SAINT GEORGE, ALASKA
Wastewater Outfall Condition Report

Wastewater Ocean Outfall Pipe

Prepared by:

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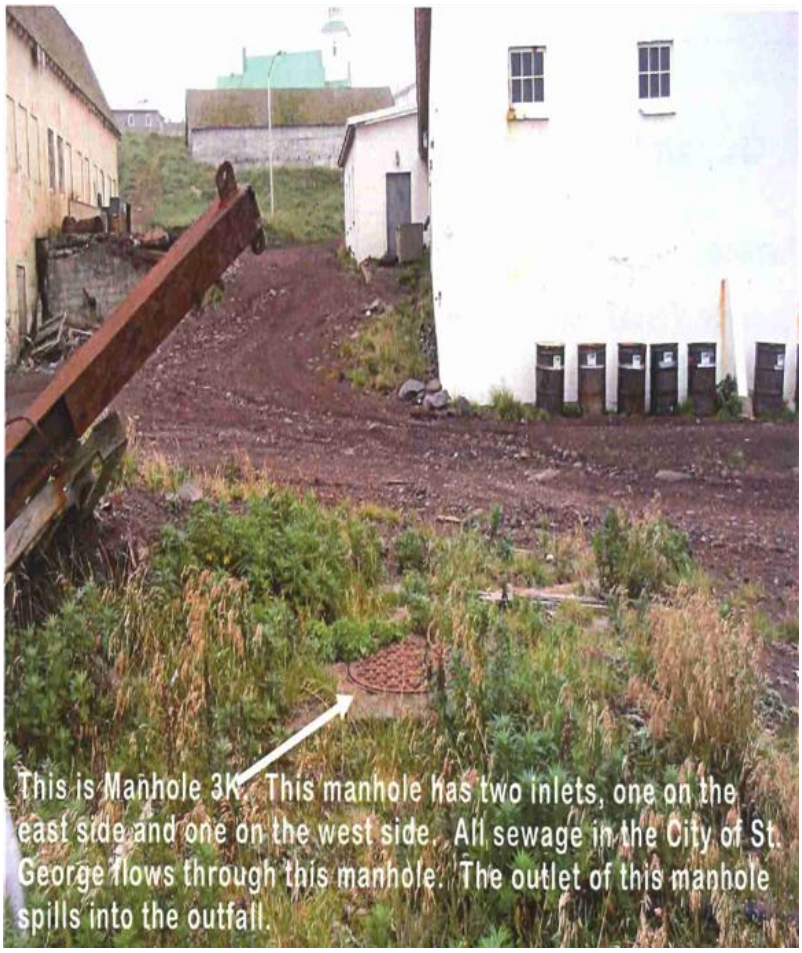
October 2011

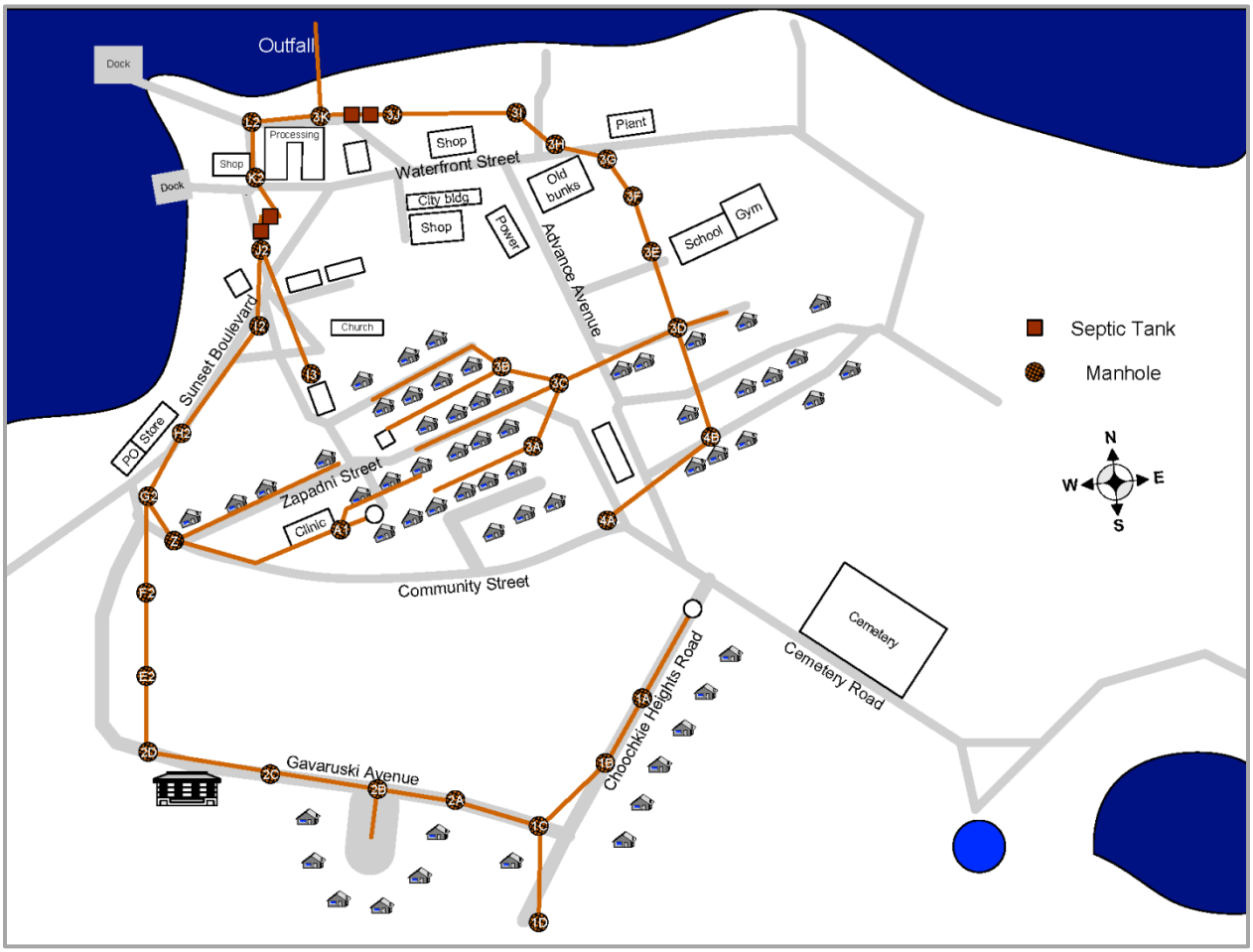
Introduction

The City of Saint George is served by a gravity flow wastewater system that uses septic tanks for primary treatment and an ocean outfall. The system of sewer mains collects wastewater from the toilets, sinks, and drains of houses and businesses. These sewer mains are sloped so the wastewater flows downhill to the septic tanks. Much of the solids in the wastewater settle into the septic tanks, while the clarified wastewater flows out of the septic tanks through the outfall pipe to the ocean. The outfall pipe was constructed in 1986, and extended 315 feet into the Bering Sea, discharging at approximately 14 feet below mean lower low water (MLLW).



The community is divided into two wastewater drainage basins, as depicted in the schematic wastewater system diagram on the next page. Sewage from homes and businesses on the south and west areas of the community flows through two 5,000-gallon septic tanks (in series) located near the old docks. Sewage from the homes and businesses on the east side of town (east of the hotel) flows through two 5,000 gallon tanks (in series) located near the old carpenter shop. Effluent from both pairs of septic tanks combines at the terminal manhole near the beach and then discharges by gravity through the ocean outfall pipe into the Bering Sea. A schematic diagram of the City of Saint George wastewater collection system, showing the approximate location of outfall, is provided on the next page.

Diagram 1 — Saint George Wastewater Collection System & Outfall Location



Primary wastewater treatment occurs in the septic tanks. All four septic tanks are 20-foot long, 7-foot diameter aluminum cylinders with an inspection hatch at each end. When properly operated the septic tanks remove sludge and scum from the wastewater to keep solids and grease from entering the Bering Sea. Sludge is partially decomposed as it builds up in the septic tanks. The sludge eventually is pumped out with a sludge pumper truck and disposed in a trench at the landfill where it is mixed with lime to destroy pathogens that may exist in the sludge. The tanks were last pumped out in Fall 2010.

Outfall Construction History

The existing wastewater outfall was placed in service in 1986. Photos of the construction were included in the Final Report of Construction for Indian Health Service (HIS) grant AN-84-306:

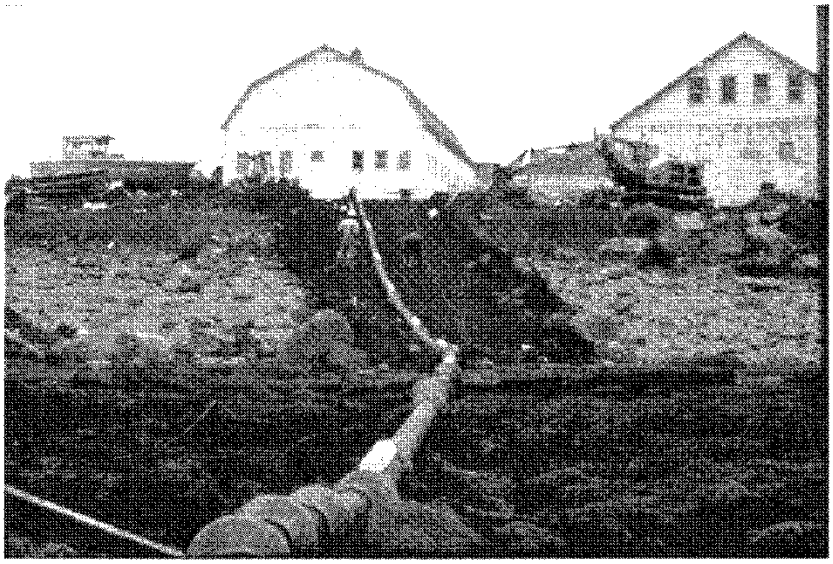


Photo 2: The flexible joint sewer outfall in place prior to the rockbolts being installed and the backfill being added.

Photo 3: A view overlooking the ocean from the village showing the new ocean outfall in place prior to the backfill being added.

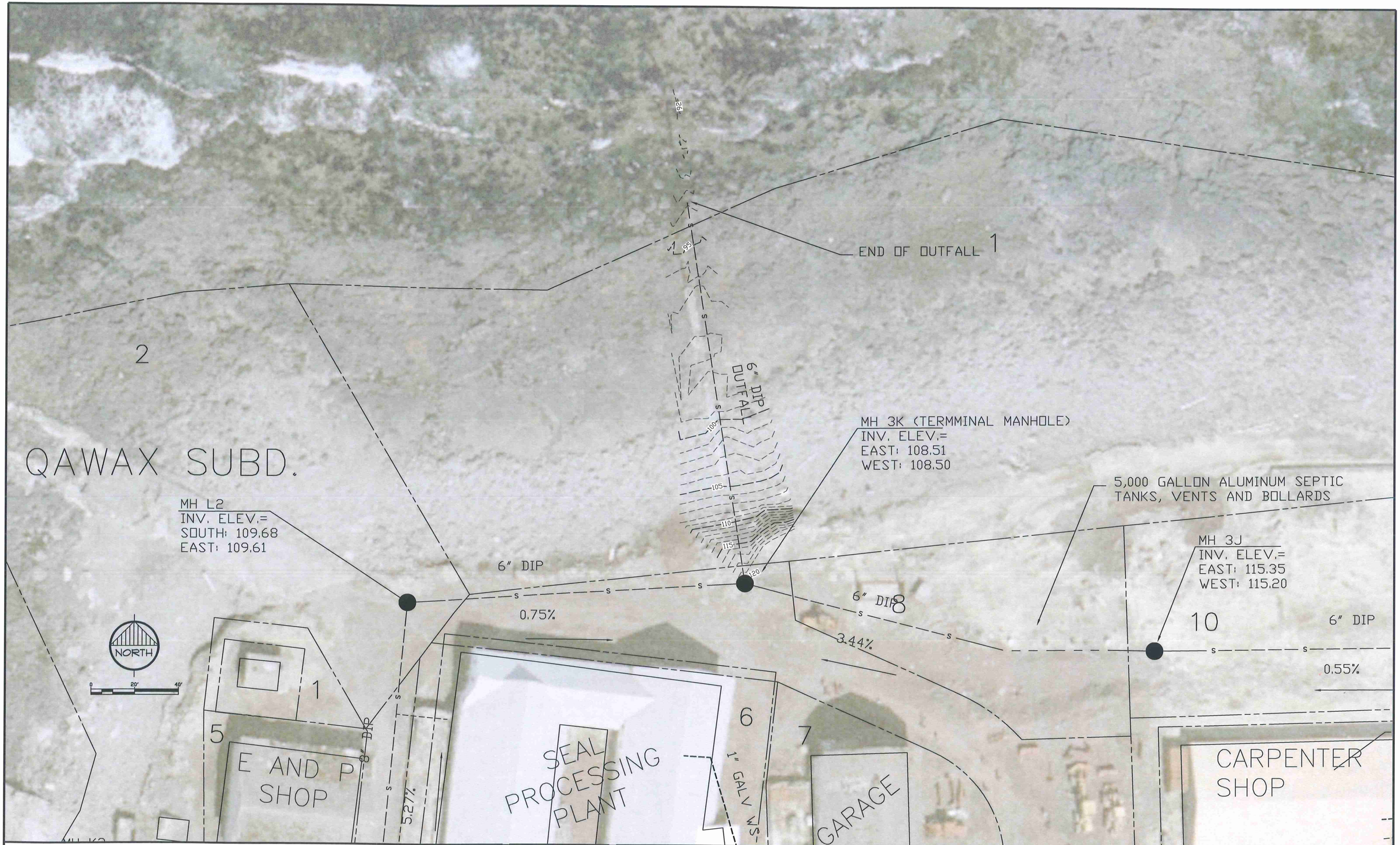
The following description of the outfall construction appears in from *Marine Outfall Construction: Background, Techniques, and Case Studies*, by Robert A. Grace, American Society of Civil Engineers:

> ***11.3.3 The St. George Town No.1 Outfall, Pribilof Islands, Alaska***
> *St. George Island had a 1990 population of 138. The town of St. George is located on the northeast shore of the island of the same name. The seabed in this area is swept clean bedrock, and a completely different form of stabilization was done for this town's outfall than that practiced at St. Paul. The 100-m-long pipe (No. 170 in Table A-1) was in service in the spring of 1986. Material was ductile iron, with an outside diameter of 175 mm and a wall thickness of 13 mm. From MLLW to mean higher high water (MHHW), this pipe was placed in a trench and concreted over. A cable-block system was set up to handle the offshore pipe. This arrangement was attached to rock bolts set in the bottom seaward of the ultimate end of the pipe. Pulling onshore was done by a tractor. Pipe float out made use of truck inner tubes, and the pipe was then dropped to the seabed. Pipe stabilization was accomplished (by commercial divers) by using stud pairs roughly at 1.8-m stations. The holes drilled in the seabed were approximately 660 mm deep and 44 mm in diameter. Commercial spin-lock rock bolts (25 mm) were inserted, expanded, and grouted in place. A stud roughly 250 mm high (above the bottom) allowed for attachment of nuts and the chain (within a length of hose) that passed over the top of the pipe.*
> Grace, Robert A. 2009. *Marine Outfall Construction: Background, Techniques, and Case Studies*, American Society of Civil Engineers, 432 pp.

Outfall Reconnaissance

Methodology: On July 15, 2011, Surveyor Scott McClintock and Diver Bill Campbell traveled to Saint George to perform a bathymetric survey of the outfall line and to visually inspect and photograph the condition of the outfall line. High surf conditions prevented the use of a dive boat and limited the visual reconnaissance. Topographic mapping of the sea bottom was collected, limited by high surf conditions, and is presented in Figure 1.

A video record with an underwater camera of the reconnaissance was made, limited by high surf and the extensive amount of bull kelp growing on the sea floor along the pipeline route. Still photos were captured from the video and are presented after the figure.



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Scale: AS SHOWN
Date: AUG. 2011
Drawn: CM

ST. GEORGE BATHYMETRIC SURVEY

WASTEWATER OCEAN OUTFALL PIPE

SAINT GEORGE, ALASKA

FIGURE 1

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Image 1—Outfall pipe on the beach showing deteriorated concrete covering.

Image 2—Outfall pipe showing rock anchor bolts and chain connector.

Image 3—Outfall pipe on July 16, 2011, from low tide line looking toward the terminal manhole. Outfall pipe was encased in concrete through the beach area when constructed. End of concrete encasement visible in photo.

Image 4—Outfall pipe at low tide line. Note extensive amounts of bull kelp present. Pipe is ductile iron with bell and spigot connections.

Image 5—Lateral break in the outfall pipe just beyond the low tide line.

Image 6—Outfall pipe, below low tide line. Note extensive bull kelp growth obscuring the pipe.

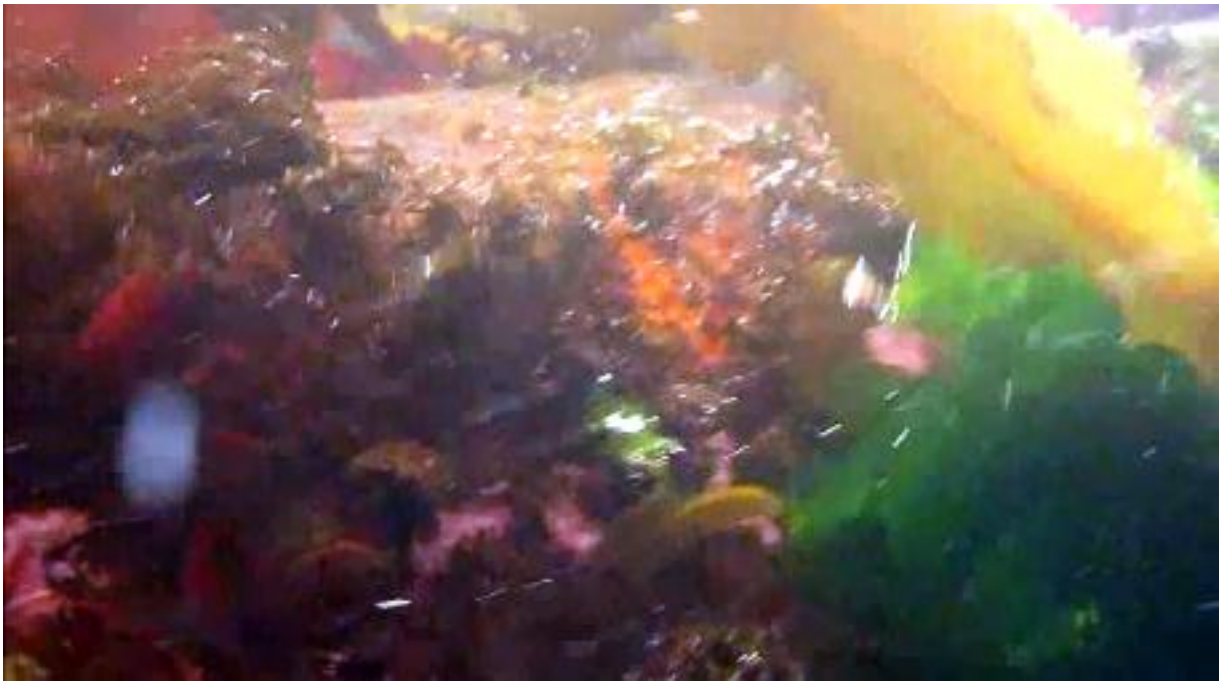


Image 7—Existing end of outfall pipe where it pulled apart approximately 160 feet from the terminal manhole. A minimum of 20 feet of pipe is "missing" from the original alignment. Due to high surf conditions, the remainder of the pipe beyond the missing piece(s) was not traced in this effort.

Image 8—Outfall pipe with anchor bolt visible beyond bell section. Construction records state anchor bolts were secured into the rock roughly every 6 to 8 feet. Holes were drilled in the seabed where spin-lock rock bolts were inserted, expanded, and grouted in place. The rock bolts allowed attachment of nuts and a chain (in a length of hose) over the pipe.

Findings

The outfall pipe is in severely deteriorated condition. Pack ice and pounding surf have exposed the pipe where it was initially covered with concrete. Pieces of concrete remain adhered to the pipe along part of its traverse from the terminal manhole to the low tide line. The pipe is broken just beyond low water and a minimum of 20 feet is missing approximately 160 feet from the terminal manhole. Anchor chains connecting the rock bolts are missing. Minimal repair of the existing outfall pipe to make it function as designed is not possible. Replacement with new pipe more rigorously protected from pack ice and pounding surf will be required to provide an acceptable service life.

Recommendations

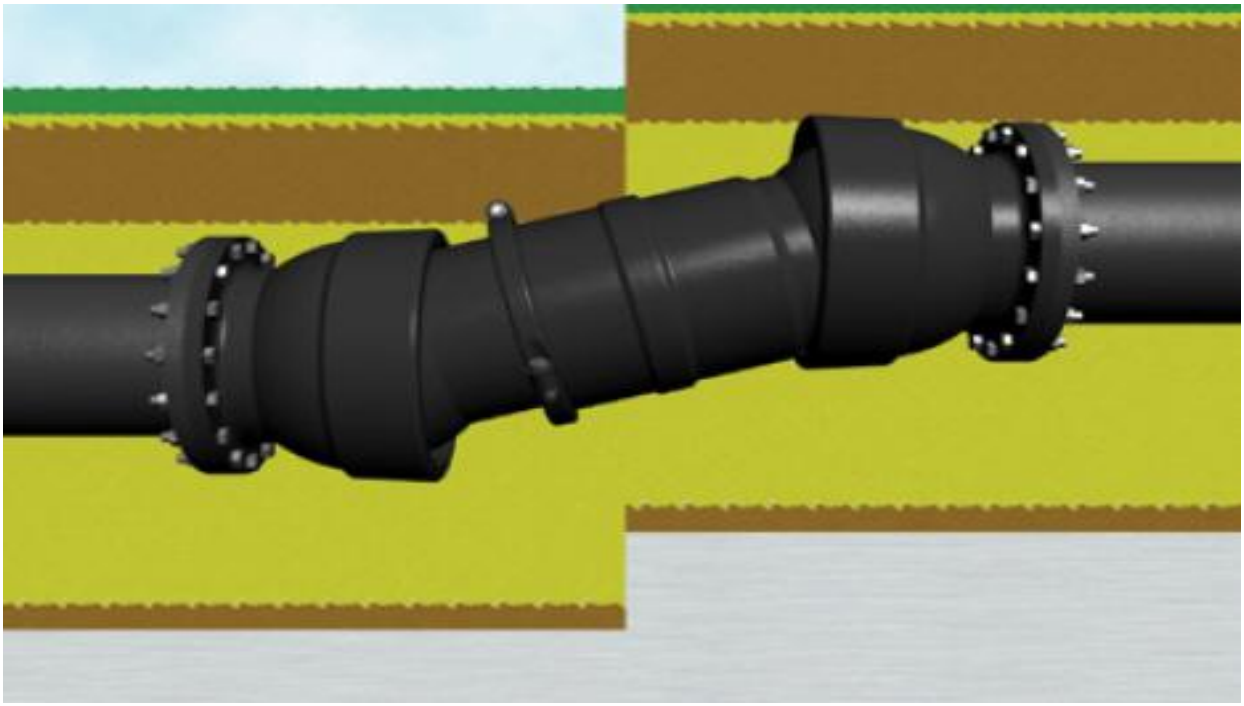
OUTFALL REPAIR

As described above, the outfall line has a lateral break just below the low tide line, and some pipe is missing at a location 160 feet beyond the terminal manhole. The extent of the missing pipe section was not determined because of the high surf conditions at the time of the diving activities.

The biggest problem with repairs is the protection of the pipe after it is repaired. The area of concern is subject to heavy surf and moving pack ice, which would cause further damage to the pipe unless it is armored.

It is recommended that to repair the pipe joints, the broken section would be removed and a flexible connection be made in the 6-in ductile iron pipe. An example of this type of connection, known as FLEX-TEND, is manufactured by Ebaa Iron and shown in Figure 2, on the next page. This component will provide up to 20 deg of rotation and 4-in minimum of linear expansion. The end connections would be mechanical joint with "Mega-Lug" end restraints.

Figure 2 - Flexible extension joint by Ebaa Iron



The joint repair for the section of the outfall missing a pipe would be made up from a ball joint and a slip joint piece at each end of the break. Regular sections of ductile iron pipe would fit between the two flexible ends. The pipe would be anchored every 8-ft by a pair of Spin-Lock rock bolts grouted into the space between the drill hole and the bolt. Stainless steel cable would span the bolts and would be laid over the pipe section.

The repaired pipe will not remain without some protection from ice and surf. It is recommended to bend 4′ x 8′ x 1″ thick steel plates to an "omega" shape to cover the 6-in pipe and bell ends from surf and ice. The shapes can be angled and cut to fit any pipe bends occurring. The steel shapes would be lowered by a crane on a work barge, or shore means. The shapes would be anchored by Spin-Lock rock bolts on 4-ft centers to resist the forces of the pack ice.

After the outfall piping is repaired, it must be reamed out to remove any accumulated dirt, sludge, or debris for flow to be unimpeded.

Repairs will be costly, as it will require the use of small booms or cranes, air compressor, air drills for underwater use, and other specialized tools to be used by divers. Weather will also be a factor, and standby time waiting for good weather could be problematic.

A realistic estimate for repairs, with adequate planning, would be in the order of $300,000, subject to logistical factors, such as barge availability and barge operators willing to enter the narrow breakwater at the St. George Harbor.

OUTFALL REPLACEMENT

The best solution to the problems of the existing outfall is to make a new outfall that is protected from pack ice and surf. The technique that would best accomplish this goal is to make a new outfall using directional drilling from the terminal manhole out to a location that would function as a mixing zone, which would meet regulatory requirements.

The directional drilling technique would involve setting a directional drilling rig at the terminal manhole, and then drill a hole in the rock, to daylight at the determined mixing zone. This pilot hole would be back-reamed to approximately 10-½" diameter while pulling a 6-in SDR11 HDPE pipe back through the reamed-out hole. A diffuser assembly would be attached to the end of the outfall pipe in the mixing zone.

Logistics to and from St. George are difficult and expensive. Drilling of the hole itself will be about $150,000, but the logistics of getting a barge with the drill, drill steel, drilling mud, mud pumps, and other equipment will drive the cost of the project to a total between $800,000 and $1.5 million. One possibility to reduce costs is the potential of shipping the drill and related equipment on a Hercules aircraft, if the drill will fit in the cargo bay of the aircraft. The logistics must be investigated as a significant cost component of the repair.