Of the anodes installed to provide cathodic protection to the joints and manholes, 14% have detached from joints and 35% have detached from manholes. The outfall shows no signs of abnormal wear or deterioration.

72-inch Outfall

The ROV survey of the 72-inch outfall was performed on was performed on 25 October 2023, inspecting the wye structure (**Figure 51**), the west diffuser leg to the terminus in 165 feet of water, the east diffuser leg to the terminus in 164 feet of water, and the main barrel inshore to 56 feet of water. The diver survey of the 72-inch outfall was performed on 14 December 2023 beginning at the point where the ROV survey ended and terminating in 42 feet of water, where the outfall went below grade.

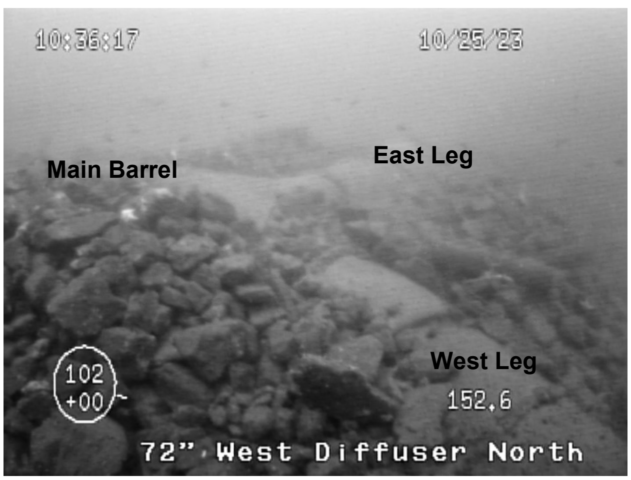

Figure 51: Wye structure of the 72-inch outfall.

All 56 ports were inspected, including the west and east diffuser leg termini ports (**Figures 52** and **53**, respectively), of which none had internal obstructions. Several of the ports had various sized barnacle collars. Without continuous effluent flow out of the ports, as seen in the 120- and 90-inch outfalls, the barnacle collars can develop over the ports causing differing degrees of external blockage. The shallowest ports were observed in 150 feet of water.


Figure 52: Terminus port on the west diffuser leg of the 72-inch outfall.


Figure 53: Terminus port on the east diffuser leg of the 72-inch outfall.

Transitioning out of the diffuser port section, the ballast rock level increased in height. Even though the ballast rock levels varied along the diffuser legs and main barrel, there was no evidence of undercutting. Some areas of the outfall were completely buried under ballast rock. The large 12-inch minus rock from the 1999 reballasting terminated at a depth of 44 feet (Appendix A).

The raised and flush manhole covers appeared to be in good condition with no evidence of corrosion. There are two pipe sections located in 105 feet of water that have two flush manhole covers per pipe section. Most of the joints appeared to be in good condition. Cracking within the joint collars was observed in 30 joints (**Figure 54, Appendix D**).

Deterioration of the joint collar, where portions of the concrete collar has spalled away from the joint, was observed in 33 joints (**Figure 55**, Appendix D). The deterioration of the concrete collars does not appear to affect the structural or functional integrity of the joint. All the encapsulated joints appear to be in good condition (**Figure 56**). Of the 214 cast iron joints and 10 cast iron manhole covers, ranging in water depth from 161 to 48 feet, that were outfitted with aluminum anodes in 2015, 54 joints and 7 manhole covers were observed having detached cable connections (Appendix D). Ten detachments from joints and one detachment from a manhole cover were new observations for this survey. Four manhole covers not listed in Appendix C were observed as not having anodes installed, located on two consecutive pipe sections between MH-72-009 and MH-72-010. Several pieces of anode cable debris and rope were seen at various locations on the outfall and within the ballast rock. A fishing pole was observed adjacent to the east diffuser leg terminus. Two moderately sized tires, which have been encountered in previous surveys, were again located within the ballast rock in 108 feet of water.

Figure 54: Cracked joint collar on the 72-inch outfall.

Figure 55: Deteriorating joint collar on the 72-inch outfall.

Figure 56: Encapsulated joint on the 72-inch outfall.

High abundances of Vermilion Rockfish, and various other Rockfish were seen within the diffuser leg sections of the outfall. Large schools of Blacksmith and high abundances of Bat stars, Gorgonians, and Brown cup corals were encountered along the entire outfall. Within the inshore waters, a large school of Jack Mackerel and high abundances of Red sea urchins and Wavy turban snails were observed.

Based upon the 2023 surveys of the 72-inch outfall and comparison with previous inspections, the outfall shows no signs of substantial structural problems. It is ballasted to the springline or above and completely buried under ballast rock in some areas. Although several ports have various sized barnacle collars, none appeared to have internal obstructions that would compromise functionality. The majority of the concrete joint collars appear to be in good condition. Although deterioration of some collars is evident, with 28% of the joints displaying either cracking or deterioration of the concrete collar, the underlying joints appear to be undamaged. Of the anodes installed to provide cathodic protection to the joints and manholes, 25% have detached from joints and 70% have detached from manholes. This outfall appears to be able to function in its role of providing hydraulic relief for flow in the outfall system during times of heavy rains.

60-inch Outfall

The ROV survey of the 60-inch outfall was performed on 25 and 26 October 2023, inspecting the entirety of the outfall from the tri-jet end structure in 110 of water and terminating in 65 feet of water, where the outfall went below grade.

The tri-jet end structure appears to be structurally sound even though the support girder has been detached since 2015 (**Figure 57).** The stainless steel crossbar installed inside the middle jet in 2001 to prevent diver access was observed intact. The steel plate on the west jet shows signs of corrosion, though the steel plate is still intact (**Figure 58)**. The steel plate covering the east jet has partially corroded away, creating an opening in the end structure that is still too small for diver access (**Figure 59**).

Figure 57: Tri-jet end structure of the 60-inch outfall showing the stainless steel crossbar within the middle jet. Little to no ballast material remains supporting the structure.

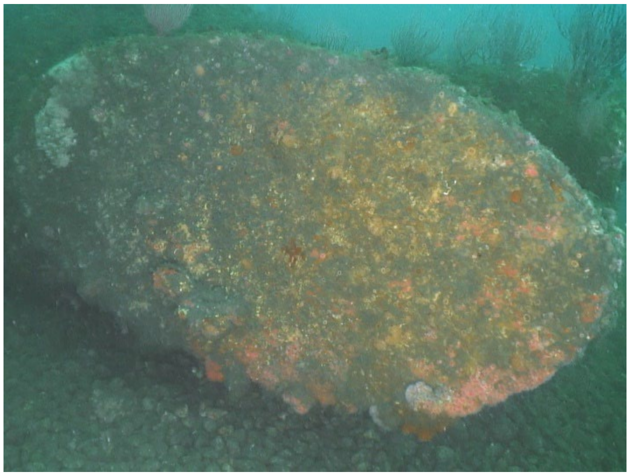
Figure 58: Signs of corrosions on the steel plate covering the west jet of the tri-jet end structure on the 60-inch outfall.


Figure 59: Partially corroded steel plate covering the east jet of the tri-jet end structure on the 60-inch outfall.

All 42 ports on the main barrel were inspected and none had internal obstructions. All of the ports had various sized barnacle collars, with several of the ports appearing to be entirely encrusted. Without continuous effluent flow out of the ports, as seen in the 120- and 90-inch outfalls, the barnacle collars can develop over the ports causing differing degrees of external blockage (**Figure 60**). The shallowest ports were observed in 98 feet of water.

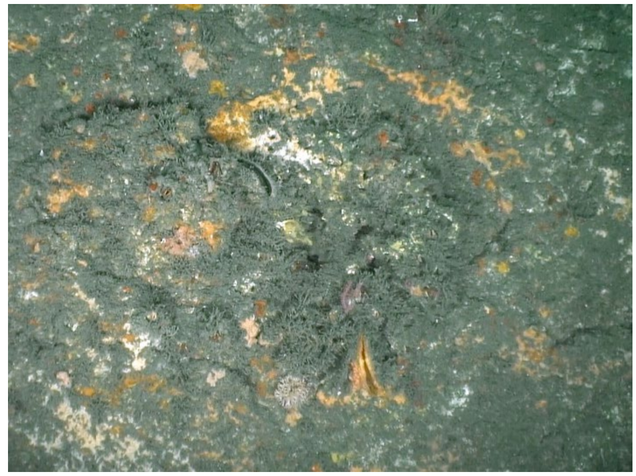
Figure 60: Barnacle collar formed around and over a port on the 60-inch outfall.

Ballast rock and/or sediment height generally fluctuated between the springline and below the lower quarter point of the outfall, except for the farthest offshore portion of the tri-jet end structure. As seen for several decades, little to no ballast material remains supporting the tri-jet end structure (Figure 57). The sand/cement bags that were placed along the outfall during the 1997 reballasting project to maintain outfall alignment and prevent undercutting (Appendix A) were encountered along both sides of the outfall and appeared to be in good condition (**Figure 61**). There was no evidence of undercutting along the main barrel of the outfall.


Figure 61: Sand/cement bags placed along the 60-inch outfall during the 1997 reballasting project.

The raised manhole covers appeared to be in functional condition with no evidence of corrosion. The inner most raised manhole cover, located in a water depth of 66 feet and fitted with six C-clamps in late 2015 (LACSD 2016), was inspected to ensure all clamps were secure (**Figure 62**). Divers conducted dives to this manhole on 20 January 2023 and 14 June 2023 and insured that the installed C-clamps were still secured. Additional dives on the manhole throughout the year will continue until new permanent clamps can be made and installed.

Figure 62: Six C-clamps were installed onto the inner most raised manhole in late 2015 on the 60-inch outfall.

Although heavily corroded, the thick cast iron joints appear structurally intact and hydraulically tight. The joints with block repairs are in various stages of deterioration (**Figure 63**). The fifth inner most block repair exhibited considerable deterioration since the 2022 outfall inspection, with nearly the entire repair breaking apart from the joint (**Figure 64**). Though deteriorating, the underlying joints appeared to be in a similar or slightly better condition than the other joints on this outfall.

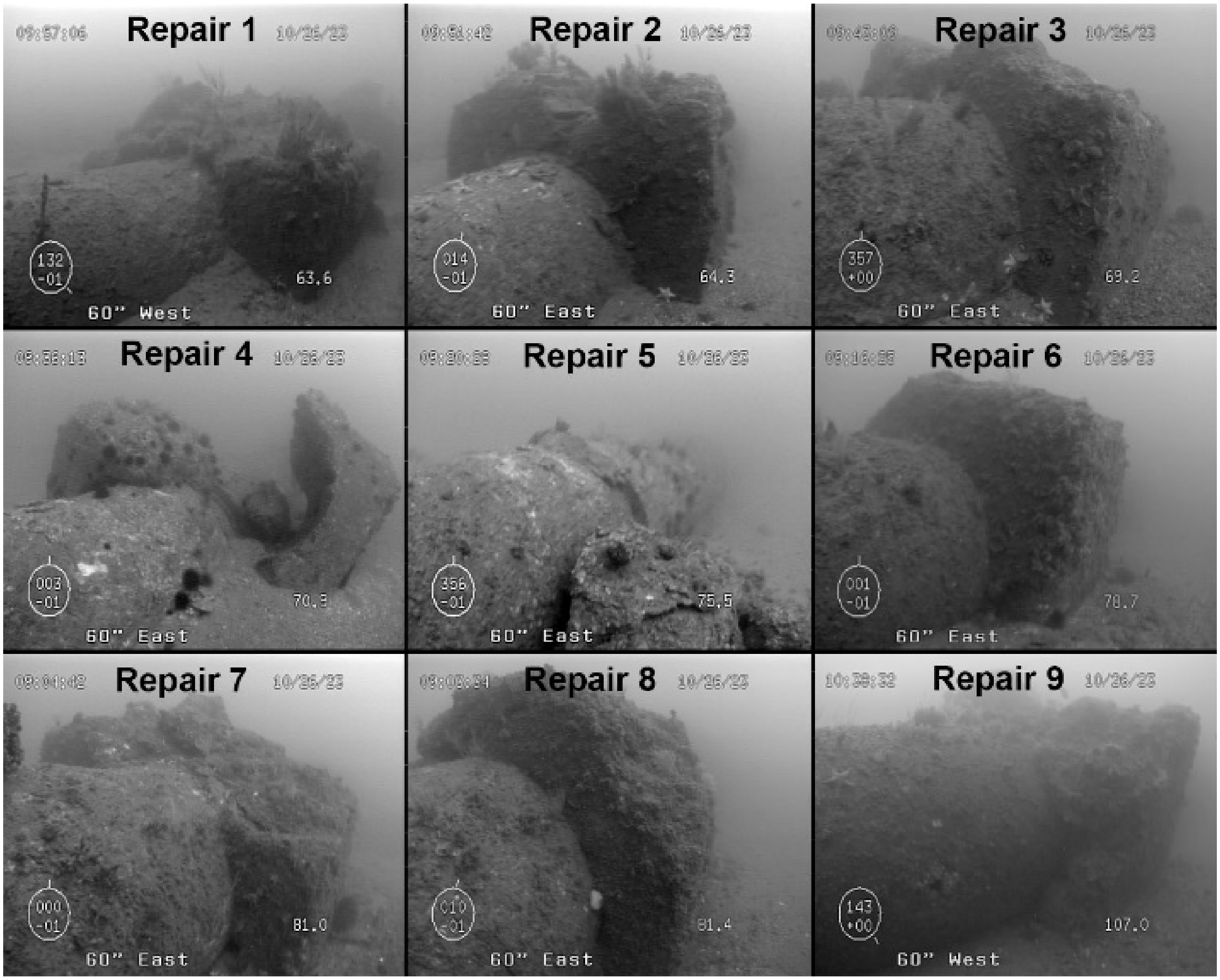

Figure 63: All the block repairs on the 60-inch outfall. The numbering starts at the most inshore repair.

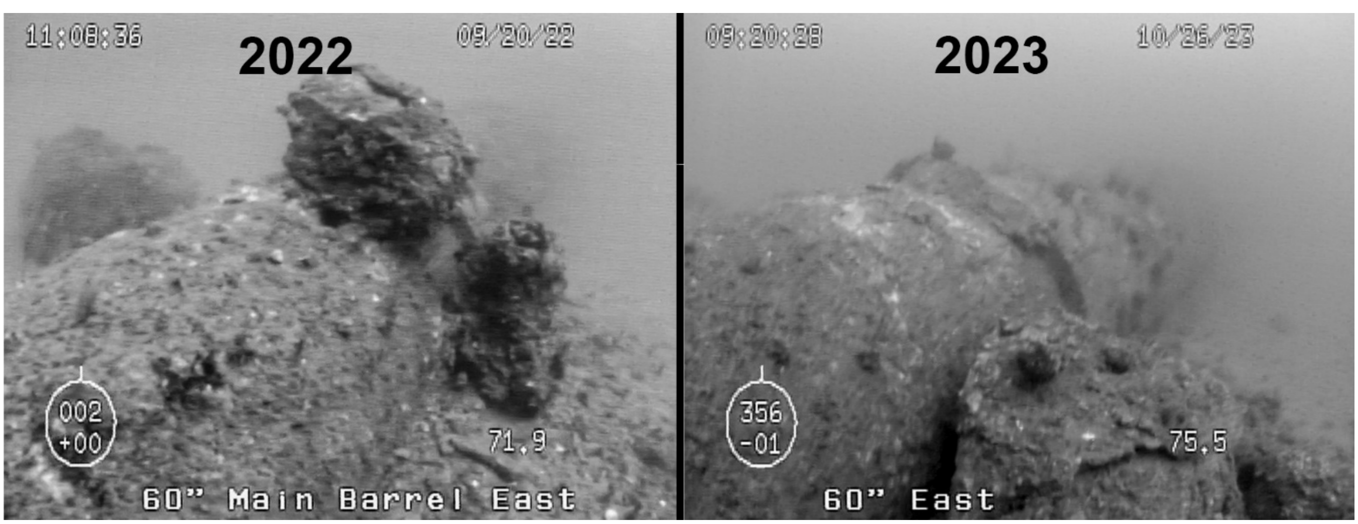

Figure 64: A comparison of the 5th inner most block repair between the 2022 outfall inspection and the 2023 outfall inspection, showing extensive deterioration.

Concrete spalls were frequently encountered along the length of the outfall, many of which extended deep enough to expose the steel rebar (**Figure 65**). Much of the exterior concrete is brittle and could be easily removed or dislodged, although the underlying concrete is hard. The most severe spalling was observed near the joints.

Figure 65: Area of spalling on the 60-inch outfall.

Fragments of fishing nets were observed draped over the outfall at two locations. Debris observed on the 60-inch outfall during this survey also included an abandoned lobster trap next to the outfall in a depth of 107 feet of water, a fishing pole adjacent to the outfall, and several pieces of rope at various locations on and alongside the outfall.

Jack Mackerel, high abundances of Strawberry anemones, and Rock scallops (*Crassadoma gigantea*) were seen within the offshore waters. High abundances of Blacksmith, California Sheephead, Bat stars, Gorgonians, and Brown cup corals were encountered along the entire outfall. Within the inshore waters, high abundances of Red sea urchins, and Wavy turban snails were observed.

Based on the 2023 survey, the cast iron terminus, while heavily corroded and with the support girder no longer in place, appears to be structurally sound. The steel plates retrofitted to the end structure in 1954 are in various stages of deterioration. Although several ports have various sized barnacle collars, none appeared to have internal obstructions that would compromise functionality. Other than the terminus, there were no visible areas of undercutting along the outfall. The temporary C-clamps installed on the inner most raised manhole cover appear to be working sufficiently. Concrete spalls were frequently encountered along the entire outfall length, many of which extended deep enough to expose the steel rebar. Much of the exterior concrete is brittle and could be easily removed. No visible cracks into the outfall were observed. Despite these conditions, this outfall appears to be able to function under its currently permitted use as a standby outfall to provide additional hydraulic relief during the very heaviest flows.

CONCLUSIONS

The 120-inch outfall continues to function as designed. It is ballasted to the spring line or above in all areas, including the grit mound area. Within this area, the original ballast is presumed buried under sediments but still stabilizes the outfall. Some areas of the outfall, including offshore and inshore portions, were completely buried under ballast rock. Nine diffuser ports, located near the offshore terminus, were buried or had some degree of blockage (1% of the total ports). All remaining diffuser ports appeared to be working as intended. The outfall shows no signs of abnormal wear or deterioration.

The 90-inch outfall continues to function as designed. It is ballasted to the springline or above, except for small areas of partial undercutting observed along the east diffuser leg. Within the grit mound areas, the original ballast is presumed buried under sediments but still stabilizes the outfall. Some areas of the outfall were completely buried under ballast rock. A single port along the east diffuser leg had an internal obstruction with reduced flow (<1% of the total ports). All remaining diffuser ports appeared to be working as intended. The outfall shows no signs of abnormal wear or deterioration.

The 72-inch outfall, although not used on a regular basis, shows no signs of substantial structural problems. It is ballasted to the spring line or above and completely buried under ballast rock in some areas. Although several diffuser ports had various sized barnacle collars, none appeared to have internal obstructions that would compromise functionality. The majority of the concrete joint collars appear to be in good condition. Although deterioration of some collars is evident, the underlying joints appear to be undamaged. This outfall appears to be able to function in its role of providing hydraulic relief during times of heavy rains.

The 60-inch outfall, although not used on a regular basis, shows no signs of substantial structural problems. Ballast rock and/or sediment height generally fluctuated between the springline and below the lower quarter point of the outfall, except for the farthest offshore portion of the tri-jet end structure which has little to no ballast material. The cast iron terminus structure, while heavily corroded and with the support girder dislodged, appears to be structurally sound. The steel plates retrofitted to the end structure in 1954 are in various stages of deterioration. Although several diffuser ports had various sized barnacle collars, none appeared to have internal obstructions that would compromise functionality. The temporary C-clamps installed on the inner most raised manhole cover appear to be working sufficiently. Concrete spalls were frequently encountered along the entire outfall length, many of which extended deep enough to expose the steel rebar. Much of the exterior concrete is brittle and could be easily removed. No visible cracks into the outfall were observed. Despite these conditions, the outfall appears to be able to function under current permitted use as a standby outfall to provide additional hydraulic relief during the very heaviest flows.

Overall, the WWRF ocean outfall system, consisting of two continuously operated outfalls (120- and 90-inch), one occasional use outfall (72-inch), and a standby outfall (60-inch), appears sound and continues to serve the intended purpose. There are no observable structural problems in the system and all the outfalls seem to be in a condition that ensures continued safe operation. To extend the life expectancy of the three largest outfalls, cathodic protection was added to the cast iron component on 634 joints and manhole covers in 2015. The cathodic protection consisted of an aluminum anode that was connected to the cast iron component with a cable. In 2023, approximately 22% of the cable connections were observed to be detached. Plans are currently under development to determine the best design for cable reattachment. The proposed cathodic protection repair project would include the replacement of detached anodes and upgrades to all other anodes of the cast iron joints and manhole covers on three of the four existing JOS outfalls. Existing anodes will be removed and replaced at each location by one proposed 190-lbs anode along each of the 72-, 90-, and 120-inch outfalls. Based on conservative assumptions, the anodes are expected to have a design life of 50 years, at which point, they could be replaced. During this time and when functioning properly, there should be little to no corrosion occurring.

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APPENDIX A

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APPENDIX A: History of the Sanitation Districts Outfall System Inspections

Since the early 1970s, the NPDES Monitoring and Reporting Program for WWRF has required external visual inspections at least once every five years of the entire above grade lengths of all four outfalls. This is to determine if the outfall structures are in serviceable condition and to ensure their continued safe operation. In the mid 1990s, the Sanitation Districts voluntarily began annual inspections of the outfalls. In 2006, the revised NPDES Permit increased the required inspection frequency to yearly. These inspections were conducted by a manned submersible until 2002, when the Sanitation Districts took over the inspections using a ROV. Since neither the submersible nor the ROV could operate in kelp beds, the Sanitation Districts began supplementing the annual inspections of inshore portions of the outfalls with visual surveys by the Sanitation Districts' SCUBA divers in the mid 1990s. The diver surveys include occasional scraping or probing of the outfall structures to help determine serviceability.

Reballasting Projects

Several of the submersible and diving surveys in the 1990s detected various sites or lengths of pipe on all four outfalls that had lost significant amounts of small sized ballast rock originally placed next to the outfalls to maintain their alignment and prevent undercutting. Ballast rock losses were likely caused by long-term erosion from storm wave action. In response to these observations, the Sanitation Districts performed numerous outfall repair projects in 1992, 1997, and 1999 at a cost of approximately four million dollars (**Figure A1**). Those projects involved placing thousands of tons of small rock and/or bags of sand/cement along the outfalls, repairing minor joint fractures, and obtaining concrete core samples.

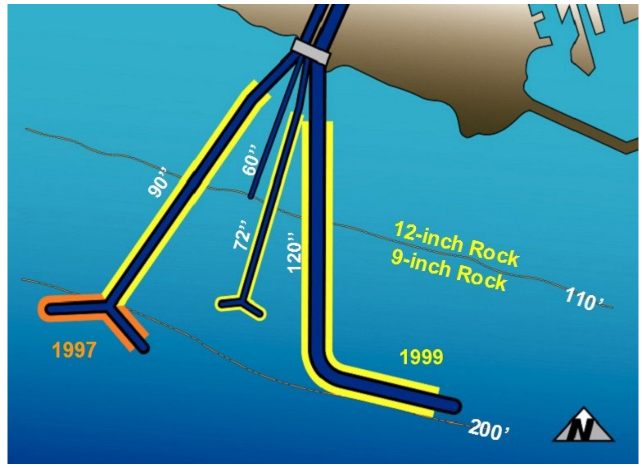

Figure A1: The ocean outfalls and portions reballasted in 1997 (orange) and 1999 (yellow), two of the more extensive reballasting projects.

In 1992, ballast material was added to the wye-shaped diffuser legs of the 72- and 90-inch outfalls. In 1997, most of the diffuser leg sections of the 90-inch outfall were again reballasted. Also in 1997 and separate from the 90-inch reballasting project, select pipe sections along the 60- and 72-inch outfalls received diver placed rock overlaid by sand/cement bags. In 1999, the most extensive of these repairs placed 36,000 tons of 9-inch and 12-inch minus rock along almost 21,500 linear feet of pipe on the three largest outfalls. Nearly the entire 120-inch outfall, with the exception of the last several hundred feet of the offshore section of the diffuser leg, was reballasted. The end of the diffuser section had an abundance of original ballast rock overlaid with sediments (grit mound area) and was therefore not reballasted. Sediments around individual ports in the grit mound area were excavated during the reballasting. During the same project, the entire length of the 72-inch outfall deeper than a depth of 50 feet and the 90-inch outfall inshore of the wye structure to a depth of 50 feet were reballasted.

Upon completion of the 1999 reballasting, the condition of the ballast material on the three largest outfalls was very robust due to the substantial quantities of large sized rock placed around them. A detailed report describing the 1999 ballast repair project was submitted to the Los Angeles Regional Water

Quality Control Board (LACSD 2000).

Life Expectancy Projects

In 2009, the Sanitation Districts evaluated the cast iron joints and main barrel of the 72- and 90-inch outfalls and the main barrel of the 120-inch outfall using cored samples from several depths along each pipe. The reinforced steel in all of the concrete pipes showed no signs of corrosion. The cast iron joints showed some signs of corrosion. By using calculations based on the amount of previous corrosion and the remaining thickness of the joint, it was estimated that the 72-inch, 90-inch, and 120-inch outfalls have remaining useful lives of 40, 60, and 60+ years, respectively (LACSD 2010). These projections are based on when the joint's wall thickness could minimally meet needed pressure capacities experienced in wet weather flow periods. These life expectancies are based on conservative assumptions and factors applied in the calculations of pipe corrosion and assume that no work will be done to extend the life of the outfalls during the 40 to 60 year period.

In an effort to extend the life expectancies of the outfalls, Sanitation Districts' engineers designed and tested the feasibility of adding cathodic protection. In late February of 2014, a contractor attached a single test aluminum anode approximately four feet in length to the cast iron component of a joint on the 90-inch outfall in approximately 52 feet of water (top of pipe). The joint connection is located on the top of the outfall, while the anode resides within the ballast rock along the west side of the outfall (**Figure A2**). With the success of the test anode installation, additional anodes were installed.

Figure A2: Aluminum anode, approximately four feet in length, residing within ballast rock along the west side of the 90-inch outfall. The joint connection is located on the top of the outfall.

In late 2015, a contractor attached 634 aluminum anodes to the cast iron components of the joints and manhole covers of the 72- and 90-inch outfalls and the cast iron component of the manhole covers of the 120-inch outfall to provide cathodic protection. The anode connections are located on the top of the outfall centered within the joint or centered on the manhole cover while the anodes, approximately four feet in length, reside within the ballast rock along the side or in a few cases, on top of the outfalls. Based on conservative assumptions, the anodes are expected to last for 50 years, at which point, they could be replaced. During this time and when functioning properly, there should be little to no corrosion occurring on the cast iron joints or manhole covers.

APPENDIX B

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APPENDIX B: Anode installation and inspection observations, 120-inch outfall

Installation Date	Tag Number	Most Recent Inspection Date	Observation * new observation during this survey
21 Nov 2015	MH-120-001	14 Dec 2023	cable detached at manhole
21 Nov 2015	MH-120-002	14 Dec 2023	cable detached at manhole
21 Nov 2015	MH-120-003	14 Dec 2023	cable detached at manhole
22 Nov 2015	MH-120-004	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-005	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-006	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-007	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-008	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-009	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-010	24 Oct 2023	attached
22 Nov 2015	MH-120-011	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-012	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-013	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-014	24 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-015	20 Oct 2023	cable detached at manhole*
22 Nov 2015	MH-120-016	20 Oct 2023	cable detached at manhole
22 Nov 2015	MH-120-017	20 Oct 2023	cable detached at manhole*
23 Nov 2015	MH-120-018	20 Oct 2023	attached
23 Nov 2015	MH-120-019	20 Oct 2023	cable detached at manhole*
23 Nov 2015	MH-120-020	20 Oct 2023	attached
23 Nov 2015	MH-120-021	20 Oct 2023	cable detached at manhole
23 Nov 2015	MH-120-022	20 Oct 2023	attached
23 Nov 2015	MH-120-023	20 Oct 2023	attached
23 Nov 2015	MH-120-024	20 Oct 2023	cable detached at manhole
23 Nov 2015	MH-120-025	20 Oct 2023	cable detached at manhole
23 Nov 2015	MH-120-026	20 Oct 2023	cable detached at manhole
23 Nov 2015	MH-120-027	20 Oct 2023	cable detached at manhole
24 Nov 2015	MH-120-028	20 Oct 2023	cable detached at manhole

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APPENDIX C

APPENDIX C: Anode installation and inspection observations, 90-inch outfall.

Installation Date	Tag Number	Most Recent Inspection Date	Observation * new observation during this survey
03 Dec 2015	JT-90-A1	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A2	17 Oct 2023	attached
03 Dec 2015	JT-90-A3	17 Oct 2023	attached
03 Dec 2015	JT-90-A4	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A5	17 Oct 2023	cable detached at joint*
03 Dec 2015	JT-90-A6	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A7	17 Oct 2023	attached
03 Dec 2015	JT-90-A8	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A9	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A10	17 Oct 2023	attached
03 Dec 2015	JT-90-A11	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A12	17 Oct 2023	attached
03 Dec 2015	JT-90-A13	17 Oct 2023	cable detached at joint
03 Dec 2015	JT-90-A14	17 Oct 2023	attached
03 Dec 2015	JT-90-A15	17 Oct 2023	attached
03 Dec 2015	JT-90-A16	14 Dec 2023	cable detached at joint
03 Dec 2015	JT-90-A17	14 Dec 2023	2 anodes attached, test anode installed in 2014
03 Dec 2015	JT-90-A18	14 Dec 2023	attached
03 Dec 2015	JT-90-A19	14 Dec 2023	attached
03 Dec 2015	JT-90-A20	14 Dec 2023	cable detached at joint
03 Dec 2015	JT-90-A21	14 Dec 2023	cable detached at joint
03 Dec 2015	JT-90-A22	14 Dec 2023	attached
03 Dec 2015	JT-90-A23	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A24	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A25	14 Dec 2023	attached
04 Dec 2015	JT-90-A26	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A27	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A28	14 Dec 2023	attached
04 Dec 2015	JT-90-A29	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A30	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A31	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A32	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A33	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A34	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A35	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A36	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A37	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A38	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A39	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A40	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A41	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A42	14 Dec 2023	cable detached at joint, entire pod

04 Dec 2015	JT-90-A43	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A44	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A45	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A46	14 Dec 2023	cable detached at joint
04 Dec 2015	JT-90-A47	14 Dec 2023	anode not installed, joint buried
04 Dec 2015	JT-90-A48	14 Dec 2023	cable detached at joint
05 Nov 2015	JT-90-001	18 Oct 2023	attached
05 Nov 2015	JT-90-002	18 Oct 2023	attached
05 Nov 2015	JT-90-003	18 Oct 2023	attached
05 Nov 2015	JT-90-004	18 Oct 2023	attached
05 Nov 2015	JT-90-005	18 Oct 2023	attached
05 Nov 2015	JT-90-006	18 Oct 2023	attached
05 Nov 2015	JT-90-007	18 Oct 2023	cable detached at joint*
05 Nov 2015	JT-90-008	18 Oct 2023	attached
05 Nov 2015	JT-90-009	18 Oct 2023	attached
05 Nov 2015	JT-90-010	18 Oct 2023	attached
05 Nov 2015	JT-90-011	18 Oct 2023	attached
05 Nov 2015	JT-90-012	18 Oct 2023	attached
05 Nov 2015	JT-90-013	18 Oct 2023	attached
05 Nov 2015	JT-90-014	18 Oct 2023	attached
05 Nov 2015	JT-90-015	18 Oct 2023	attached
05 Nov 2015	JT-90-016	18 Oct 2023	attached
05 Nov 2015	JT-90-017	18 Oct 2023	attached
05 Nov 2015	JT-90-018	18 Oct 2023	attached
05 Nov 2015	JT-90-019	18 Oct 2023	attached
05 Nov 2015	JT-90-020	18 Oct 2023	attached
05 Nov 2015	JT-90-021	18 Oct 2023	attached
06 Nov 2015	JT-90-022	18 Oct 2023	cable detached at joint
06 Nov 2015	JT-90-023	18 Oct 2023	attached
06 Nov 2015	JT-90-024	18 Oct 2023	attached
06 Nov 2015	JT-90-025	18 Oct 2023	attached
06 Nov 2015	JT-90-026	18 Oct 2023	attached
06 Nov 2015	JT-90-027	18 Oct 2023	attached
06 Nov 2015	JT-90-028	18 Oct 2023	attached
06 Nov 2015	JT-90-029	18 Oct 2023	attached
06 Nov 2015	JT-90-030	18 Oct 2023	attached
06 Nov 2015	JT-90-031	18 Oct 2023	attached
06 Nov 2015	JT-90-032	18 Oct 2023	attached
06 Nov 2015	JT-90-033	18 Oct 2023	attached
06 Nov 2015	JT-90-034	18 Oct 2023	attached
06 Nov 2015	JT-90-035	18 Oct 2023	attached
06 Nov 2015	JT-90-036	18 Oct 2023	cable detached at joint
06 Nov 2015	JT-90-037	18 Oct 2023	attached
06 Nov 2015	JT-90-038	18 Oct 2023	attached
06 Nov 2015	JT-90-039	18 Oct 2023	attached
06 Nov 2015	JT-90-040	18 Oct 2023	attached
06 Nov 2015	JT-90-041	18 Oct 2023	attached

06 Nov 2015	JT-90-042	18 Oct 2023	cable detached at joint
06 Nov 2015	JT-90-043	18 Oct 2023	attached
06 Nov 2015	JT-90-044	18 Oct 2023	attached
06 Nov 2015	JT-90-045	18 Oct 2023	attached
06 Nov 2015	JT-90-046	18 Oct 2023	attached
06 Nov 2015	JT-90-047	18 Oct 2023	attached
06 Nov 2015	JT-90-048	18 Oct 2023	attached
06 Nov 2015	JT-90-049	18 Oct 2023	attached
06 Nov 2015	JT-90-050	18 Oct 2023	attached
06 Nov 2015	JT-90-051	18 Oct 2023	attached
06 Nov 2015	JT-90-052	18 Oct 2023	attached
06 Nov 2015	JT-90-053	18 Oct 2023	attached
06 Nov 2015	JT-90-054	18 Oct 2023	attached
06 Nov 2015	JT-90-055	18 Oct 2023	attached
06 Nov 2015	JT-90-056	18 Oct 2023	attached
06 Nov 2015	JT-90-057	18 Oct 2023	attached
06 Nov 2015	JT-90-058	18 Oct 2023	attached
06 Nov 2015	JT-90-059	18 Oct 2023	attached
06 Nov 2015	JT-90-060	18 Oct 2023	attached
06 Nov 2015	JT-90-061	18 Oct 2023	cable detached at joint*
06 Nov 2015	JT-90-062	18 Oct 2023	attached
06 Nov 2015	JT-90-063	18 Oct 2023	attached
06 Nov 2015	JT-90-064	18 Oct 2023	attached
06 Nov 2015	JT-90-065	18 Oct 2023	attached
06 Nov 2015	JT-90-066	18 Oct 2023	attached
06 Nov 2015	JT-90-067	18 Oct 2023	attached
06 Nov 2015	JT-90-068	18 Oct 2023	attached
06 Nov 2015	JT-90-069	18 Oct 2023	attached
07 Nov 2015	JT-90-070	18 Oct 2023	attached
07 Nov 2015	JT-90-071	18 Oct 2023	attached
07 Nov 2015	JT-90-072	18 Oct 2023	attached
07 Nov 2015	JT-90-073	18 Oct 2023	attached
07 Nov 2015	JT-90-074	18 Oct 2023	attached
07 Nov 2015	JT-90-075	18 Oct 2023	cable detached at joint
07 Nov 2015	JT-90-076	18 Oct 2023	attached
07 Nov 2015	JT-90-077	18 Oct 2023	attached
07 Nov 2015	JT-90-078	18 Oct 2023	attached
07 Nov 2015	JT-90-079	18 Oct 2023	attached
07 Nov 2015	JT-90-080	18 Oct 2023	attached
07 Nov 2015	JT-90-081	18 Oct 2023	attached
07 Nov 2015	JT-90-082	18 Oct 2023	attached
07 Nov 2015	JT-90-083	18 Oct 2023	attached
07 Nov 2015	JT-90-084	18 Oct 2023	attached
07 Nov 2015	JT-90-085	18 Oct 2023	attached
07 Nov 2015	JT-90-086	18 Oct 2023	attached
07 Nov 2015	JT-90-087	18 Oct 2023	attached
07 Nov 2015	JT-90-088	18 Oct 2023	attached

07 Nov 2015	JT-90-089	18 Oct 2023	cable detached at joint
07 Nov 2015	JT-90-090	18 Oct 2023	attached
07 Nov 2015	JT-90-091	18 Oct 2023	attached
07 Nov 2015	JT-90-092	18 Oct 2023	attached
07 Nov 2015	JT-90-093	18 Oct 2023	attached
07 Nov 2015	JT-90-094	18 Oct 2023	cable detached at joint
07 Nov 2015	JT-90-095	18 Oct 2023	attached
07 Nov 2015	JT-90-096	18 Oct 2023	attached
07 Nov 2015	JT-90-097	18 Oct 2023	attached
07 Nov 2015	JT-90-098	18 Oct 2023	attached
07 Nov 2015	JT-90-099	18 Oct 2023	attached
07 Nov 2015	JT-90-100	18 Oct 2023	attached
07 Nov 2015	JT-90-101	18 Oct 2023	attached
07 Nov 2015	JT-90-102	18 Oct 2023	attached
07 Nov 2015	JT-90-103	18 Oct 2023	attached
07 Nov 2015	JT-90-104	18 Oct 2023	attached
08 Nov 2015	JT-90-105	18 Oct 2023	attached
08 Nov 2015	JT-90-106	18 Oct 2023	attached
08 Nov 2015	JT-90-107	18 Oct 2023	attached
08 Nov 2015	JT-90-108	18 Oct 2023	attached
08 Nov 2015	JT-90-109	18 Oct 2023	attached
08 Nov 2015	JT-90-110	18 Oct 2023	attached
09 Nov 2015	JT-90-111	18 Oct 2023	attached
09 Nov 2015	JT-90-112	18 Oct 2023	attached
09 Nov 2015	JT-90-113	18 Oct 2023	attached
09 Nov 2015	JT-90-114	18 Oct 2023	attached
09 Nov 2015	JT-90-115	18 Oct 2023	attached
09 Nov 2015	JT-90-116	18 Oct 2023	cable detached at joint
09 Nov 2015	JT-90-117	18 Oct 2023	cable detached at joint*
12 Nov 2015	JT-90-118	18 Oct 2023	attached
12 Nov 2015	JT-90-119	18 Oct 2023	attached
12 Nov 2015	JT-90-120	18 Oct 2023	attached
12 Nov 2015	JT-90-121	18 Oct 2023	attached
12 Nov 2015	JT-90-122	18 Oct 2023	attached
12 Nov 2015	JT-90-123	18 Oct 2023	attached
12 Nov 2015	JT-90-124	18 Oct 2023	attached
12 Nov 2015	JT-90-125	18 Oct 2023	attached
12 Nov 2015	JT-90-126	18 Oct 2023	attached
12 Nov 2015	JT-90-127	18 Oct 2023	attached
12 Nov 2015	JT-90-128	18 Oct 2023	attached
12 Nov 2015	JT-90-129	18 Oct 2023	attached
12 Nov 2015	JT-90-130	18 Oct 2023	attached
12 Nov 2015	JT-90-131	18 Oct 2023	attached
12 Nov 2015	JT-90-132	18 Oct 2023	attached
12 Nov 2015	JT-90-133	18 Oct 2023	attached
12 Nov 2015	JT-90-134	18 Oct 2023	attached
12 Nov 2015	JT-90-135	18 Oct 2023	attached

13 Nov 2015	JT-90-136	18 Oct 2023	attached
13 Nov 2015	JT-90-137	18 Oct 2023	attached
13 Nov 2015	JT-90-138	18 Oct 2023	attached
13 Nov 2015	JT-90-139	18 Oct 2023	attached
13 Nov 2015	JT-90-140	18 Oct 2023	attached
13 Nov 2015	JT-90-141	18 Oct 2023	attached
13 Nov 2015	JT-90-142	18 Oct 2023	attached
13 Nov 2015	JT-90-143	18 Oct 2023	attached
13 Nov 2015	JT-90-144	18 Oct 2023	attached
13 Nov 2015	JT-90-145	18 Oct 2023	attached
13 Nov 2015	JT-90-146	18 Oct 2023	attached
13 Nov 2015	JT-90-147	18 Oct 2023	attached
13 Nov 2015	JT-90-148	18 Oct 2023	attached
13 Nov 2015	JT-90-149	18 Oct 2023	attached
13 Nov 2015	JT-90-150	18 Oct 2023	attached
13 Nov 2015	JT-90-151	18 Oct 2023	attached
13 Nov 2015	JT-90-152	18 Oct 2023	attached
13 Nov 2015	JT-90-153	18 Oct 2023	attached
13 Nov 2015	JT-90-154	18 Oct 2023	attached
13 Nov 2015	JT-90-155	18 Oct 2023	attached
13 Nov 2015	JT-90-156	18 Oct 2023	attached
13 Nov 2015	JT-90-157	18 Oct 2023	attached
13 Nov 2015	JT-90-158	18 Oct 2023	attached
13 Nov 2015	JT-90-159	18 Oct 2023	attached
13 Nov 2015	JT-90-160	18 Oct 2023	attached
13 Nov 2015	JT-90-161	18 Oct 2023	attached
13 Nov 2015	JT-90-162	18 Oct 2023	attached
13 Nov 2015	JT-90-163	18 Oct 2023	attached
14 Nov 2015	JT-90-164	18 Oct 2023	attached
14 Nov 2015	JT-90-165	18 Oct 2023	attached
14 Nov 2015	JT-90-166	18 Oct 2023	cable detached at joint
14 Nov 2015	JT-90-167	18 Oct 2023	attached
14 Nov 2015	JT-90-168	18 Oct 2023	attached
14 Nov 2015	JT-90-169	18 Oct 2023	attached
14 Nov 2015	JT-90-170	18 Oct 2023	attached
14 Nov 2015	JT-90-171	18 Oct 2023	attached
14 Nov 2015	JT-90-172	18 Oct 2023	attached
14 Nov 2015	JT-90-173	18 Oct 2023	attached
14 Nov 2015	JT-90-174	18 Oct 2023	attached
14 Nov 2015	JT-90-175	18 Oct 2023	attached
14 Nov 2015	JT-90-176	18 Oct 2023	attached
14 Nov 2015	JT-90-177	18 Oct 2023	attached
14 Nov 2015	JT-90-178	18 Oct 2023	attached
14 Nov 2015	JT-90-179	18 Oct 2023	attached
14 Nov 2015	JT-90-180	18 Oct 2023	attached
14 Nov 2015	JT-90-181	18 Oct 2023	attached
14 Nov 2015	JT-90-182	18 Oct 2023	attached

14 Nov 2015	JT-90-183	18 Oct 2023	attached
14 Nov 2015	JT-90-184	18 Oct 2023	attached
14 Nov 2015	JT-90-185	18 Oct 2023	attached
14 Nov 2015	JT-90-186	18 Oct 2023	attached
14 Nov 2015	JT-90-187	18 Oct 2023	attached
14 Nov 2015	JT-90-188	18 Oct 2023	attached
14 Nov 2015	JT-90-189	18 Oct 2023	attached
14 Nov 2015	JT-90-190	18 Oct 2023	attached
15 Nov 2015	JT-90-191	18 Oct 2023	attached
14 Nov 2015	JT-90-192	18 Oct 2023	attached
18 Nov 2015	JT-90-193	18 Oct 2023	attached
18 Nov 2015	JT-90-194	18 Oct 2023	attached
18 Nov 2015	JT-90-195	18 Oct 2023	attached
18 Nov 2015	JT-90-196	18 Oct 2023	attached
18 Nov 2015	JT-90-197	18 Oct 2023	attached
18 Nov 2015	JT-90-198	18 Oct 2023	attached
18 Nov 2015	JT-90-199	18 Oct 2023	attached
18 Nov 2015	JT-90-200	18 Oct 2023	attached
18 Nov 2015	JT-90-201	18 Oct 2023	attached
18 Nov 2015	JT-90-202	18 Oct 2023	attached
18 Nov 2015	JT-90-203	18 Oct 2023	cable detached at joint*
18 Nov 2015	JT-90-204	18 Oct 2023	attached
18 Nov 2015	JT-90-205	18 Oct 2023	attached
18 Nov 2015	JT-90-206	18 Oct 2023	attached
18 Nov 2015	JT-90-207	18 Oct 2023	attached
18 Nov 2015	JT-90-208	18 Oct 2023	attached
19 Nov 2015	JT-90-209	18 Oct 2023	attached
19 Nov 2015	JT-90-210	18 Oct 2023	attached
19 Nov 2015	JT-90-211	18 Oct 2023	attached
19 Nov 2015	JT-90-212	18 Oct 2023	attached
19 Nov 2015	JT-90-213	18 Oct 2023	attached
19 Nov 2015	JT-90-214	18 Oct 2023	attached
19 Nov 2015	JT-90-215	18 Oct 2023	attached
19 Nov 2015	JT-90-216	18 Oct 2023	attached
19 Nov 2015	JT-90-217	18 Oct 2023	attached
19 Nov 2015	JT-90-218	18 Oct 2023	attached
19 Nov 2015	JT-90-219	17 Oct 2023	attached
19 Nov 2015	JT-90-220	17 Oct 2023	attached
19 Nov 2015	JT-90-221	17 Oct 2023	attached
19 Nov 2015	JT-90-222	17 Oct 2023	attached
19 Nov 2015	JT-90-223	17 Oct 2023	attached
19 Nov 2015	JT-90-224	17 Oct 2023	attached
19 Nov 2015	JT-90-225	17 Oct 2023	attached
19 Nov 2015	JT-90-226	17 Oct 2023	attached
19 Nov 2015	JT-90-227	17 Oct 2023	attached
19 Nov 2015	JT-90-228	17 Oct 2023	attached
19 Nov 2015	JT-90-229	17 Oct 2023	attached

19 Nov 2015	JT-90-230	17 Oct 2023	attached
19 Nov 2015	JT-90-231	17 Oct 2023	attached
20 Nov 2015	JT-90-232	17 Oct 2023	attached
20 Nov 2015	JT-90-233	17 Oct 2023	attached
20 Nov 2015	JT-90-234	17 Oct 2023	attached
20 Nov 2015	JT-90-235	17 Oct 2023	attached
20 Nov 2015	JT-90-236	17 Oct 2023	attached
20 Nov 2015	JT-90-237	17 Oct 2023	attached
20 Nov 2015	JT-90-238	17 Oct 2023	attached
20 Nov 2015	JT-90-239	17 Oct 2023	attached
20 Nov 2015	JT-90-240	17 Oct 2023	attached
20 Nov 2015	JT-90-241	17 Oct 2023	attached
20 Nov 2015	JT-90-242	17 Oct 2023	attached
20 Nov 2015	JT-90-243	17 Oct 2023	attached
20 Nov 2015	JT-90-244	17 Oct 2023	attached
20 Nov 2015	JT-90-245	17 Oct 2023	attached
21 Nov 2015	JT-90-246	17 Oct 2023	attached
21 Nov 2015	JT-90-247	17 Oct 2023	attached
21 Nov 2015	JT-90-248	17 Oct 2023	attached
21 Nov 2015	JT-90-249	17 Oct 2023	attached
21 Nov 2015	JT-90-250	17 Oct 2023	attached
28 Nov 2015	JT-90-251	17 Oct 2023	attached
28 Nov 2015	JT-90-252	17 Oct 2023	attached
28 Nov 2015	JT-90-253	17 Oct 2023	attached
28 Nov 2015	JT-90-254	17 Oct 2023	attached
28 Nov 2015	JT-90-255	17 Oct 2023	attached
28 Nov 2015	JT-90-256	17 Oct 2023	cable detached at joint*
28 Nov 2015	JT-90-257	17 Oct 2023	attached
28 Nov 2015	JT-90-258	17 Oct 2023	attached
28 Nov 2015	JT-90-259	17 Oct 2023	attached
28 Nov 2015	JT-90-260	17 Oct 2023	attached
28 Nov 2015	JT-90-261	17 Oct 2023	attached
28 Nov 2015	JT-90-262	17 Oct 2023	attached
28 Nov 2015	JT-90-263	17 Oct 2023	attached
28 Nov 2015	JT-90-264	17 Oct 2023	attached
28 Nov 2015	JT-90-265	17 Oct 2023	attached
28 Nov 2015	JT-90-266	17 Oct 2023	attached
28 Nov 2015	JT-90-267	17 Oct 2023	attached
28 Nov 2015	JT-90-268	17 Oct 2023	attached
29 Nov 2015	JT-90-269	17 Oct 2023	attached
29 Nov 2015	JT-90-270	17 Oct 2023	attached
29 Nov 2015	JT-90-271	17 Oct 2023	attached
29 Nov 2015	JT-90-272	17 Oct 2023	attached
29 Nov 2015	JT-90-273	17 Oct 2023	attached
29 Nov 2015	JT-90-274	17 Oct 2023	attached
29 Nov 2015	JT-90-275	17 Oct 2023	attached
29 Nov 2015	JT-90-276	17 Oct 2023	attached

29 Nov 2015	JT-90-277	17 Oct 2023	attached
29 Nov 2015	JT-90-278	17 Oct 2023	attached
29 Nov 2015	JT-90-279	17 Oct 2023	cable detached at joint*
29 Nov 2015	JT-90-280	17 Oct 2023	attached
29 Nov 2015	JT-90-281	17 Oct 2023	attached
29 Nov 2015	JT-90-282	17 Oct 2023	attached
29 Nov 2015	JT-90-283	17 Oct 2023	attached
29 Nov 2015	JT-90-284	17 Oct 2023	attached
29 Nov 2015	JT-90-285	17 Oct 2023	attached
29 Nov 2015	JT-90-286	17 Oct 2023	attached
29 Nov 2015	JT-90-287	17 Oct 2023	attached
29 Nov 2015	JT-90-288	17 Oct 2023	attached
29 Nov 2015	JT-90-289	17 Oct 2023	attached
30 Nov 2015	JT-90-290	17 Oct 2023	attached
30 Nov 2015	JT-90-291	17 Oct 2023	attached
30 Nov 2015	JT-90-292	17 Oct 2023	attached
30 Nov 2015	JT-90-293	17 Oct 2023	attached
30 Nov 2015	JT-90-294	17 Oct 2023	attached
30 Nov 2015	JT-90-295	17 Oct 2023	cable detached at joint
30 Nov 2015	JT-90-296	17 Oct 2023	attached
30 Nov 2015	JT-90-297	17 Oct 2023	attached
30 Nov 2015	JT-90-298	17 Oct 2023	attached
30 Nov 2015	JT-90-299	17 Oct 2023	attached
30 Nov 2015	JT-90-300	17 Oct 2023	attached
30 Nov 2015	JT-90-301	17 Oct 2023	attached
30 Nov 2015	JT-90-302	17 Oct 2023	attached
30 Nov 2015	JT-90-303	17 Oct 2023	attached
30 Nov 2015	JT-90-304	17 Oct 2023	attached
30 Nov 2015	JT-90-305	17 Oct 2023	attached
30 Nov 2015	JT-90-306	17 Oct 2023	attached
30 Nov 2015	JT-90-307	17 Oct 2023	attached
30 Nov 2015	JT-90-308	17 Oct 2023	attached
30 Nov 2015	JT-90-309	17 Oct 2023	attached
30 Nov 2015	JT-90-310	17 Oct 2023	attached
30 Nov 2015	JT-90-311	17 Oct 2023	attached
01 Dec 2015	JT-90-312	17 Oct 2023	attached
01 Dec 2015	JT-90-313	17 Oct 2023	attached
01 Dec 2015	JT-90-314	17 Oct 2023	attached
01 Dec 2015	JT-90-315	17 Oct 2023	cable detached at joint*
01 Dec 2015	JT-90-316	17 Oct 2023	attached
01 Dec 2015	JT-90-317	17 Oct 2023	attached
01 Dec 2015	JT-90-318	17 Oct 2023	attached
04 Dec 2015	MH-90-0A	14 Dec 2023	cable detached at manhole
06 Nov 2015	MH-90-001	18 Oct 2023	attached
07 Nov 2015	MH-90-002	18 Oct 2023	cable detached at manhole
08 Nov 2015	MH-90-003	18 Oct 2023	cable detached at manhole
12 Nov 2015	MH-90-004	18 Oct 2023	attached

13 Nov 2015	MH-90-005	18 Oct 2023	attached
13 Nov 2015	MH-90-006	18 Oct 2023	attached
14 Nov 2015	MH-90-007	18 Oct 2023	attached
14 Nov 2015	MH-90-008	18 Oct 2023	attached
18 Nov 2015	MH-90-009	18 Oct 2023	attached
19 Nov 2015	MH-90-010	18 Oct 2023	attached
19 Nov 2015	MH-90-011	18 Oct 2023	cable detached at manhole
20 Nov 2015	MH-90-012	17 Oct 2023	attached
20 Nov 2015	MH-90-013	17 Oct 2023	attached
28 Nov 2015	MH-90-014	17 Oct 2023	attached
29 Nov 2015	MH-90-015	17 Oct 2023	anode not installed, broken pad eye
30 Nov 2015	MH-90-016	17 Oct 2023	cable detached at manhole
30 Nov 2015	MH-90-017	17 Oct 2023	cable detached at manhole*

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APPENDIX D

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APPENDIX D: Anode installation and inspection observations, including joint collar condition, 72-inch outfall.

Installation Date	Tag Number	Most Recent Inspection Date	Observation * new observation during this survey
13 Oct 2015	JT-72-001	14 Dec 2023	cable detached at joint
15 Oct 2015	JT-72-002	14 Dec 2023	cable detached at joint
15 Oct 2015	JT-72-003	14 Dec 2023	anode not installed; joint buried by rocks
15 Oct 2015	JT-72-004	14 Dec 2023	cable detached at joint
15 Oct 2015	JT-72-005	14 Dec 2023	attached; cracked joint collar
15 Oct 2015	JT-72-006	14 Dec 2023	attached
15 Oct 2015	JT-72-007	14 Dec 2023	cable detached at joint; cracked joint collar
15 Oct 2015	JT-72-008	14 Dec 2023	attached
15 Oct 2015	JT-72-009	14 Dec 2023	attached
15 Oct 2015	JT-72-010	14 Dec 2023	attached
15 Oct 2015	JT-72-011	14 Dec 2023	attached
15 Oct 2015	JT-72-012	14 Dec 2023	cable detached at joint
15 Oct 2015	JT-72-013	14 Dec 2023	attached
15 Oct 2015	JT-72-014	14 Dec 2023	attached
15 Oct 2015	JT-72-015	14 Dec 2023	attached; deteriorating joint collar
15 Oct 2015	JT-72-016	14 Dec 2023	anode not installed, encapsulated joint
15 Oct 2015	JT-72-017	25 Oct 2023	cable detached at joint
15 Oct 2015	JT-72-018	25 Oct 2023	cable detached at joint*; deteriorating joint collar
15 Oct 2015	JT-72-019	25 Oct 2023	attached; deteriorating joint collar
15 Oct 2015	JT-72-020	25 Oct 2023	attached; deteriorating joint collar
15 Oct 2015	JT-72-021	25 Oct 2023	cable detached at joint
15 Oct 2015	JT-72-022	25 Oct 2023	attached
15 Oct 2015	JT-72-023	25 Oct 2023	anode not installed, encapsulated joint
16 Oct 2015	JT-72-024	25 Oct 2023	attached; deteriorating joint collar
16 Oct 2015	JT-72-025	25 Oct 2023	anode not installed, encapsulated joint
16 Oct 2015	JT-72-026	25 Oct 2023	anode not installed, encapsulated joint
16 Oct 2015	JT-72-027	25 Oct 2023	attached
15 Oct 2015	JT-72-028	25 Oct 2023	cable detached at joint; deteriorating joint collar
15 Oct 2015	JT-72-029	25 Oct 2023	cable detached at joint*; deteriorating joint collar
15 Oct 2015	JT-72-030	25 Oct 2023	attached
15 Oct 2015	JT-72-031	25 Oct 2023	cable detached at joint
16 Oct 2015	JT-72-032	25 Oct 2023	cable detached at joint; deteriorating joint collar
16 Oct 2015	JT-72-033	25 Oct 2023	cable detached at joint; deteriorating joint collar
16 Oct 2015	JT-72-034	25 Oct 2023	attached; deteriorating joint collar
16 Oct 2015	JT-72-035	25 Oct 2023	attached
16 Oct 2015	JT-72-036	25 Oct 2023	attached; cracked joint collar
16 Oct 2015	JT-72-037	25 Oct 2023	cable detached at joint
16 Oct 2015	JT-72-038	25 Oct 2023	cable detached at joint; cracked joint collar
16 Oct 2015	JT-72-039	25 Oct 2023	cable detached at joint; deteriorating joint collar
16 Oct 2015	JT-72-040	25 Oct 2023	cable detached at joint; deteriorating joint collar
16 Oct 2015	JT-72-041	25 Oct 2023	anode not installed, encapsulated joint

16 Oct 2015	JT-72-042	25 Oct 2023	anode not installed, encapsulated joint
16 Oct 2015	JT-72-043	25 Oct 2023	attached; cracked joint collar
16 Oct 2015	JT-72-044	25 Oct 2023	anode not installed, encapsulated joint
20 Oct 2015	JT-72-045	25 Oct 2023	attached; deteriorating joint collar
20 Oct 2015	JT-72-046	25 Oct 2023	attached; deteriorating joint collar
20 Oct 2015	JT-72-047	25 Oct 2023	cable detached at joint
20 Oct 2015	JT-72-048	25 Oct 2023	cable detached at joint; cracked joint collar
20 Oct 2015	JT-72-049	25 Oct 2023	cable detached at joint; deteriorating joint collar
20 Oct 2015	JT-72-050	25 Oct 2023	attached; deteriorating joint collar
20 Oct 2015	JT-72-051	25 Oct 2023	attached; deteriorating joint collar
20 Oct 2015	JT-72-052	25 Oct 2023	attached; deteriorating joint collar
20 Oct 2015	JT-72-053	25 Oct 2023	attached; cracked joint collar
20 Oct 2015	JT-72-054	25 Oct 2023	cable detached at joint
20 Oct 2015	JT-72-055	25 Oct 2023	attached; cracked joint collar
20 Oct 2015	JT-72-056	25 Oct 2023	attached; deteriorating joint collar
20 Oct 2015	JT-72-057	25 Oct 2023	attached
21 Oct 2015	JT-72-058	25 Oct 2023	cable detached at joint*
21 Oct 2015	JT-72-059	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-060	25 Oct 2023	attached
21 Oct 2015	JT-72-061	25 Oct 2023	attached
21 Oct 2015	JT-72-062	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-063	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-064	25 Oct 2023	cable detached at joint*; cracked joint collar
21 Oct 2015	JT-72-065	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-066	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-067	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-068	25 Oct 2023	anode not installed, encapsulated joint
21 Oct 2015	JT-72-069	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-070	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-071	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-072	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-073	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-074	25 Oct 2023	cable detached at joint; deteriorating joint collar
21 Oct 2015	JT-72-075	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-076	25 Oct 2023	attached
21 Oct 2015	JT-72-077	25 Oct 2023	attached
21 Oct 2015	JT-72-078	25 Oct 2023	attached; deteriorating joint collar
21 Oct 2015	JT-72-079	25 Oct 2023	attached; deteriorating joint collar
21 Oct 2015	JT-72-080	25 Oct 2023	attached
21 Oct 2015	JT-72-081	25 Oct 2023	attached; cracked joint collar
21 Oct 2015	JT-72-082	25 Oct 2023	cable detached at joint
21 Oct 2015	JT-72-083	25 Oct 2023	attached; deteriorating joint collar
21 Oct 2015	JT-72-084	25 Oct 2023	attached; deteriorating joint collar
21 Oct 2015	JT-72-085	25 Oct 2023	anode not installed, encapsulated joint
22 Oct 2015	JT-72-086	25 Oct 2023	attached
22 Oct 2015	JT-72-087	25 Oct 2023	attached
22 Oct 2015	JT-72-088	25 Oct 2023	attached

22 Oct 2015	JT-72-089	25 Oct 2023	attached
22 Oct 2015	JT-72-090	25 Oct 2023	attached; cracked joint collar
22 Oct 2015	JT-72-091	25 Oct 2023	attached
22 Oct 2015	JT-72-092	25 Oct 2023	cable detached at joint
22 Oct 2015	JT-72-093	25 Oct 2023	cable detached at joint
22 Oct 2015	JT-72-094	25 Oct 2023	attached
22 Oct 2015	JT-72-095	25 Oct 2023	attached; deteriorating joint collar
22 Oct 2015	JT-72-096	25 Oct 2023	attached; cracked joint collar
22 Oct 2015	JT-72-097	25 Oct 2023	attached; cracked joint collar
22 Oct 2015	JT-72-098	25 Oct 2023	attached; deteriorating joint collar
22 Oct 2015	JT-72-099	25 Oct 2023	cable detached at joint
22 Oct 2015	JT-72-100	25 Oct 2023	cable detached at joint
22 Oct 2015	JT-72-101	25 Oct 2023	attached
22 Oct 2015	JT-72-102	25 Oct 2023	attached
22 Oct 2015	JT-72-103	25 Oct 2023	attached
22 Oct 2015	JT-72-104	25 Oct 2023	attached
22 Oct 2015	JT-72-105	25 Oct 2023	cable detached at joint*
22 Oct 2015	JT-72-106	25 Oct 2023	attached; cracked joint collar
22 Oct 2015	JT-72-107	25 Oct 2023	attached
22 Oct 2015	JT-72-108	25 Oct 2023	attached
22 Oct 2015	JT-72-109	25 Oct 2023	anode not installed, encapsulated joint
22 Oct 2015	JT-72-110	25 Oct 2023	cable detached at joint*
22 Oct 2015	JT-72-111	25 Oct 2023	attached
22 Oct 2015	JT-72-112	25 Oct 2023	attached
22 Oct 2015	JT-72-113	25 Oct 2023	attached
22 Oct 2015	JT-72-114	25 Oct 2023	attached
22 Oct 2015	JT-72-115	25 Oct 2023	attached; deteriorating joint collar
22 Oct 2015	JT-72-116	25 Oct 2023	attached
22 Oct 2015	JT-72-117	25 Oct 2023	anode not installed, encapsulated joint
22 Oct 2015	JT-72-118	25 Oct 2023	attached
22 Oct 2015	JT-72-119	25 Oct 2023	attached
22 Oct 2015	JT-72-120	25 Oct 2023	cable detached at joint
22 Oct 2015	JT-72-121	25 Oct 2023	cable detached at joint
22 Oct 2015	JT-72-122	25 Oct 2023	attached
22 Oct 2015	JT-72-123	25 Oct 2023	attached
22 Oct 2015	JT-72-124	25 Oct 2023	attached
22 Oct 2015	JT-72-125	25 Oct 2023	attached
22 Oct 2015	JT-72-126	25 Oct 2023	attached
22 Oct 2015	JT-72-127	25 Oct 2023	attached
22 Oct 2015	JT-72-128	25 Oct 2023	attached
22 Oct 2015	JT-72-129	25 Oct 2023	attached
23 Oct 2015	JT-72-130	25 Oct 2023	attached
23 Oct 2015	JT-72-131	25 Oct 2023	attached; cracked joint collar
23 Oct 2015	JT-72-132	25 Oct 2023	attached
23 Oct 2015	JT-72-133	25 Oct 2023	attached
23 Oct 2015	JT-72-134	25 Oct 2023	attached
23 Oct 2015	JT-72-135	25 Oct 2023	attached

23 Oct 2015	JT-72-136	25 Oct 2023	anode not installed, encapsulated joint
23 Oct 2015	JT-72-137	25 Oct 2023	attached; cracked joint collar
23 Oct 2015	JT-72-138	25 Oct 2023	attached
23 Oct 2015	JT-72-139	25 Oct 2023	attached
23 Oct 2015	JT-72-140	25 Oct 2023	anode not installed, encapsulated joint
23 Oct 2015	JT-72-141	25 Oct 2023	cable detached at joint
23 Oct 2015	JT-72-142	25 Oct 2023	attached
23 Oct 2015	JT-72-143	25 Oct 2023	cable detached at joint
23 Oct 2015	JT-72-144	25 Oct 2023	attached
23 Oct 2015	JT-72-145	25 Oct 2023	attached
23 Oct 2015	JT-72-146	25 Oct 2023	cable detached at joint*
23 Oct 2015	JT-72-147	25 Oct 2023	attached; cracked joint collar
23 Oct 2015	JT-72-148	25 Oct 2023	cable detached at joint
23 Oct 2015	JT-72-149	25 Oct 2023	attached
23 Oct 2015	JT-72-150	25 Oct 2023	attached
23 Oct 2015	JT-72-151	25 Oct 2023	attached
23 Oct 2015	JT-72-152	25 Oct 2023	attached; cracked joint collar
23 Oct 2015	JT-72-153	25 Oct 2023	attached
23 Oct 2015	JT-72-154	25 Oct 2023	attached
23 Oct 2015	JT-72-155	25 Oct 2023	attached
23 Oct 2015	JT-72-156	25 Oct 2023	attached
23 Oct 2015	JT-72-157	25 Oct 2023	cable detached at joint
23 Oct 2015	JT-72-158	25 Oct 2023	attached
23 Oct 2015	JT-72-159	25 Oct 2023	attached
23 Oct 2015	JT-72-160	25 Oct 2023	attached
23 Oct 2015	JT-72-161	25 Oct 2023	attached
23 Oct 2015	JT-72-162	25 Oct 2023	attached
23 Oct 2015	JT-72-163	25 Oct 2023	attached
24 Oct 2015	JT-72-164	25 Oct 2023	attached
24 Oct 2015	JT-72-165	25 Oct 2023	attached
24 Oct 2015	JT-72-166	25 Oct 2023	attached
24 Oct 2015	JT-72-167	25 Oct 2023	attached
24 Oct 2015	JT-72-168	25 Oct 2023	attached
24 Oct 2015	JT-72-169	25 Oct 2023	attached
24 Oct 2015	JT-72-170	25 Oct 2023	attached
24 Oct 2015	JT-72-171	25 Oct 2023	attached
24 Oct 2015	JT-72-172	25 Oct 2023	attached
24 Oct 2015	JT-72-173	25 Oct 2023	attached
24 Oct 2015	JT-72-174	25 Oct 2023	attached
24 Oct 2015	JT-72-175	25 Oct 2023	attached
25 Oct 2015	JT-72-176	25 Oct 2023	attached
26 Oct 2015	JT-72-177	25 Oct 2023	attached
26 Oct 2015	JT-72-178	25 Oct 2023	cable detached at joint*
26 Oct 2015	JT-72-179	25 Oct 2023	attached
26 Oct 2015	JT-72-180	25 Oct 2023	attached
26 Oct 2015	JT-72-181	25 Oct 2023	attached
26 Oct 2015	JT-72-182	25 Oct 2023	attached

26 Oct 2015	JT-72-183	25 Oct 2023	attached
26 Oct 2015	JT-72-184	25 Oct 2023	attached
26 Oct 2015	JT-72-185	25 Oct 2023	attached
26 Oct 2015	JT-72-186	25 Oct 2023	attached
26 Oct 2015	JT-72-187	25 Oct 2023	attached
26 Oct 2015	JT-72-188	25 Oct 2023	attached
26 Oct 2015	JT-72-189	25 Oct 2023	attached
26 Oct 2015	JT-72-190	25 Oct 2023	attached
26 Oct 2015	JT-72-191	25 Oct 2023	attached
26 Oct 2015	JT-72-192	25 Oct 2023	attached; cracked joint collar
26 Oct 2015	JT-72-193	25 Oct 2023	attached
26 Oct 2015	JT-72-194	25 Oct 2023	attached
26 Oct 2015	JT-72-195	25 Oct 2023	attached
26 Oct 2015	JT-72-196	25 Oct 2023	attached
26 Oct 2015	JT-72-197	25 Oct 2023	attached
26 Oct 2015	JT-72-198	25 Oct 2023	attached; cracked joint collar
26 Oct 2015	JT-72-199	25 Oct 2023	cable detached at joint*
26 Oct 2015	JT-72-200	25 Oct 2023	attached
27 Oct 2015	JT-72-201	25 Oct 2023	attached
27 Oct 2015	JT-72-202	25 Oct 2023	attached
27 Oct 2015	JT-72-203	25 Oct 2023	attached
27 Oct 2015	JT-72-204	25 Oct 2023	attached; cracked joint collar
27 Oct 2015	JT-72-205	25 Oct 2023	attached
27 Oct 2015	JT-72-206	25 Oct 2023	attached
27 Oct 2015	JT-72-207	25 Oct 2023	attached
27 Oct 2015	JT-72-208	25 Oct 2023	attached
27 Oct 2015	JT-72-209	25 Oct 2023	attached
27 Oct 2015	JT-72-210	25 Oct 2023	attached
27 Oct 2015	JT-72-211	25 Oct 2023	attached
27 Oct 2015	JT-72-212	25 Oct 2023	attached
27 Oct 2015	JT-72-213	25 Oct 2023	attached
27 Oct 2015	JT-72-214	25 Oct 2023	attached
27 Oct 2015	JT-72-215	25 Oct 2023	attached
27 Oct 2015	JT-72-216	25 Oct 2023	attached
27 Oct 2015	JT-72-217	25 Oct 2023	attached
27 Oct 2015	JT-72-218	25 Oct 2023	attached
27 Oct 2015	JT-72-219	25 Oct 2023	attached
27 Oct 2015	JT-72-220	25 Oct 2023	cable detached at joint
27 Oct 2015	JT-72-221	25 Oct 2023	attached
27 Oct 2015	JT-72-222	25 Oct 2023	attached
28 Oct 2015	JT-72-223	25 Oct 2023	attached
28 Oct 2015	JT-72-224	25 Oct 2023	attached
28 Oct 2015	JT-72-225	25 Oct 2023	attached
28 Oct 2015	JT-72-226	25 Oct 2023	attached
28 Oct 2015	JT-72-227	25 Oct 2023	cable detached at joint*
28 Oct 2015	JT-72-228	25 Oct 2023	attached
15 Oct 2015	MH-72-001	14 Dec 2023	anode not installed, pad eye missing

16 Oct 2015	MH-72-002	25 Oct 2023	cable detached at manhole
20 Oct 2015	MH-72-003	25 Oct 2023	cable detached at manhole
21 Oct 2015	MH-72-004	25 Oct 2023	cable detached at manhole
21 Oct 2015	MH-72-005	25 Oct 2023	cable detached at manhole
22 Oct 2015	MH-72-006	25 Oct 2023	cable detached at manhole
22 Oct 2015	MH-72-007	25 Oct 2023	cable detached at manhole
22 Oct 2015	MH-72-008	25 Oct 2023	anode not installed, pad eye missing
22 Oct 2015	MH-72-009	25 Oct 2023	anode not installed, pad eye broken
24 Oct 2015	MH-72-010	25 Oct 2023	attached
24 Oct 2015	MH-72-011	25 Oct 2023	attached
26 Oct 2015	MH-72-012	25 Oct 2023	attached
27 Oct 2015	MH-72-013	25 Oct 2023	cable detached at manhole*

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