MOTT MACDONALD

Cypress Island Site 1 Atlantic Salmon Net Pens Engineering Assessment

January 29, 2018

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Acronyms and Abbreviations

AGS	American Gold Seafoods
AIS	marine vessel Automatic Identification System
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BAP	Best Aquaculture Practices
DNR	Washington State Department of Natural Resources
ft.	feet
ECY	Washington State Department of Ecology
Hs	Significant Wave height
in.	inch
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
NOAA	National Oceanographic and Atmospheric Administration
OHW	Ordinary High Water
ORN	Orchard Rocks – North
ORS	Orchard Rocks - South
PATON	Coast Guard Private Aids to Navigation
ROV	Remotely Operated Vehicle
Tp	Peak wave period
USACE	US Army Corps of Engineers

Certifications

This report has been prepared by Mott MacDonald under the supervision of a Professional Engineer, including all findings and recommendations.

Date: January 29, 2018

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1 Introduction

This report presents the results of a document review, site visit, and engineering assessment of Net Pen #1 located near Cypress Island, owned by Cooke Aquaculture. **Figure 1** is an aerial photo of the site. This work has been performed by Mott MacDonald for the State of Washington Department of Natural Resources (DNR). The dive inspection portion of the work has been performed by Collins Engineers, Inc. as a subconsultant to Mott MacDonald.

Figure 1: Cypress Island Net Pens – Aerial Photo

Source: GoogleEarth7/24/2017

This report is one of seven engineering assessment reports that are being prepared by Mott MacDonald, one for each net pen at different sites in Puget Sound and Port Angeles. DNR holds several lease agreements with Cooke that authorize Cooke to operate Atlantic salmon net pen facilities in Washington state waters at four locations. The locations of these facilities and the planned reports by Mott MacDonald are as follows:

Hope Island	(1 facility)
Port Angeles Harbor	(2 facilities; Primary net pen and Secondary net pen)
Rich Passage	(2 facilities; Orchard Rocks net pen and Fort Ward net pen)
Cypress Island	(2 facilities; Site 1 and Site 3)

In addition to these seven reports, Mott MacDonald previously prepared a report for DNR in October 2017 concerning the Clam Bay net pen facility in Rich Passage. Mott MacDonald is also involved in the investigation of the Cypress Island Site 2 net pen failure that occurred in August 2017.

1.1 Purpose and Methods

This report is for use by DNR and other state agencies. The information from the engineering assessment reports may be used by DNR to address outstanding lease obligations and for making proprietary and regulatory decisions.

The work performed includes a review of relevant documents provided by Cooke and DNR. References and standards applicable to salmon aquaculture and net pens have also been researched by Mott MacDonald and applied. During the site visit an above water visual inspection of the facility was performed that focused on the structural elements of the net pen superstructure. An underwater visual and tactile inspection was performed by Collins. Underwater areas that were inspected included conditions of every anchor and mooring line; permanent floating structures; selected areas of the net pen floatation system; and underneath the superstructure that were areas of potential damage or concern. The underwater inspection was completed by Collins using both divers and Remotely Operated Vehicles (ROV).

The document review and site visit includes review of the following general elements:

- DNR lease requirements.
- Best Aquaculture Practices (BAP)
- Permit applicant documentation (inspection reports, design conditions, etc.).
- Inspection type and frequency.
- Maintenance and repair history.
- Facility design documentation and lease requirements.
- Industry standards for design, operations, maintenance, and best management practices.
- Site visit observations and dive inspection with respect to the above listed documents and standards.

This work is limited in scope. Detailed inspection and physical material sampling were not performed. A load rating or structural analysis has not been performed. Repair or maintenance recommendations are not included in this report.

The site visit and inspection only included those elements above water at the time of the site visit. These included the grating, the visible framing components of the floats, mooring brackets on the floats, and cleats. Not included in this review are mechanical systems and utilities, such as lighting, power and water lines, pumps, and fish feeder systems.

This assessment is focused on the structural elements of the net pens. The floating shed and barge and the crew quarters (The House) are included for completeness, but were not inspected in detail. Mott MacDonald did not access closed spaces or access the roof of the floating shed or the House.

1.2 Inspection Scope and Standards

Mott MacDonald and Collins Engineers have followed the recommended standards and practices in ASCE Manual No. 130 - *Waterfront Facilities Inspection and Assessment* published by the American Society of Civil Engineers (ASCE, 2015).

The above water inspection by Mott MacDonald staff is consistent with a Level I visual and tactile inspection of all surfaces that were visible without removing coatings or opening hatches. The methods were consistent with a “Routine” type of inspection. The Collins Engineers dive inspection is consistent with a Level I inspection with a Level II inspection at selected areas. The Level I and II methods and Routine inspection type are defined in ASCE No. 130.

Condition assessment definitions from ASCE Manual No. 130 are applied in this report and listed below in **Table 1**. These are assigned to the major components of the facility.

Table 1: Condition Assessment Rating

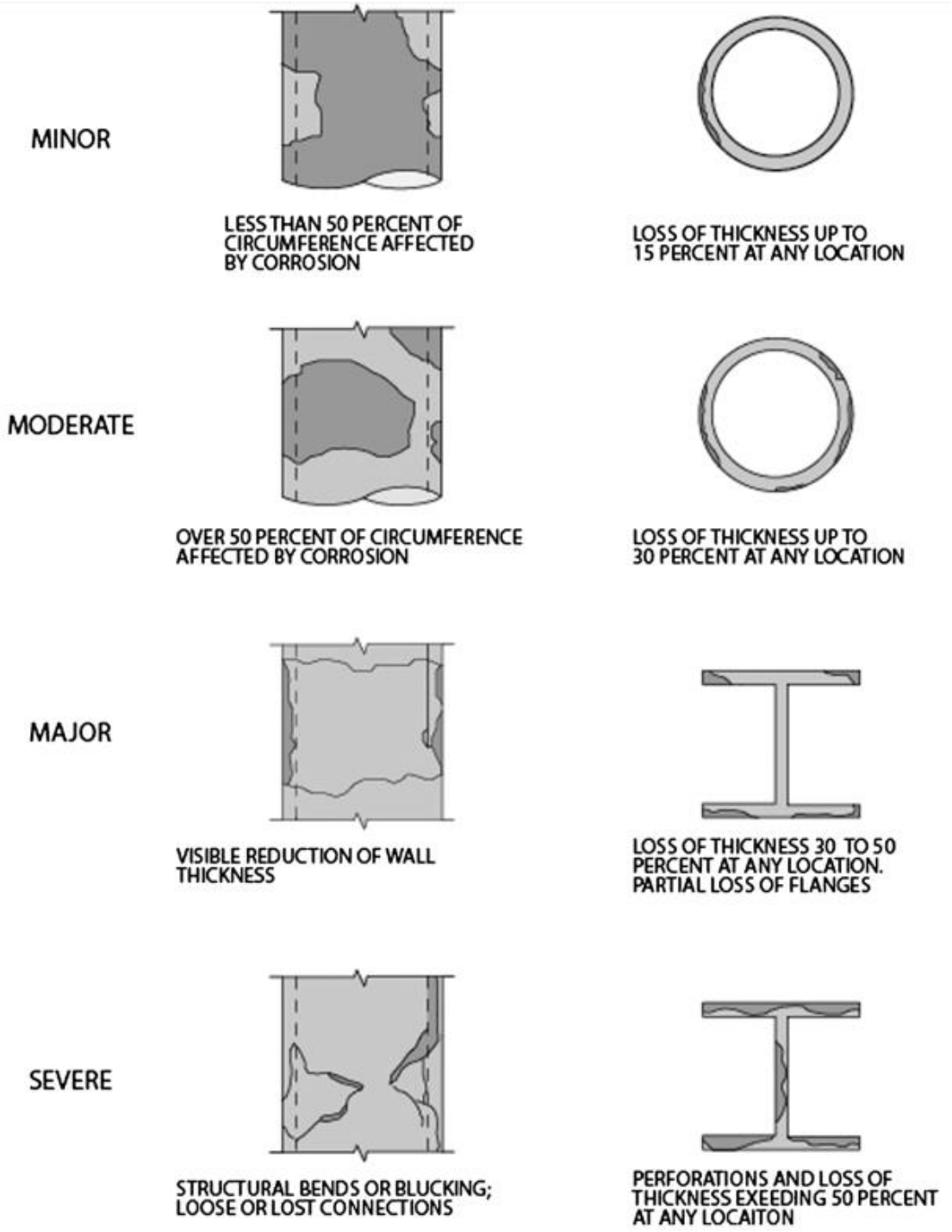
Rating	Description
6 Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
5 Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
4 Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
3 Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2 Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components. Local failures are possible, and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1 Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

Source: Table 2-14 in ASCE Manual No. 130

The damage/condition rating system in ASCE Manual No. 130 includes the following condition ratings: “Minor, Moderate, Major, and Severe,” which are defined for different material types. The damage rating definitions for Steel elements are shown below in **Figure 2** for ease of

reference. The ASCE Manual No. 130 has similar figures for mooring hardware, timber, concrete, and other materials.

Figure 2: Damage Rating for Steel Elements



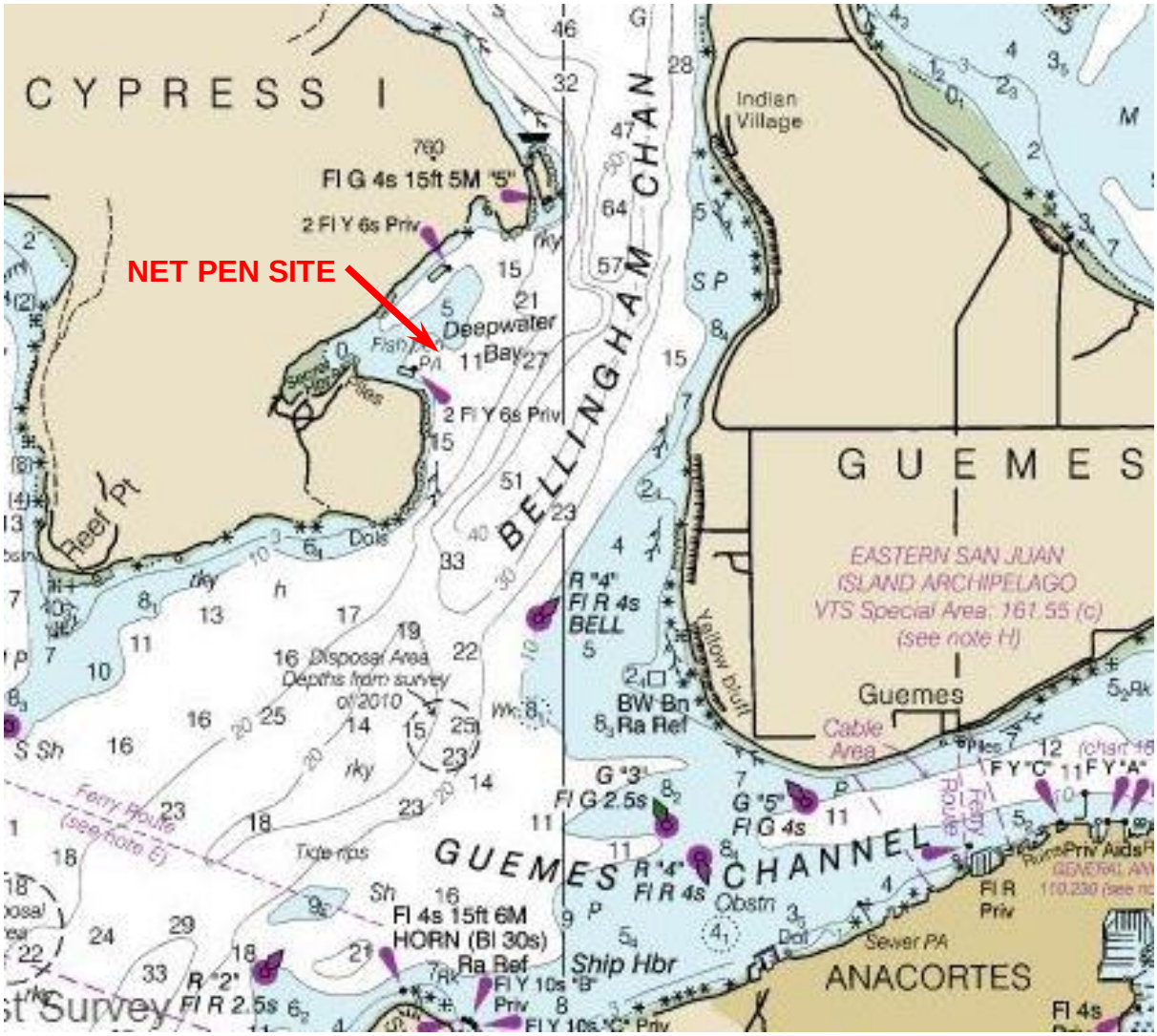
Source: ASCE Standard of Practice No. 130 "Waterfront Facilities Inspection and Assessment"

2 Document Review

The Cypress Island fish farm consisted of three net pens. Each net pen was made up of a moored floating structure relying upon forces imposed on the walkway floats and net systems to be resisted by a series of mooring chains and anchors. The following is a summary of the key components of Site 1:

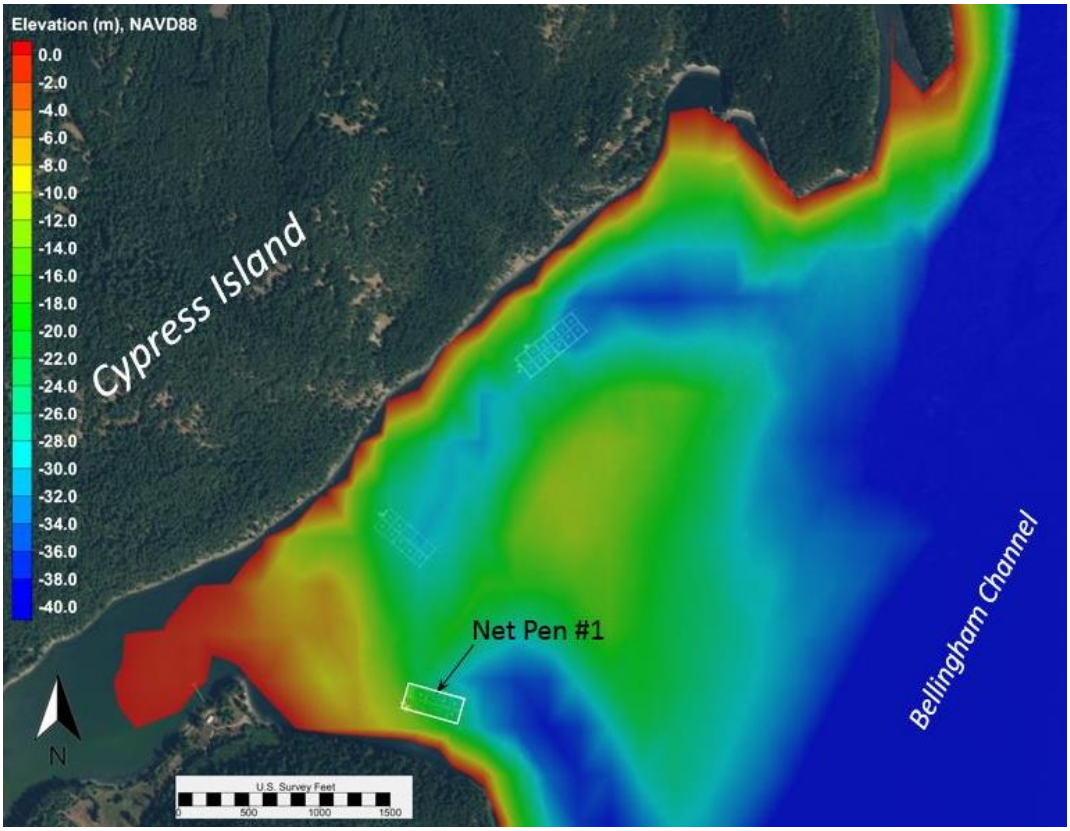
The Cypress Island facility is located in Deepwater Bay on the east side of Cypress Island. **Figure 3** is an area map. **Figure 4** shows the bathymetry in more detail. The depths appear to be between 60 feet and 100 feet (MLLW) along the length of the Cypress Island net pens. Drawings in Appendix A show a general plan and photos of the existing facilities. Additional site photos are in Appendix C.

Figure 3: Area Map



Source: NOAA Chart 18421

Figure 4: Cypress Island Bathymetry



Source: NOAA Digital Elevation Model (DEM) of Puget Sound Bathymetry

2.1 Document Review

Documents reviewed by Mott MacDonald are described **Table 2**. Document interpretations are included elsewhere in this report.

Table 2: Document Review – Summary

No.	Description	Comments
General Documents received from Cooke		
1	System Farm W24-3,16 Large Steel Cage System – Marine Construction AS, Norway.	This document includes a technical description of the cage system, and instruction regarding assembly, installation, maintenance, transportation, and handling.
2	October 2017 Pollution Prevention Plan Updated, 6 pages	Not relevant to this report.
3	October 2017 Spill Prevention Control and Response Plan Undated, 5 pages.	Not relevant to this report.
4	2017 Cooke Aquaculture Fish Escape Prevention Plan. Updated January 2017, 9 pages.	Outlines requirements for moorage system damage inspections, frequency of inspection and post-storm inspection.
Cypress Island Specific Documents received from Cooke		

No.	Description	Comments
5	Cypress Island Aquatic Lands Net Pen Lease No. 201-B12517.	This document contains information about the net pen facility including the description of the facility, intended use, lease terms, existing and proposed improvements at the facility, and maintenance and repair requirements. The document also has plans showing the layout of the facility.
6	Cypress Island Site 1 and 3 site plan fuel storage and spill kit locations, 2 pages	Includes a schematic site map.
7	Surface Inspection Reports from Oct. 19, 2017 to Nov. 9, 2017.	These documents show the comments from the inspection of the net pen facility during the period Oct. 19, 2017 to Nov. 9, 2017.
8		
9	Cypress Island Mooring Diagram, Excel spreadsheet	Mooring diagram of existing conditions, includes piles, anchors, chains, rodes, and information on inspection and replacement
10	NPDES Permit for Cypress Island Sites 1 and 3, each 30 pages	Issued 2007 and expired 2012. Not relevant to this report.
11	Fish stock containment net packing lists dated April 29 and 30, 2016	List of fishing nets that seems to have been attached to an invoice.
12	October 2017 Net Inventory	Inventory includes dimensions, mesh size, make, year made, etc.
Standards, Guidelines, Studies, Plans		
13	Norwegian Standard NS 9415.E:2009 -- Marine fish farms Requirements for site survey, risk analyses, design, dimensioning, production, installation, and operation	The standard includes site survey requirements, load and load combinations, general requirements for the main components of a marine fish farm, requirements regarding net pens, floating collars, rafts, and mooring.
14	Aquaculture Facility Certification Salmon Farms Best Aquaculture Practices (BAPs) Certification Standards, Guidelines, - by the Global Aquaculture Alliance	BAPs are practices adopted and self-enforced by the industry. A number of references are available from different states and countries. In Washington state, the BAPs are assumed to include the 1986 interim guidelines (described below).
15	Recommended Interim Guidelines for the Management of Salmon Net-Pen Culture in Puget Sound – Dec. 1986	These interim guidelines prepared for the Washington Department of Ecology are intended to provide a coordinated agency approach to management of salmon net-pens in the Puget Sound. The guidelines are for interim use until a programmatic EIS can be completed and focus on environmental protection. Guidelines include water quality, site selection, and environmental surveys.
Miscellaneous		
16	2014 Fin Fish Aquaculture Plan of Operation – updated June 2014 by American Gold Seafoods	Obtained by Mott MacDonald. The 2014 plan includes an overview of existing farming sites, stock species, and health certifications and screenings. Attachment A lists the facility locations and permits, 2014 Fish Escape Prevention Plan, Employee and guidance for routine handling procedures to minimize the potential for escape.

Source: Mott MacDonald

3 Metocean Review

A review of environmental conditions of the Cypress Island Net Pen facility located on the east shoreline of Cypress Island, WA within Deepwater Bay (shown in **Figure 4**) was conducted as part of the facility review. Site 1 is located approximately 300 feet offshore, in approximately 65 to 100 feet water depth. Environmental conditions at the site were described by the lessee in the lease agreement document (*AQUATIC LANDS NET PEN LEASE 20-B12517)*. American Gold Seafoods, LLC (AGS) was the lessee of the Cypress Island Net Pens site at the time of lease application submittal, and that document was submitted to DNR by the current lessee (Cooke) as their understanding of existing environmental conditions at the site. To evaluate the environmental conditions described in the lease document, Mott MacDonald conducted an independent assessment. The evaluation used publicly-available data, as well as data from internal Mott MacDonald project databases. Environmental conditions reviewed include water levels, currents, winds, waves, and vessel traffic.

3.1 Water Levels

Tides at the Cypress Island net pens were described in the DNR lease document (20-B12517) as "…The extreme tidal range for the project is approximately 13.5 feet…".

Water levels and tidal datum data from a NOAA station (ID # 9449932) at Armitage Island approximately 5.5 miles west of the site were reviewed. This station has a diurnal tidal range of 7.84 feet and an estimated extreme tidal range of 13.5 feet[1]. The tidal datums and water levels are in **Table 3**. The length of record at the Armitage Island tide gage is approximately 3 years.

Table 3: Tidal Datums for Armitage Island, WA (NOAA Station No. 9449932)

Water Level	Elevation (feet, MLLW)
Highest Observed Water Level (12/16/1997)	10.45
Highest Astronomic Tide (predicted tide)	9.42
MHHW	7.84
MHW	7.23
MSL	4.66
MLW	2.32
MLLW	0.0
Lowest Astronomic Tide (predicted tide)	-4.08
Lowest Observed Water Level (6/22/1986)	-3.66

Source: NOAA

Assessment:

Mott MacDonald takes no exception to an extreme tide range of 13.5 feet.

[1] Extreme tidal range was defined as the difference in elevation between high astronomical tide (HAT) and low astronomical tide (LAT).

3.2 Currents

Current velocities at the Cypress Island Net Pen site were described in the lease agreement as follows:

- Maximum current velocity for the site is 0.45 cm/s *(J. Rensel, Current Velocity Study, 1996)*
- Average current velocity for the site is 0.35 cm/s *(J. Rensel, Current Velocity Study, 1996)*

The document, "*Current Velocity Study" (*J. Rensel, 1996) was not provided to Mott MacDonald for review. Reported velocities of less than one centimeter per second are unlikely. Based on prior project experience in Puget Sound, it is likely that the units were reported in error, and that units were intended to be in meters per second. Therefore, for this review it is assumed currents reported in the lease agreeement were intended to be:

- Maximum current velocity for the site is 0.45 m/s
- Average current velocity for the site is 0.35 m/s

Reported currents were reviewed relative to publicly available information and data provided to Mott MacDonald by DNR. Review of the document *"NPDES Sampling Report 2002. Cypress Island Inc Net Pens"* (Rensel, 2003) includes measured currents at Site 1 from a single day (September 21, 1994). This date was described as a "average amplitude tidal day" (Rensel, 2003). Reported daily maximum current for the average amplitude day was reported as 0.45 m/s, which matches the reported maximum current velocity for the site in the lease document.

Based on engineering experience and local knowledge in Puget Sound, extreme current velocities do not typically occur on average amplitude tidal days. Review of measured and predicted current velocities (during 2017) from a NOAA station (PUG1740, PCT2121) located in the main Bellingham Channel, 1.2 miles to the east of the net pens site, indicate that seasonal maximum current velocities can significantly exceed the daily maximum on days with an average tidal amplitude. Also, current velocities and directions can vary significantly by location. Measured currents at the current station may not be representative of currents at Site 1. Without long term measurements at the specific net pen sites, or a validated numerical model, estimates for maximum current speeds or directions at the site are not determined.

Assessment:

The extreme current velocities reported by the lessee appear to be low. The lessee reported maximum current velocity appears to be more representative of an average current velocity, but cannot be confirmed without additional measured data or numerical modeling. The maximum current velocity at Site 1 cannot be estimated without additional measured data, or a numerical hydraulic model.

3.3 Winds

Winds at the Cypress Island Net Pen site were described in the lease agreement as follows:

- Storm winds can exceed 50 knots.
- Typical storm winds are in the range of 20-30 knots (personal observation of farm staff).
- Southeasterly winds have the highest potential for large waves and the net pens. Site 1 is more protected from southeast winds, but is more exposed during northerly winds.

Wind in the vicinity of the facility was assessed based on available data. The wind record at Padilla Bay Reserve (12 miles away), was evaluated for comparison to the wind conditions described by the lessee in the lease document. The 2-year return period sustained wind speed (2-minute average) at Padilla Bay is estimated to be approximately 38 knots. The 25-year return period sustained wind speed (2-minute average) is estimated to be approximately 55 knots.

Assessment:

Mott MacDonald takes no exception to the description of the wind conditions described in the lease agreement.

3.4 Waves

Waves at the Cypress Island net pens site were described in the lease agreement as follows:

- Maximum wave height is typically less than 4 feet; however, waves of greater heights are occasionally observed.
- The largest wave heights observed over the past 20 years are estimated at 6 feet by farm personnel.
- Waves reaching site 1 from the north typically are no greater than 4 feet.
- Southeasterly winds have the highest potential for large waves at the net pens.

A review of wind-wave conditions at the net pens site was conducted. The project site is not exposed to ocean swell, and therefore only wind-waves affect the site. Wind-waves are generated by the stress of winds acting over a distance of water (also known as fetch). The maximum fetch to generate wind-waves at the project site is approximately 3.5 miles. Based on a calculation using an empirical wave generation method (USACE) and a 25-year return period wind speed of 55 knots, the significant wave height for wind generated waves near the nets is estimated to be less than 4 feet. Larger significant and maximum wave heights are possible at higher wind speeds.

Assessment:

Mott MacDonald takes no exception to the description of the wave conditions in the lease agreement.

3.5 Vessel traffic and Marine Navigation

Vessel traffic and marine navigation at the Cypress Island net pens site were described in the lease agreement as follows:

- There is recreational navigational use of the waters around Cypress Island and within Deepwater Bay.
- There is no commercial navigational use of the project site.
- The net pens are located well inside Deepwater Bay, far away from the designated commercial shipping lanes of Rosario Strait, Guemes Channel, and Bellingham Channel.
- Potential for minimum impact to recreational boating of the area occupied by the net pens:
    - There is ample area around the net pens for safe passage of recreational boaters.

- The net pen sites are well marked with navigation devices.

According to publicly-available vessel tracking data (Marine Cadastre, 2017), vessel traffic in Bellingham Channel can consist of tugs, cargo vessels, navy vessels, research vessels, fishing vessels, pleasure craft, passenger vessels, and tankers. The channel is approximately 0.5 miles from the net pen sites. Vessel wakes are unlikely to affect the net pens sites.

Assessment:

Mott MacDonald takes no exception to the description of the vessel traffic and marine navigation described in the lease agreement.

4 Net Pen Structure

The Cypress Island fish farm facility was first built in 1985. It consisted of three net pen structures. New structures for the net pens were installed at Site 1 in 2001. The exact dates of the installation are unknown. **Figure 5** shows satellite imagery of the fish farm facility. Site 1 and 2 appear to have been relocated between 2008 and 2011 based on a review of aerial photos.

Figure 5: Cypress Island Fish Farm Facility

Source: Google Earth

In August 2017, the Site 2 net pen failed and was removed. At the time of the site visit by Mott MacDonald, only Site 1 and Site 3 remained in Deepwater Bay.

The existing net pen structures are the “SystemFarm” modular steel cage system designed by Marine Construction AS (Norway). Site 1 consists of eight square cages 80 ft. by 80 ft. The structures consist of walkways made up of a framework of heavy gauged, galvanized, steel box beams with galvanized metal walkway grating welded on top. The steel walkways are interconnected by hinges and supported by plastic, foam-filled, floatation tubs bolted underneath the framework. These floating walkway structures support the nets forming the fish pens. The structures rely upon a series of mooring chains and anchors to resist the forces imposed on the floats and net systems.

Following is a summary of the key components of the system which were reviewed as part of the site assessment work. The basis of the information includes the documents provided for review and our observations during the site visit. Drawings of the net pen structure are in Appendix A.

As shown in the drawings, in addition to the walkway float structures, Site 1 has several floating structures connected to the net pen walkway floats. These include a utility shed supported on a floating barge, a crew quarters called the “House,” and four other platforms made up of walkway floats. Three of the walkway floats had sheds on them. The floating sheds, crew quarters, barge, and the floats supporting them were not inspected as part of this exercise.

4.1 Anchors

A mooring system schematic plan was provided by Cooke and is included on Sheet 2 of Appendix A. There are 24 mooring lines identified on the Cooke Mooring plan. Lines 1 through 17 and lines 23 and 24 are connected to anchors on the seafloor.

Lines 18 through 22 are connected to “Shore Pins.” The Shore Pins are 6-in. diameter steel piles embedded into the seabed close to shore but submerged at all tide levels. The length of these piles is unknown. Except for line 15, the anchors on all the lines connected to anchors are identified as Danforth type anchors of varying weights. The anchor on line 15 is identified as a Navy type anchor of 8,500 lbs.

The mooring lines connected to the embedded shore pin piles are secured by a shackle to a pad-eye attached to the piles.

4.2 Mooring Line & Hardware

The mooring lines are composed of upper anchor chains (typically 30 or 45 ft.), nylon rode lines (200 ft. to 400 ft.), and lower anchor chains (approximately 90 ft.) connected with shackles and other mooring hardware. The upper chain of the mooring line is connected to the float frame at the top, with its trailing end connected to the rode line. The trailing end of the rode line is connected to the lower anchor chain, which is ultimately connected to the anchor on the seabed. Lines, 1, 2, 7 through, 11, 13 through 17, and line 23 have buoys which support the mooring lines by connecting to the upper anchor chains.

4.3 Mooring Line to Float Connection

The mooring lines are connected by shackles to mooring brackets on the floats. The mooring brackets consist of two pad-eyes attached to a hinge welded to the floats a few inches below the walking surface. A stainless-steel bolt acts as the pin in the hinge. Typically, the mooring lines were found to be attached to only one pad-eye at each connection point. **Figure 6** shows a typical mooring bracket. Most anchor mooring lines had a single point of attachment, rather than a “bridle” or “hen’s foot” arrangement as shown on the plan provided by the owner. A bridle connection divides the mooring line near the net pen into two lines that attach to two different points on the net pen structure.

4.4 Predator Exclusion Net

Predator exclusion nets surround the exterior of the facility, connected to steel pipe railings that runs along the outboard perimeter of the walkway float framing. The predator exclusion nets are weighted down by steel pipes at the bottom. These nets are typically vertical in the water, and enclose the bottom of the entire net pen. Above the waterline, the nets are connected to steel poles slotted into the walkways at regular intervals to extend the nets vertically for approximately 4 feet above the walkway. This prevents seals and sea lions from accessing the floats and net pens and also discourages trespassing.

4.5 Fish Stock Containment Net

The fish stock containment net system connects to a steel pipe railing that runs along the inboard perimeter of the walkway float framing. The fish stock containment nets are additionally tied to the tops of the handrails to keep fish contained when jumping. According to Cooke, each fish stock containment net extends approximately 40 ft. into the water.

4.6 Aviary Net

Aviary nets are stretched across the top of each fish pen and secured to the tops of the handrails to prevent birds from landing inside the pen and consuming the fish or feed.

Figure 6: Cypress Island Site 1 - Mooring Bracket at Line 20

Source: Mott MacDonald

4.7 Walkways

Steel structural framing provides support for the walkways, predator exclusion nets, fish pen nets, and aviary nets. Walkway floats are modular units connected by a series of hinges with stainless steel pins. Underneath the walkways, the framing was supported by plastic, foam-filled flotation tubs. The surface of the walkway is made of steel bar grating 1 ½" deep with openings of 1 ½" by 3". The center walkway is wider with additional framing and flotation. The center walkway supports the fish feeding equipment and provides a route for a small forklift. Forklifts typically operate only on the center walkway.

4.8 Float Tubs

The walkways are supported by plastic, foam-filled tubs bolted to the underside of the walkway framing.

5 Inspection, Maintenance & Repair History

A review of the inspection, maintenance, and repair history was primarily based on the information provided and as described by Cooke personnel during our site visit. Surface inspection sheets (Weekly inspection logs) from October 19, 2017 to November 2, 2017 were also reviewed.

5.1 Background

The following documents and standards apply to the net pen system inspection and maintenance activities:

- DNR Aquatic Lease #20-B12517 (January 14, 2008). Tenant shall, at its sole cost and expense, keep and maintain the Property and all improvements (regardless of ownership) in good order and repair, in a clean, attractive, and safe condition. Tenant shall, at its sole cost and expense, make any and all additions, repairs, alterations, maintenance, replacements, or changes to the Property or to any improvements on the Property which may be required by any public authority. Minor maintenance to the cage structures, anchor lines and netting occurs throughout the year and on a continual basis. Major maintenance of cage structures is typically replacement. Average service life expectancy of new structures is approximately 15 years. Metal fatigue can be a factor based on constant wave action and flexing. Visual inspections of the below water connections are made periodically by divers, while the surface connections can be checked daily by farm staff. Components in the mooring systems are periodically replaced on average every 6 years of service; however, repairs are made as needed. Maintenance of fish stock containment nets is carried out on a year-round basis. Nets are replaced after approximately 6 years of service.
- Cooke Aquaculture Pacific Pollution Prevention Plan (October 2017). Document includes netwashing practices, weekly visual inspections of exposed lines, shackles, and mooring points, and annual inspection of below water mooring components.
- SystemFarm W24-3,16 Large Steel Cage System – 16-page technical description and with figures and other information. The cover of the document shows the Supplier is Marine Construction AS (Norway) and is dated June 16, 1999. It appears to be prepared for Omega Salmon Group Ltd. and Cypress Island Inc. for 12 cages delivered on March 1999. This document was assumed by Mott MacDonald to have been prepared for net pen facilities at Cypress Island Site 1. The document includes recommended maintenance intervals for different components.
- Industry Standards. Various industry standards and other governmental standards for marine fish farming facility inspection and maintenance exist. These include requirements in other U.S. States, Canada, and Norway. These other governments and industry practice have a summary of recommended inspection and maintenance activities for net pen systems.

5.2 Inspection

The following documents were reviewed pertaining to inspection of the net pen facility:

- Three weekly inspection forms were reviewed, from October 19 to November 2, 2017. There is an additional inspection form which is undated. These include the mooring plan, and a table with condition of the following:
    - System Mooring Points (Pad-eyes, Mooring Plates)
    - Surface Shackles, Thimbles, Hardware
    - Mooring Lines
    - Surface Chain Connections
    - Walkway Hinge Points
    - Walkway Grating Condition
- A table showing the inspection from October 2017 of the mooring line and anchor system listing their condition. Since this inspection covers the components underwater, this was likely a dive inspection.
- No other inspection documents were available for review.

The inspection reports from October 19 and 26 indicate that walkways are rusty and need to be replaced. The inspection report from October 19 states that the surface framework and grating are compromised.

On the undated report, the plasma line on line 5 was found to be frayed and unserviceable. A “chain and spectra” was used to reinforce this. It is unclear what the term “chain and spectra” mean, but spectra probably refers to a type of synthetic mooring line. Lines 3 and 4 were also reinforced with chains.

The report from November 2nd states that the anchor pin at line 17 was found ungrounded and was replaced and reset with an anchor. Details of this repair are not included.

5.3 Assessment

The following is our assessment of the inspection, maintenance and repairs being conducted at the facility.

- Documentation of historical maintenance and repair work was sparse, based on the information provided at the time of this assessment.
- Inspection of key float frame and net support systems such as the structural frame and fish stock containment net support pipe system do not appear to be occurring. Consideration for inspection of these elements should be made in the future, as they are integral elements of the overall net pen structural support system.
- Inspections as outlined in the supplier documentation and industry standards typically require a greater level of inspection and documentation thereof than what appears to be conducted and as outlined in the information provided for this assessment.
- Detailed documentation of repairs conducted to implement deficiencies identified in the inspection reports should be provided.

6 Site Visit and Existing Conditions

Mott MacDonald visited the net pen facility on January 10 and 14, 2018. Collins Engineers performed underwater inspection work on site from January 10-14, 2018, using both divers and ROV. The personnel present included Nels Sultan and John Jacob with Mott MacDonald, divers with Collins Engineers, Cooke Aquaculture employees, and DNR staff. **Figure 7** shows the net pens. Photographs are included in Appendices A and C. The dive inspection report by Collins is in Appendix B.

Figure 7: Cypress Island Site 1 – View from Southeast

Source: Mott MacDonald photograph January 10, 2018

During the site visit, observations were made and photos were taken. On January 10 at 7:40 am the weather was cool, 50°F, overcast, no precipitation, with winds light and variable, and the sea calm. Wake waves from passing vessels were not observed to be noticeable at the net pens during the site visit. The predicted tide elevations are below in **Table 4**. The predicted currents in are in **Table 5**. The predicted current speeds are at a point approximately 0.75 miles northeast of the Site 1 net pen**.** The maximum predicted current speed during the site visit on January 10 was 2.98 knots in the middle of the channel, but this current magnitude was not observed at the net pens during the site visit.

Table 4: Predicted Tide Elevation at Anacortes on January 10, 2018

Tide	Time (Pacific Daylight)	Elevation
High	1/10/2018 12:30 am	+5.7 feet, MLLW
Low	1/10/2018 4:46 am	+4.7 feet
High	1/10/2018 11:21 am	+8.7 feet
Low	1/10/2018 6:49 pm	+1.6 feet

Source: Tides&Currents Software

Table 5: Predicted Currents in Bellingham Channel on January 10, 2018

Time (Pacific Daylight)	Speed	Direction
2018-01-10 05:24 AM	0	slack
2018-01-10 08:44 AM	1.24 knots	045°, Flood
2018-01-10 10:53 AM	0	slack
2018-01-10 03:21 PM	2.98 knots	185°, Ebb
2018-01-10 07:48 PM	0	slack
2018-01-10 11:50 PM	0.79 knots	045°, Flood

Source: www.tidesandcurrents.noaa.gov

The components and observed deficiencies are discussed below, and summarized in **Table 6**. The assessment is based on the conditions observed during the site visit, a document review and our professional judgment and experience. See the drawings in Appendix A for the numbering system.

The year built is estimated based on available documents, discussions with Cooke Aquaculture employees on site, and our experience with marine facilities in the region.

Table 6: Cypress Island Site 1 – Existing Conditions Summary

Component	Year Built (estimate)	Description	Deficiencies	Component
Anchors	Unknown	All underwater anchors appear to exist but were not observed closely.	Anchors at lines 7, 13, 17, and 24 were not adequately embedded in the seabed.	Satisfactory condition, but some anchors do not have adequate embedment.
Mooring Lines	Unknown	Most underwater mooring lines and hardware appeared in satisfactory condition.	Some lines were observed to have corrosion with section losses up to 75%.	Satisfactory conditions but with severe section loss observed on anchor lines 7 and 9.
Steel Frame and Mooring Brackets	2001	Galvanized steel tube and structural sections, welded to form units connected by hinges.	Severe corrosion in several locations	Satisfactory to Serious.
Float Tubs (plastic)	2001	Plastic, foam-filled tubs, bolted to underside of steel walkways	Inadequate flotation along the East and West walkways. Minor damage to one individual tub was observed.	Fair
Walkways, Gratings, and Railings	2001	Steel fabrication with metal grate walking surface and hinged connections	Severe corrosion at several locations. Some locations have been overlaid with fiberglass grating.	Fair to Critical.

Component	Year Built (estimate)	Description	Deficiencies	Component
Predator Exclusion Nets	Unknown	Aviary nets cover each fish pen and nets line to perimeter of the facility to keep out marine mammals	None observed, not part of this inspection.	N/A
Fish Stock Containment Nets	Unknown	Nets deployed within active fish pens.	None observed, not part of this inspection.	N/A
Floating Barge and Shed	Unknown	Concrete barge with wood framed shed, metal roof and siding.	None observed, not part of this inspection.	N/A
Floating crew quarters (aka House)	Unknown	Concrete barge with wood framed shed, metal roof and timber siding.	None observed, not part of this inspection.	N/A
Miscellaneous floats moored to the net pen structure	Unknown	Four total floats; three with wood framed sheds. Varying construction.	None observed, not part of this inspection.	N/A
Records and Documents at site	N/A		Not inspected.	Not inspected.

Source: Mott MacDonald

6.1 Anchors

- The anchors are three different types: Danforth, Navy, and shore pins (steel piles).
- Most anchors were observed by the divers to be almost completely buried under the seabed with minimal exposure, as expected, except for the anchors at lines 7, 13, 17, and 24. These anchors were generally 90° out of alignment, and consequently, had only one anchor fluke and its peg embedded to some extent in the seabed.
- The buried anchors were not observed during the underwater inspection.
- None of the anchors showed any signs of appreciable movement along the seabed.
- All shore pins, except that at line 18, indicate a stable anchorage. The pile at anchor line 18 is deformed to where it is bent essentially horizontal towards the fish pens. This appears to be the result of excessive load exerted on the anchor line.

6.2 Mooring Lines and Mooring Brackets

- Mooring brackets are attached to the walkway structure frame near the walking surface. The brackets are evenly distributed around the net pen structure, located at walkway intersections. Details of the connection are shown on sheet 4 of the drawings in Appendix A. Typically, only one mooring line was connected to a single pad-eye in each bracket.
- Mooring brackets were observed during our site visit to be in fair to satisfactory condition with minor corrosion and deformation observed in places.
- Above water, the anchor mooring lines consist of steel chains and shackles connected to the steel frame. Mott MacDonald has not reviewed an engineering study or mooring plan for this facility.

- Connections between the upper anchor chains of the mooring lines and the net pen float framing were generally found to be in satisfactory condition.
- The upper and lower anchor chains typically exhibited light to moderate corrosion. At anchor lines 18, 20, and 21, the chains showed an estimated 25% of section loss at certain locations on the lower anchor chain. On lines 9 and 17, the upper chains showed an estimated section loss of 50% to 75%.
- The nylon rode lines were typically found to be in satisfactory condition with no excessive fraying or other detectable abrasion damage except for minor strand damage at anchor line 7.
- In general, the mooring brackets and mooring lines observed were in satisfactory condition.

6.3 Steel Framing

- The primary structural framing consists of rectangular HSS steel members. The condition of the framing members varied from serious to satisfactory. Framing members on the floats adjacent to pens 112, 113, 122, and 123 and running north-south showed the most corrosion. Framing members on the floats along the perimeter of Site 1 were rated as between poor and fair. The framing members under the central walkway were rated as being fair to satisfactory.
- At the intersections of the central walkway floats with the walkway floats running north-south, chains were laid in an “X” pattern to connect the framing members of central walkway floats with the walkway floats running north-south. According to staff on site these chains were installed recently to provide redundancy in the structural system and help connect the components.

6.4 Walkways

- Walkway surfaces consist of steel grating panels. Several areas of the grating show signs of severe corrosion. New fiberglass grating has been overlaid on some areas where the grating panels have holes in them. However, there are other locations where the walkways are not safe to walk on due to the extremely corroded condition of the grating.
- The walkways are interconnected by barrel hinges at their ends. Generally, the hinges were in fair condition. Minor to moderate corrosion of the hinges was observed in places.
- At the ends of the walkways, steel plates are welded to the framing members at the surface. These steel plates have mooring cleats bolted through them. On some outer floats connected to the mooring lines, cracks were observed in the welds connecting these steel plates. See photo C-26 in Appendix C.
- Along the east walkways, there are square HSS (4” x 4” x 3/8”) members restrained by bolted connections to the surface of the walkways. There are two HSS members – one on either side of the float perpendicular to and meeting the walkway floats forming the east walkway. These HSS members appear to have been installed as repairs to the walkways. However, the reason for needing repairs is unknown. The HSS member at the northeast corner along the outside of the north walkway is not restrained because of missing bolted connections.

- No corrosion protection measures such as anodes were observed on the facility, other than galvanizing.

6.5 Floats

- The walkways are supported by large, plastic, foam-filled tubs bolted to the underside of the framing.
- Flotation was observed to be insufficient along the east and west sides of the facility. The northeast and northwest corners were submerged underwater. The freeboard along the east walkway ranged from -3” (underwater at the corners) to +7”. The freeboard along the west walkway ranged from -6” (underwater) to +7”, with the west side of the west walkway lower than the east side throughout its length (listing). Cooke staff on site said the low freeboard and list on the west walkway was a result of removing the fish pen nets but not the predator exclusion nets, thereby causing an unbalanced load.
- The freeboard along the north and south walkways was observed to be generally uniform, varying from 12” to 15” at different points along the structure. The freeboard along the central walkway was also observed to be generally uniform ranging from 18” to 22”.
- One of the floats along the East walkway showed signs of minor damage where the floatation foam was exposed.

6.6 Predator Exclusion Nets and Connections

- Predator exclusion nets include both in-water nets to prevent seals and other marine mammals from entering the pens, and above water nets to prevent bird predation of the fish stock. The predator exclusion nets also discourage trespassing, theft, and vandalism.
- The in-water nets are supported by pipe rails attached to the steel framing along the outside of the walkway floats. The nets are taut, vertical in the water and held in place by pipe weights at the bottom.

6.7 Fish Stock Containment Nets and Connections

- The fish stock containment nets confine the salmon inside each individual pen. The nets are supported by pipe rails that surround the inside perimeter of each pen. Surface corrosion was observed on the pipe connections to the frame. Some of the nets had been pulled up on the date of the site visit with no fish in those pens.

6.8 Floating Shed

- The floating shed is a one-story structure, consisting of timber framing built on top of a concrete barge. An assessment of the floating shed structure above the barge is outside the scope of this study.

6.9 Records and Documents On-Site

- No records or documents on site were reviewed.

7 Conclusions

Based on Mott MacDonald's review of the available information and documents, the site investigation, and our experience and judgment, Mott MacDonald offers the following findings.

1. Site History and Facility Age: Net pens have been at the site since the 1980's based on information in the lease agreement. The exact age of the Site 1 net pens has not been determined.

   Based on all available information, the age of the net pen at Site 1 (but not the mooring lines) is estimated to be approximately 17 years. The lease agreement states that "the new cages have an average expected service life of approximately 15 years".

1. Environmental Conditions: The net pens are exposed to moderate to strong tidal currents, in addition to wind, wave and vessel wakes. The current has the potential to exert substantial loads on the nets, structure, and mooring systems. Current induced drag forces and other environmental loads need to be accounted for in the design and a site-specific mooring analysis.
2. Net Pen System Design:
   a. No site-specific stamped engineering design documents for the original net pen structure design were available for review. Information in the manufacturer supplied information appears to be generic, and not specific to the system installed. The drawings and information in the document from Marine Construction are general information for the installed system.
   b. Repairs have been conducted to the net pen structure over its life; however, these repairs do not appear to be engineered solutions.
3. Mooring System Analysis and Design:
   a. The design of the mooring system is not documented. As such, there is no information to verify adequacy for site conditions.
   b. The schematic mooring diagram and notes describing the existing components, which was provided, does not show all the components of Site 1 accurately. There are additional anchor lines in the mooring system than what is shown on the schematic plan. A review of the installed mooring system relative to a specified design to assess overall adequacy could not be conducted with the information made available for this assessment.
4. Underwater Components: Except for a few locations, where corrosion was observed in the anchor chains, the mooring system appears to be in satisfactory condition. Although several anchors were found to not be adequately embedded in the seabed, there was no indication that any of the anchors had moved. The underwater inspection did not reveal any significant deterioration or deficiencies for the components or their connections that would suggest any appreciable reduction in their originally designed integrity or stability.
5. Components Above Water: Severe corrosion damage was observed in several locations of the walkway grating above water. Several of the float framing members above water also showed signs of severe corrosion. The mooring brackets, the predator

exclusion net pen supports, and the supports for the handrail were observed to be in fair to satisfactory condition.

6. Repairs: Some repairs conducted on the structure have deteriorated or failed such as the broken bolted connections holding down the HSS members and the cracks in the welds in the steel plates. Detailed documentation of repairs on the structure were not available for review.
7. Corrosion Protection: No corrosion protection measures were observed on Site 1 other than galvanizing.
8. Review of Inspection Documents: Inspections conducted by Cooke do not appear to be in accordance with manufacturer's recommendations, industry standards, or Cooke's latest Pollution Prevention Plan. Inspections of additional critical structure elements should be conducted. The Monthly and Annual inspection forms included in the SystemFarm document from Marine Construction should be used. The floating steel structure and mooring system should be inspected at least annually.
9. General Observations:
    a. In general, the facility is in poor condition, with several repairs needed. Site 1 is likely past the end of its service life and needs to be replaced.
    b. Although no major damage was observed, there were several locations exhibiting severe corrosion.
    c. The net pen structure shows deflections in the system that are far greater than what would be expected for a similar structure under service conditions. The low freeboard, with the corners along the north walkway being underwater, and the differential displacements at various locations in the structure are cause for concern – especially because they are observed during normal operations of the facility. Also, the floats are not level.
    d. Given the existing condition of the structure and the uncertainty in its capacity (due to a lack of engineering documentation) to resist loads acting upon it, the structure could experience a catastrophic failure even under less-than-critical loading scenarios. Similar structures, in almost identical environments, have experienced such failures towards the end of their service life.

The findings and results of this assessment work by Mott MacDonald do not constitute a certification of the facility structural integrity but rather an overall review of the condition as represented by the applicant and verified in the field during a site visit and underwater inspection.

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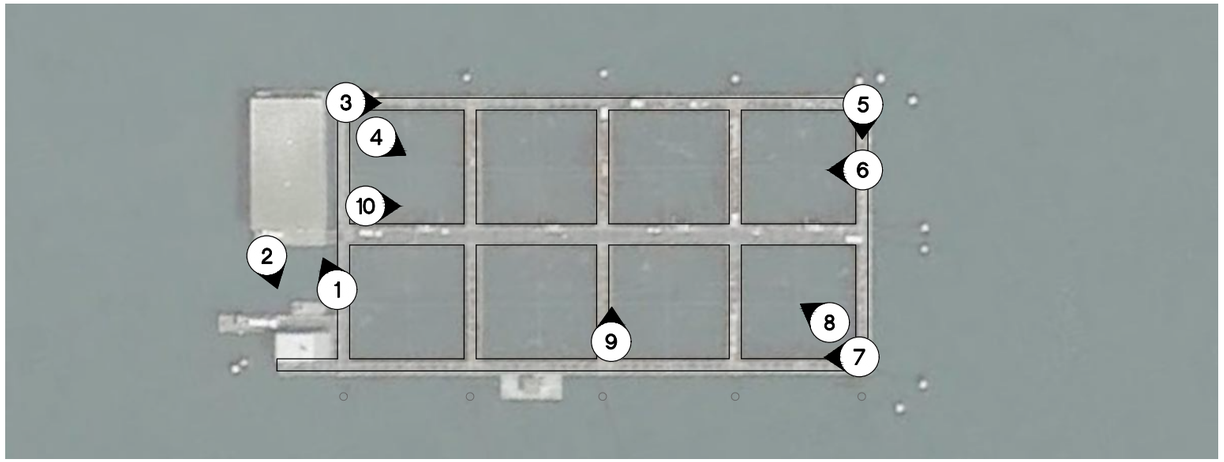
Weekly Cypress Site 1 Surface Inspection Sheet – 10/19/2017; 10/26/2017; 11/02/2017.



CYPRESS ISLAND NET PEN #1

PHOTOS-PLAN

0 50 100

SCALE IN FEET

LEGEND

1 PHOTO LOCATION AND ORIENTATION

NOTES

MOORING SYSTEM NOT SHOWN, SEE SHEETS 2 AND 3

PHOTO 1

PHOTO 2

PHOTO 3

PHOTO 4

PHOTO 5

PHOTO 6

PHOTO 7

PHOTO 8

PHOTO 9

PHOTO 10

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WASHINGTON DEPARTMENT OF NATURAL RESOURCES

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	1/24/18	TM	PLAN AND PHOTOS	JJ	NS

Designed	J. Jacob		Eng check	S. Phillips	
Drawn	T. Morrison		Coordination		
Dwg check	N. Sultan		Approved		

Scale at ANSI D: As Shown | Status | Rev | Security

Project Number: 391980 | B/O: 1 | Total: 5

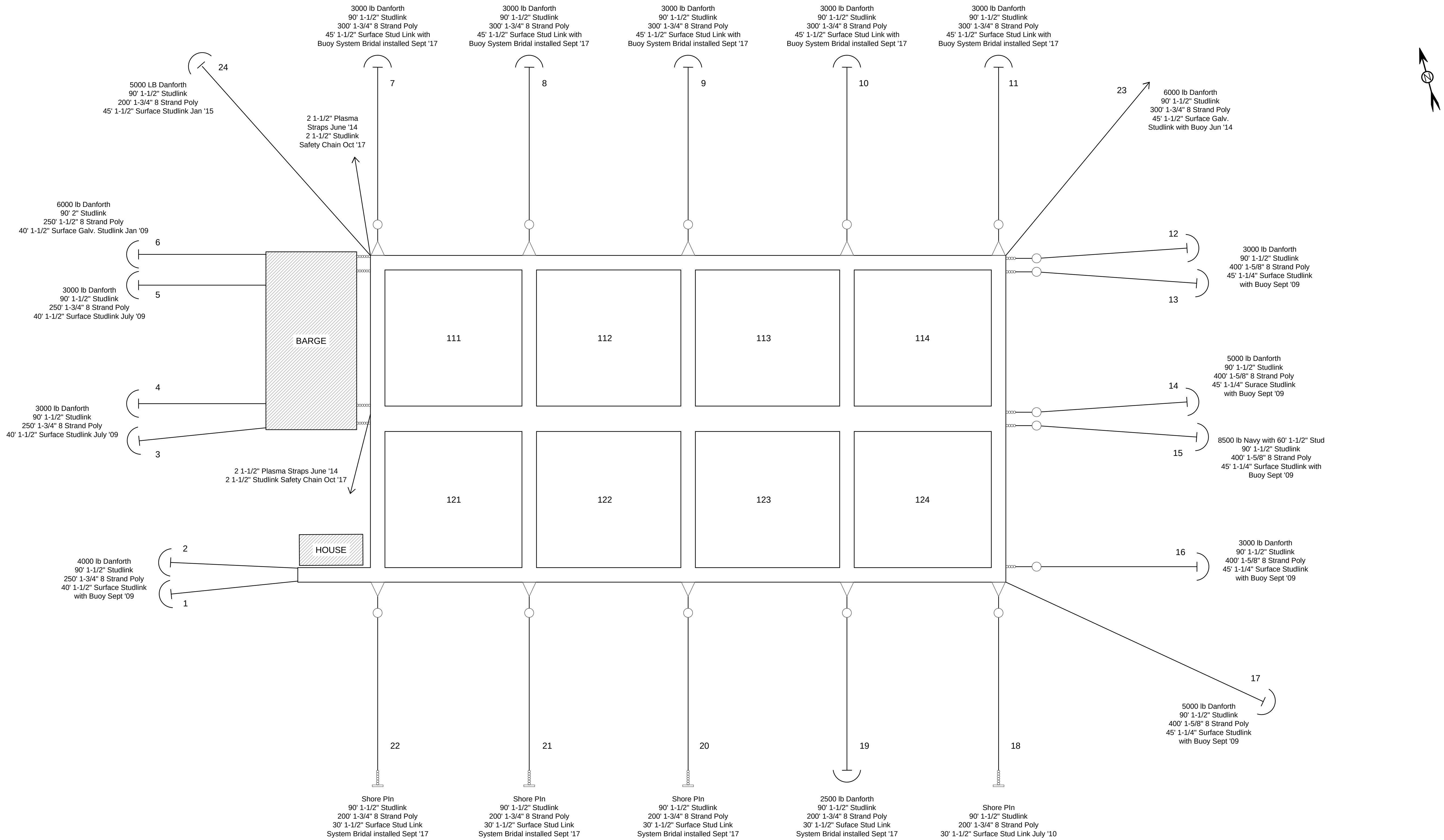
Drawing Number

Title

Washington State
Department of Natural Resources
Cypress Island Net Pen #1

Photo Locations Plan

pw://pimspwise.hmmg.cc:pw_ports_harbors/Documents/391980-PUGET SOUND NET PEN ASSESSMENT/Drawings_Models/12_MA_Marine/7 - Design/CAD/E - Preliminary/391980-Cypress Island Net Pen #1.dwg Jan 23, 2018 - 6:20PM MOR69830



CYPRESS ISLAND NET PEN #1

MOORING PLAN

NOT TO SCALE

NOTES

MOORING SYSTEM SCHEMATIC PLAN
PROVIDED BY COOKE AQUACULTURE.

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Drawn	T. Morrison	Coordination	
Dwg check	N. Sultan	Approved	
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Project Number: 391980 | B/O: 2 | Total: 5 | Drawing Number:

Title:
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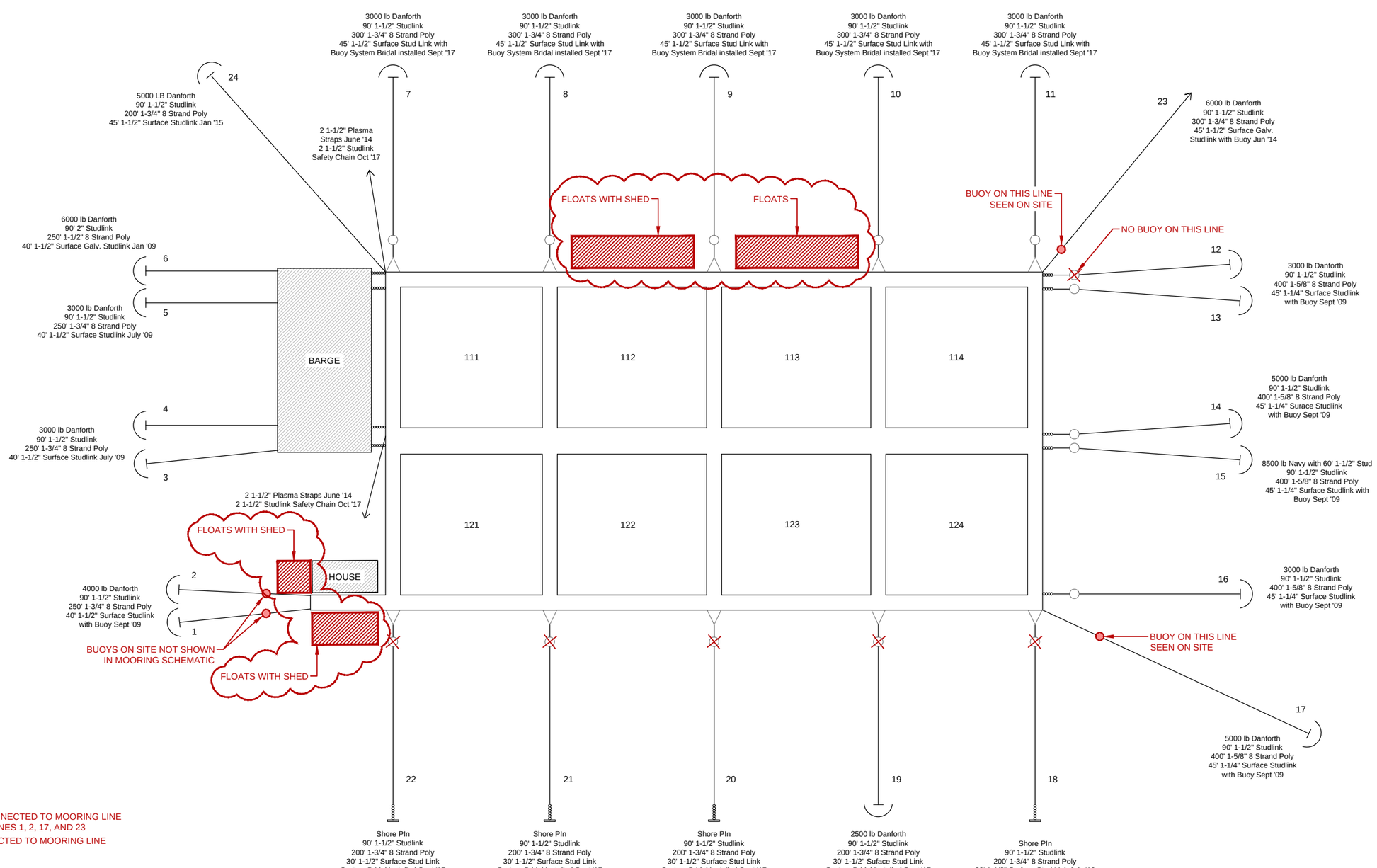
Cypress Island Net Pen #1

MOORING SCHEMATIC PLAN



LEGEND

- STEEL BUOY CONNECTED TO MOORING LINE
  BUOYS ARE AT LINES 1, 2, 17, AND 23
- NO BUOY CONNECTED TO MOORING LINE

NOTES

1. MOORING SYSTEM SCHEMATIC PLAN PROVIDED BY COOKE AQUACULTURE.
2. CORRECTIONS AND NOTES BY MOTT MACDONALD ARE IN RED.

CYPRESS ISLAND NET PEN #1

MOORING PLAN

NOT TO SCALE

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Dwg check	N. Sultan		Approved		

Project Number	B/O	Total
391980	3	5

Scale at ANSI D	Status	Rev	Security
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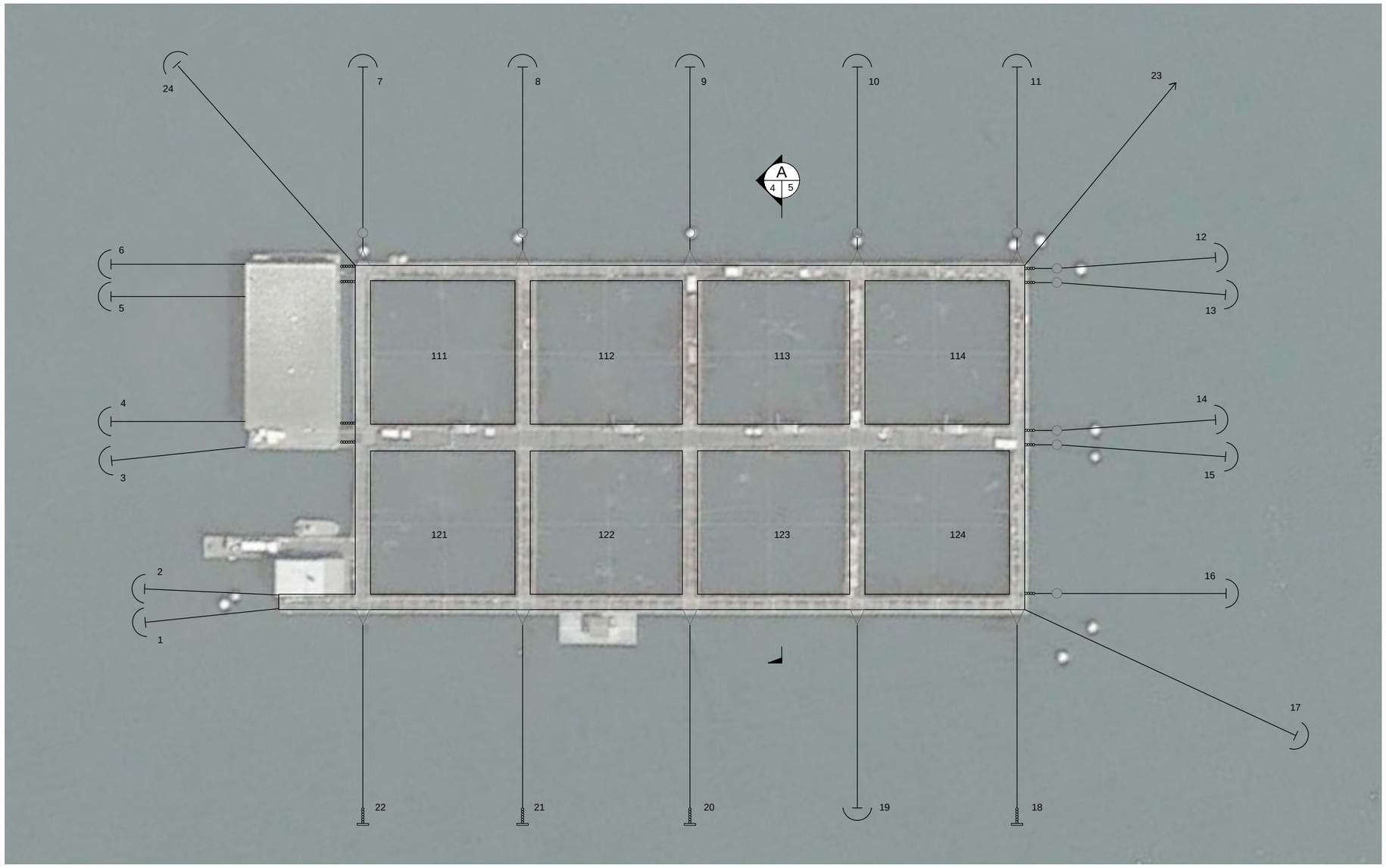
Department of Natural Resources
Cypress Island Net Pen #1

Mooring Schematic Plan
Revised with Notes



CYPRESS ISLAND NET PEN #1

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SCALE IN FEET

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Drawn	T. Morrison		Coordination		
Dwg check	N. Sultan		Approved		

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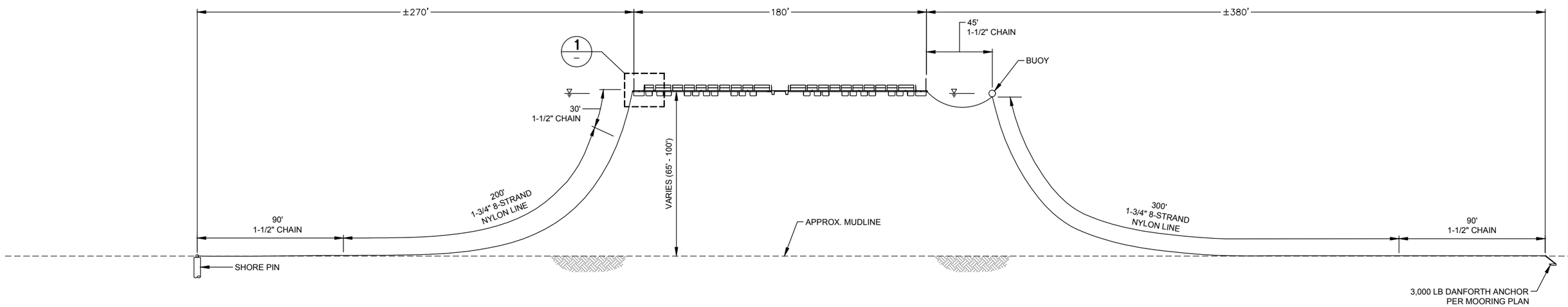
Project Number: 391980 | B/O: 4 | Total: 5

Drawing Number

Title

Washington State
Department of Natural Resources
Cypress Island Net Pen #1

Existing Site - General Plan



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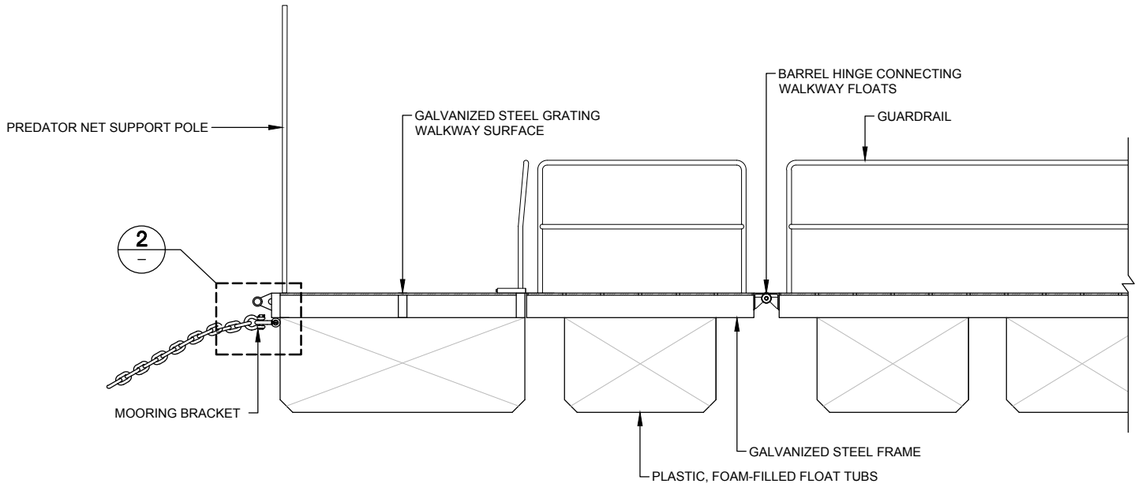

1 – DETAIL

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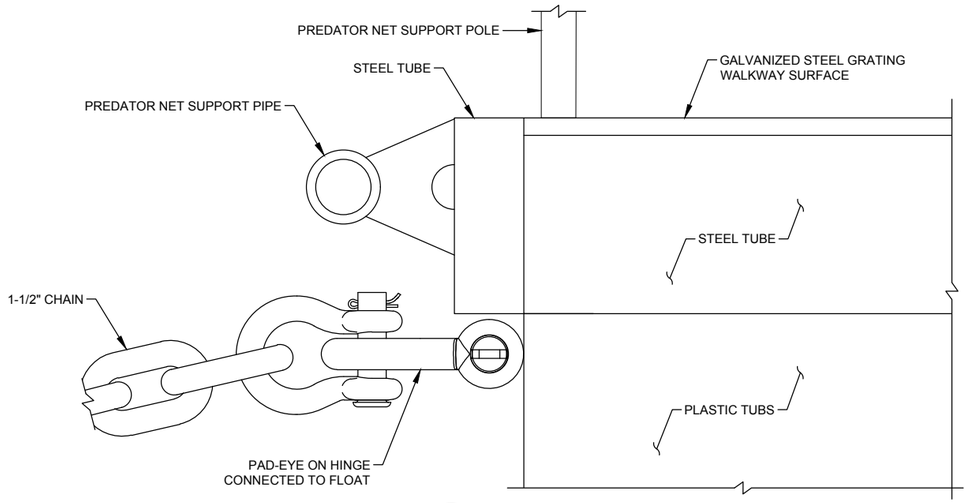
SCALE IN FEET



2 – DETAIL

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SCALE IN INCHES

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1	1/24/18	TM	PLAN AND PHOTOS	JJ	NS

Project Number	B/O	Total
391980	5	5

Designed	J. Jacob		Eng check	S. Phillips	
Drawn	T. Morrison		Coordination		
Dwg check	N. Sultan		Approved		

Scale at ANSI D	Status	Rev	Security
As Shown			

Drawing Number

Title

Washington State
Department of Natural Resources
Cypress Island Net Pen #1

Sections and Details

January 29, 2018
Collins Job No. 45-10819

Underwater Inspection of the Site 1 Cypress Island
Fish Net Pens System in Deepwater Bay, WA

Nels Sultan, Ph.D, P.E.
Principal Engineer
North America Ports, Coastal and Offshore
Mott MacDonald
110 James Street, Suite 101
Edmonds, WA 98020

Dear Mr. Sultan,

Collins Engineers, Inc. conducted an underwater inspection of the Site 1 Cypress Island Fish Net Pens System located in Deepwater Bay, WA from January 10 through January 14, 2018. The scope of the inspection was to perform a below water visual and tactile inspection of the facility components, consisting of the anchor line assemblies and the barges/floats under the operations and feed house buildings, and then based on the findings, comment on the integrity and stability of the submerged components of the fish net pens system.

The fish net pens system components inspected included all of the anchor line assemblies that stabilize the net pens system, as well as the barges/floats that support the operations and the feed house buildings of the facility. The inspection intensity consisted primarily of a Level I inspection effort (visual and tactile techniques), with very limited cleaning of existing marine growth, and the overall inspection process followed the guidelines established by the ASCE Manual of Practice 101 – Underwater Investigations: Standard Practice Manual and ASCE Manual of Practice 130 – Waterfront Facilities Inspection and Assessment. The inspection was performed by a dive team consisting of five (5) Association of Diving Contractors (ADCI) engineer/divers with rotating rolls to optimize dive time and safety. An underwater Remotely Operated Vehicle (ROV) was also utilized to inspect the anchor lines with their lower portions located in water deeper than 100 fsw, which is the OSHA limitation for commercial dive operations not requiring a recompression chamber to be on site. In this regard, due to prevailing water depths being greater than 100 fsw at the anchor location, ROV inspection was used to supplement the diving inspection at Anchor Lines 12 through 16 and 23 at the Site 1 Cypress Island Net Pens System.

Refer to Photographs 1 through 82 for views of the typical and specific conditions observed during the underwater inspection of the Site 1 Cypress Island Fish Net Pens System components. In addition, all of the photographs and videos taken during the underwater inspection of the Site 1 Cypress Island Fish Net Pens System components have been made available for reference digitally.

Overall, the underwater inspection revealed the following key findings for the Site 1 Cypress Island Net Pens System:

- The anchor line arrangement was consistent with the drawing provided by Cooke Aquaculture, with the exception that there were two additional anchor lines, one each on the northerly and southerly sides of the feed house barge/float. It should be noted, however, that although apparently once in place on the southerly side of the feed house barge/float, the southerly anchor line was detached below the water line at a depth of approximately 10 fsw and not in place at the time of inspection.
- The anchor line assemblies were generally found to be in satisfactory condition, with no structurally significant deterioration in most instances, and in all cases with all connection elements presently intact and secure. Regarding the various shackles used throughout the system, although presently secure, there were, however, approximately 50% of the shackles were missing a safety wire/chord (screw type pin) or cotter pin (bolt and nut type pin) in place.
- Overall, the extent of marine growth on the various chains and rode lines of the anchor line assemblies was fairly consistent throughout the net pens system suggesting that the majority of the anchor lines have been in service for a comparable length of time. The exception to this was at Anchor Lines 7, 9, 20 and 24, where the rode line rope and upper and lower anchor chains appeared to be much newer than all others with minimal marine growth on those items. It should also be noted that at Anchor Lines 7 and 9, as well as at Anchor Line 10, the rode line rope was noticeably slack, suggesting that resistance from the anchor line is currently not being relied on by the net pens system.
- The anchor line ropes were typically attached at their connections to the upper and lower lengths of chain with a metal thimble inside an eye secured by a bowline knot instead of a more typical splice. In a few instances, an eye splice with an adequate rope weave was used instead of the loop and knot arrangement. In all instances, the rode line rope connections were secure and sound, although at Anchor Line 20, the thimble was displaced from the loop and no longer serving its intended purpose. In this instance, there was no rope damage observed thus far and the connection was still secure; however, ideally a thimble should ultimately be properly installed to afford the rope the best protection.
- The upper and lower lengths of chain in the anchor lines as well as their related shackles used at the rope connections, typically exhibited minor to moderate corrosion that was not structurally significant and had pitting that was 1/16 in. deep or less. The only exceptions

to this were observed at the lower anchor chain runs at Anchor Lines 18, 20 and 21, where it appeared that a smaller than typical chain size was used and random links had up to an estimated 25% loss of original section.

- A majority of the anchor lines had steel buoys supporting their upper lengths of anchor chain apparently in an effort to relieve some of the downward load on the floating net pens system. Typically, the smaller chains used to make the buoy to anchor line chain connections exhibited an extent of corrosion similar to that of the anchor line chains, although at Anchor Lines 9 and 17, there was an estimated 50% to 75% loss of original section observed for the smaller buoy chain links due to both corrosion and wear.
- At Anchor Lines 1 through 4, 6, 9, 10, 12 and 24, between 45 ft and 90 ft (full shot length) of the lower anchor chain was exposed before becoming fully embedded in the seabed along with its respective anchor. Typically, at the remainder of the anchor lines, there was just minimal anchor exposure (top of stem and/or head of Danforth or Navy type anchor), suggesting that the anchor was well-founded. The exception to this was observed for the anchors of Anchor Lines 7, 13, 17 and 19, where the anchor (Danforth type) was mostly resting on the seabed, with its orientation approximately 90 degrees from normal and only one fluke partially embedded. At Anchor Lines 18 and 20 through 22, the anchor line anchorage was a driven 6 in. diameter pipe, which presently appeared to be providing adequate support, although at Anchor Line 18, the pipe was heavily deformed due to apparent overload.
- At the location of the anchor for Anchor Lines 8 and 9 and the anchor line running out from the northerly side of the feed house barge/float, it should be noted that there was a considerable amount of abandoned rope, netting and other debris on the seabed in and around the anchor and lower anchor chain in the vicinity of the anchor, at times extending up 2 ft to 3 ft above the level of the seabed.
- The floating barges/floats carrying the operations and feed house buildings at the westerly end of the Site 1 net pens system did not exhibit any notable deterioration or any other damage to their concrete (feed house building) or polystyrene (operations building) submerged surfaces, and only exhibited heavy marine growth throughout.

Anchor Line Assemblies

The anchor line assemblies typically consisted of:

- Upper Anchor Chains (±30 ft)
- Ropes (200 ft to 400 ft – rode line)
- Lower Anchor Chains (90 ft – one shot of chain)
- Anchors (Danforth, Navy or pile type)

The connections between the net pens framing or building barge/float and the upper anchor chains were typically found to be fully intact, secure, and in good to satisfactory condition. In most instances, the padeyes were fully galvanized and exhibited little or no corrosion. The steel shackles also typically exhibited little, if any, deterioration, and in many instances appeared to be relatively new. The shackles were typically found to be properly aligned and secure, and although screw in type shackle pins were always tight, the majority of the shackles did not have any restraining wire or chord in place for the shackle pin. The inspection of the accessible portions of the steel framing that provides the overall attachment between the aforementioned padeyes and the pen system walkway construction typically revealed that framing to be sound and secure with no concerns for instability.

The upper and lower anchor chain to rode line rope connections (thimble and shackle) were typically found to be fully intact, secure, and in satisfactory condition. These components generally exhibited a moderate layer of marine growth, consisting of up to a 1/2 in. thick layer of hard growth covered by 1 in. to 3 in. of softer growth. The steel thimbles, which were always in place for the rope eye loops, typically exhibited only minor to moderate corrosion with up to 1/16 in. deep pitting. It should be noted that there was one instance, at Anchor Line 20, where the thimble was displaced from the rope loop and no longer serving its intended purpose; however, no rope damage was observed thus far and the connection was still secure. In nearly all instances, the ropes were secured beyond the thimble with a bowline knot instead of a more typical splice, which typically appeared to be adequately secure. The only exceptions to this were present at the lower connections of Anchor Lines 3, 5, 6 and 21, where there was an eye splice and rope weave used that also appeared to be adequately secure. Similar to the thimbles, the steel shackles used for these connections also only exhibited minor to moderate corrosion with up to 1/16 in. deep pitting, and the shackles were always found to be properly aligned and secure. Although the shackle pins, which were either the screw type or bolt and nut type, were always tight, it should be noted that only an estimated 50% of the shackles had either a restraining wire/chord or cotter pin in place as an added measure of keeping the pin secure and in place.

The ±30 ft long upper anchor chains were typically found to be in satisfactory condition with no structurally significant deterioration. The upper lengths of chain generally exhibited only minor to moderate corrosion that had minimal section loss associated with it and just pitting that was typically 1/16 in. deep or less. Regarding the upper lengths of chain, it should also be noted that for the anchor line on the southerly side of the feed house barge/float, only approximately 10 ft of the upper chain was hanging in place. It is unknown if this chain was once part of an anchor line assembly. The below water portions of the upper anchor chains typically exhibited a moderate layer of marine growth, consisting of up to a 1/2 in. thick layer of hard growth covered by 1 in. to 3 in. of softer growth. A majority of the upper anchor chains (main exception being Anchor Lines 17 through 22 along the southerly side of the net pens system) had steel buoys attached to and supporting the upper chain in an apparent effort to relieve some of the downward load on the

floating net pens system. Typically, the smaller chains used to make the buoy to anchor line chain connections exhibited an extent of corrosion similar to that of the upper anchor line chains, although at Anchor Lines 9 and 17, there was an estimated 50% to 75% loss of original section (as little as 1/4 in. link diameter remaining) observed for the smaller buoy chain links due to both corrosion and wear.

The 200 ft to 400 ft long rode line ropes were typically found to be in satisfactory condition with no excessive fraying or other detectable abrasion damage observed, with the exception of minor strand damage at Anchor Line 7. In general, the majority of the rode line ropes exhibited comparable amounts of marine growth, which typically consisted of a softer growth that was 2 in. to 4 in. thick along the upper portions of the ropes that then sometimes increased to be 6 in. to 12 in. thick in deeper water closer to the seabed. The marine growth on the ropes also typically included clusters of larger barnacles at random locations along the rope. The exception to this was observed at Anchor Lines 7, 9, 20 and 24, where the rode line ropes appeared to be of much newer vintage with little or no marine growth present on the rope. In most instances, there was sufficient tension in the rode line rope, suggesting that it was being relied on to afford support to the net pens system; however, it was observed at Anchor Lines 7, 9 and 10 that there was noticeable slack in the rode line rope, indicating that resistance from the anchor line is currently not being relied on by the net pens system.

The 90 ft long (one shot of chain) lower anchor chains were typically found to be in satisfactory condition, typically with minimal marine growth and no structurally significant deterioration. The lower lengths of chain generally exhibited only minor to moderate corrosion that had minimal section loss associated with it and just pitting that was typically 1/16 in. deep or less. There was, however, some heavier than normal corrosion observed at the lower anchor chains of Anchor Lines 18, 20 and 21. At each of these anchor lines, the lower length of chain was of a noticeably smaller size than that of all of the other anchor lines, and there was heavier corrosion present that has resulted in up to an estimated 25% loss of original section for various links along the chain. As little as 45 ft and typically (at 18 of the 26 anchor lines) the full shot length of 90 ft of the lower anchor chains was exposed and resting or slightly embedded the seabed as the anchor chain progressed to the anchor location. In that regard, less than 90 ft of the lower anchor chain was only exposed at Anchor Lines 1 through 4, 6, 9, 10, 12 and 24, with the anchor chain becoming fully embedded in the seabed before the anchor was reached. The chain resting on and/or embedded in the seabed typically suggests an appropriate anchor location and anchor line assembly length to promote proper setting and subsequent grip of the Danforth (typical) and Navy (one location) type anchors. In most instances, the manner in which the chain was on or in the seabed, with no notable rutting or plowing of the seabed, suggests that the lower anchor chains are not being lifted up or being moved from side-to-side in the seabed. The exception to this was noted at Anchor Lines 1 and 11, where there was some slight rutting (up to 12 in. deep valley/trench), although it did not appear to be enough seabed disruption to suggest that there was any problem with the anchor line's overall anchorage and/or excessive anchor chain movement.

As for the anchors, the majority were found to be either completely buried (Anchor Lines 1 through 4, 6, 9, 10, 12 and 24) or with very minimal exposure (just the top of stem and/or head – Anchor Lines 5, 8, 11, 14 through 16, 23 and northerly side of feed house barge/float), which suggests that they were well-seated and adequately gripping into the seabed. The exceptions to this were at Anchors 7, 13, 17 and 19, which were all just slightly embedded in the seabed. At all of these anchor locations, the anchor was generally set 90 degrees from what would normally be the proper alignment for a Danforth type anchor (flukes parallel to seabed rather than perpendicular), and as a result, just one of the anchor flukes, and it's corresponding peg, were embedded to some extent into the seabed. In all instances, however, the configuration of the seabed in and around the anchor, as well the lay of the lower anchor chain leading up to the anchor, suggested that the anchors were adequately founded and that there has been no appreciable movement of these anchors since they were placed. Regarding Anchor Lines 18 and 20 through 22, the anchor type was that of a driven pipe (±6 in. diameter), with the lower anchor chain secured to the pile anchor with a padeye when exposed (connection buried in seabed at Anchor Lines 20 and 21). Where the chain to pipe anchor connection was exposed at Anchor Lines 18 and 20, it was observed to be secure, although with the chain wrapped once around the pipe before reaching the shackle at the padeye. For all of the pipe anchors, the existing conditions suggested a stable anchorage, although at Anchor Line 18, the pipe anchor was deformed such that it was orientated essentially horizontal (bent towards the fish net pens from originally being vertically aligned) due to what appeared to be an excessive load exerted on the anchor line.

Operations and Feed House Building Barges/Floats

The operations building is supported by two parallel polystyrene floats that run along the northerly and southerly sides of the building and span its full east/west length, while the feed house building is carried by a concrete (presumed Styrofoam filled) barge/float that matches the plan of the building in size. Overall, the inspection of the submerged surfaces of operations and feed house barges/floats revealed them to be in good to satisfactory condition with no observable deterioration, deformation or other notable damage for either the concrete of the feed house barge/float or the two polystyrene floats under the operations building. It was only observed that all of the submerged surfaces of the building barges/floats exhibited a fairly uniform and heavy coverage of marine growth that was generally 6 in. to 12 in. thick.

Conclusions

Overall, the anchor line assemblies were generally found to be in satisfactory condition, typically with no structurally significant deterioration, and with all connection elements sound and secure. The rating of satisfactory is deemed appropriate since it implies that there may be some deterioration or other defects present, but those conditions are primarily minor and not compromising the integrity of the affected component. Except for the lower anchor chains at

Anchor Lines 18, 20 and 21, the various lengths of chain and related shackles inspected along the anchor lines exhibited only minor deterioration, with just minor to moderate corrosion being present that had no appreciable loss of original section associated with it. With respect to the ropes running between the upper and lower anchor chains, they were always found to be in a satisfactory, full original section condition, with no evidence of notable fraying or abrasion related damage, with the exception of minor strand damage at Anchor Line 7. The thimbles and related rope knots or splices, which were used to connect the ropes to the upper and lower chain shackles, were also typically found to be sound and secure with no evidence of any conditions that would compromise the connections. Presently, all of the anchor line anchors, whether it be the Danforth or Navy type anchor or the driven pipe type, and including the four anchors that were minimally embedded in the seabed, were observed to be stable and affording what appeared to be sufficient anchorage for the net pens system. As for the barges/floats supporting the operations and feed house building, they were overall in good to satisfactory condition, with negligible deficiencies and affording what appeared to be the necessary floatation for the building structures. Currently, the only items of possible concern noted were the instances of heavier section loss due to deterioration and wear on the smaller chains connecting the steel buoys to the upper anchor chains of Anchor Lines 9 and 17. In particular, if these conditions were to progress, they could result in the failure of the buoy chain, which in turn could allow for change in anchor line configuration and greater loading on the net pens system.

In conclusion, the underwater inspection of the Site 1 Cypress Island Fish Net Pens System did not reveal any structurally significant deterioration or other notable deficiencies that would suggest any appreciable reduction in the inherent integrity or stability of the overall system. In that regard, the components inspected below water were typically found to be in sound condition with no indication that an appreciable reduction in the originally intended capacity of a component or connection could be expected. It should again be noted, however, that while the aforementioned deficient buoy attachments do not affect the capacity of the anchor lines per se, if they were to fail, that could disrupt the equilibrium of the overall net pens system, and therefore, consideration should be given to renewing the heavily deteriorated items.

If you have any questions or require any additional information with respect to the underwater inspection findings, please don't hesitate to contact me.

January 29, 2018

Very truly yours,

COLLINS ENGINEERS, INC.

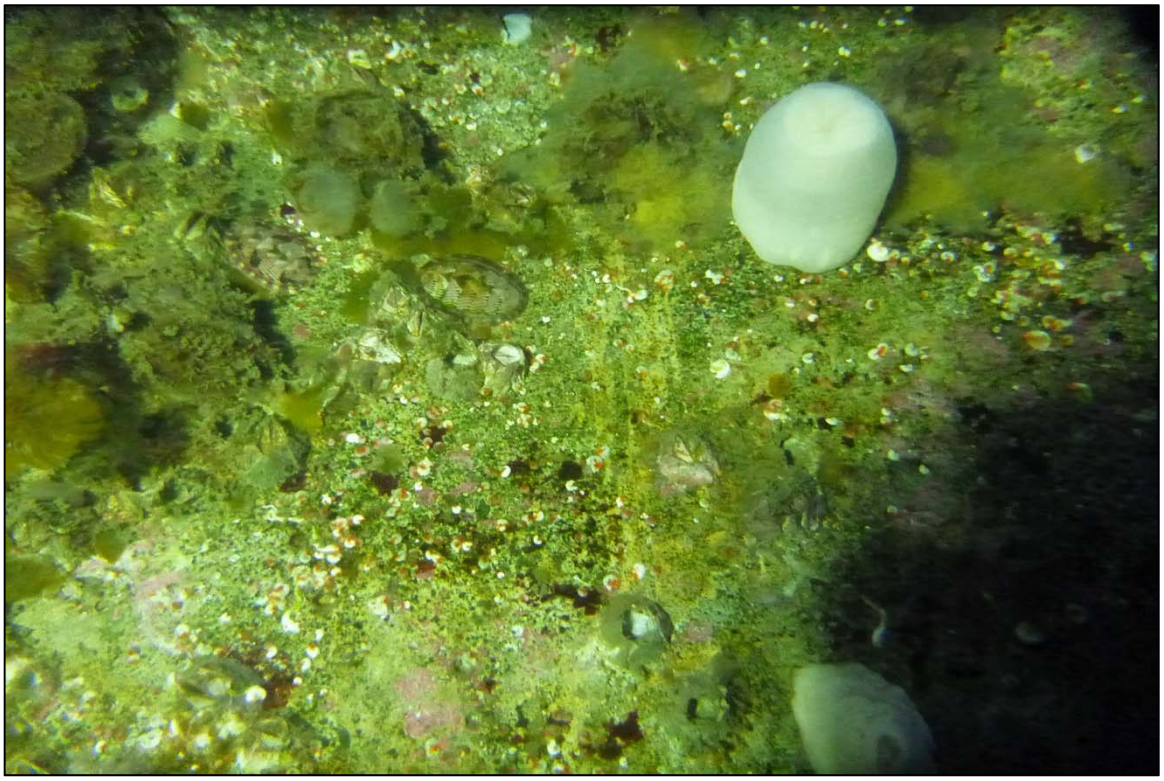
Daniel G. Stromberg, P.E.
Chief Structural Engineer/Diver

Photograph 1: Overall View of the Site 1 Fish Net Pens System, Looking Northwest.

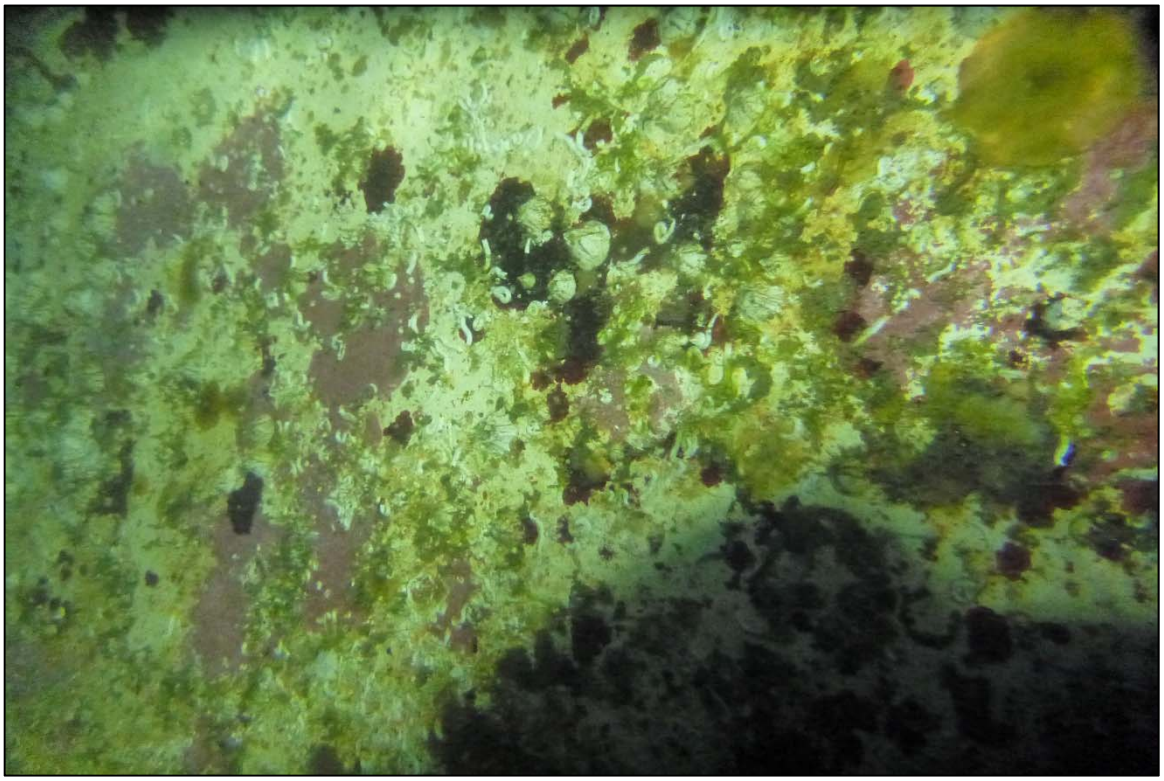
Photograph 2: Overall View of the Site 1 Fish Net Pens System, Looking Northeast.

Photograph 3: Overall View of the Site 1 Fish Net Pens System, Looking East.

Photograph 4: Overall View of the Site 1 Fish Net Pens System, Looking Southwest.



Photograph 5: View of the Barge Float Condition at Site 1 Fish Net Pens System, Looking East.



Photograph 6: View of the House Float Condition at Site 1 Fish Net Pens System, Looking East.

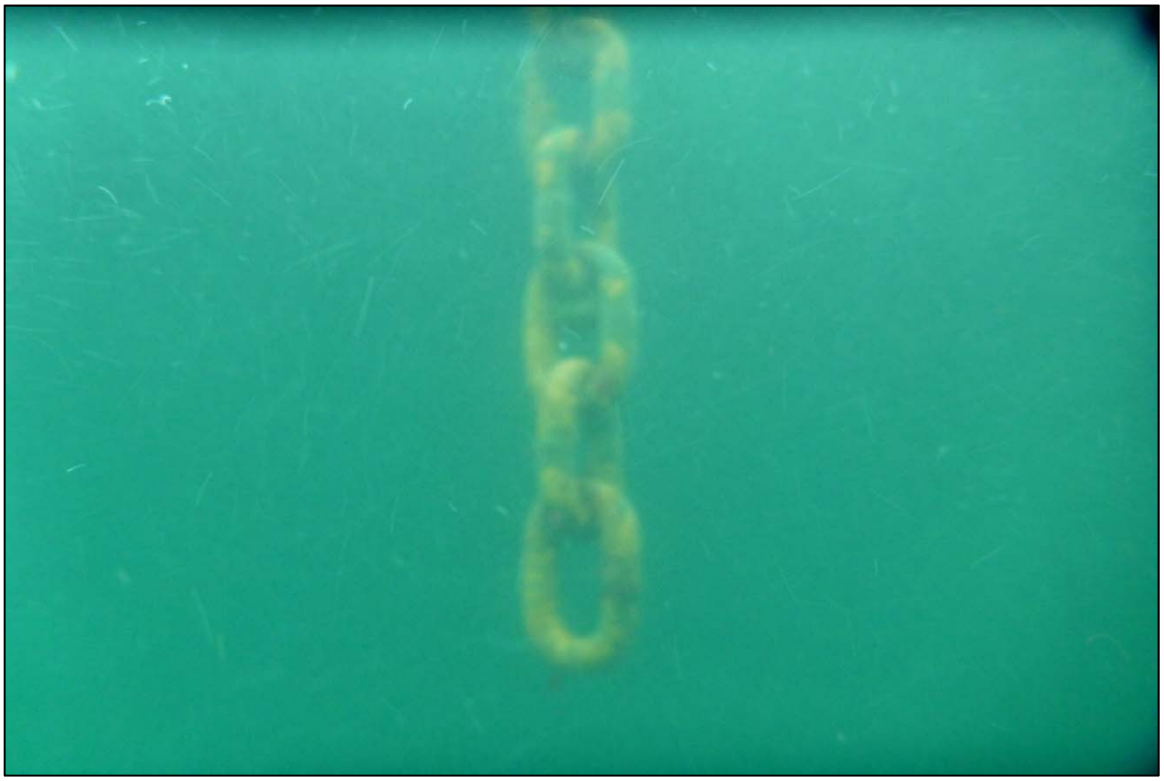
Photograph 7: View of the Uneven Walkway at the Northwest Corner of Site 1 Fish Net Pens System, Looking South.

Photograph 8: View of the Uneven Walkway at the Northwest Corner of Site 1 Fish Net Pens System, Looking Northwest.

Photograph 9: View of the Severe Corrosion in the Upper Anchor Chain at Site 1 Feed Barge North Anchor Line, Looking East.

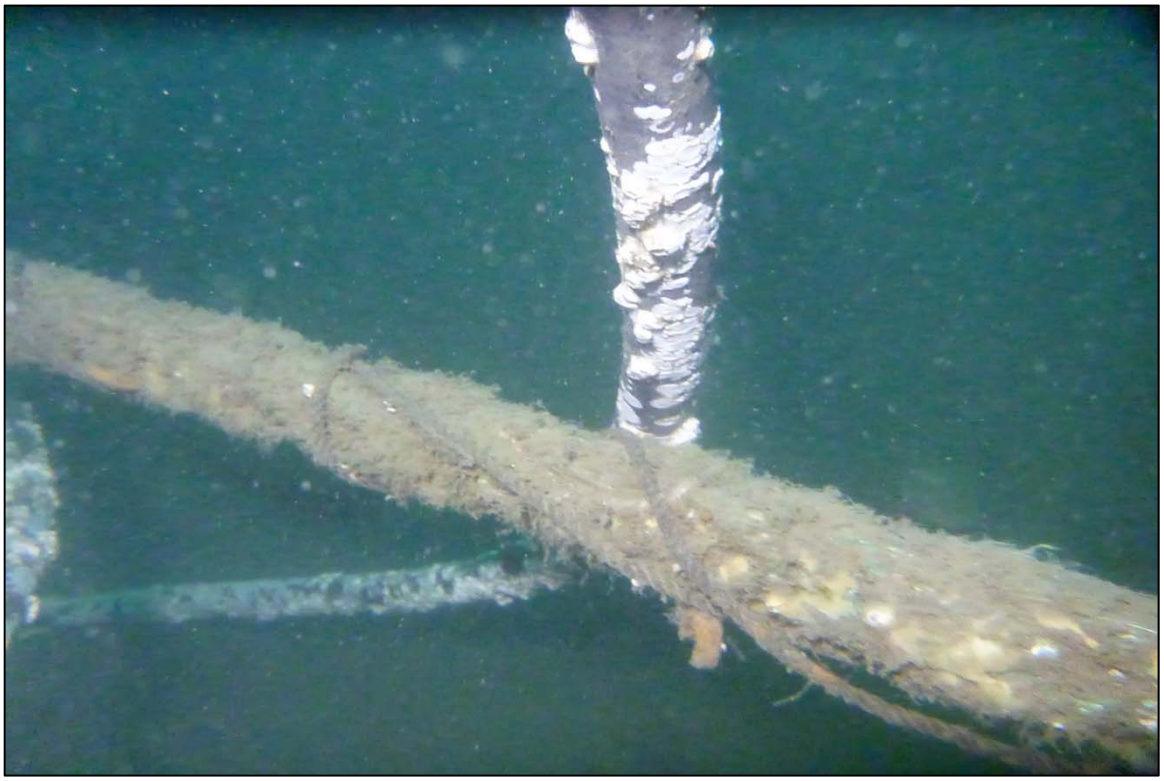
Photograph 10: View of the Rope to Lower Anchor Chain (Shackle) at Site 1 Feed Barge North Anchor Line, Looking North.

Photograph 11: View of the Lower Anchor Chain to Anchor Connection (Shackle) at Site 1 Feed Barge North Anchor Line, Looking West.

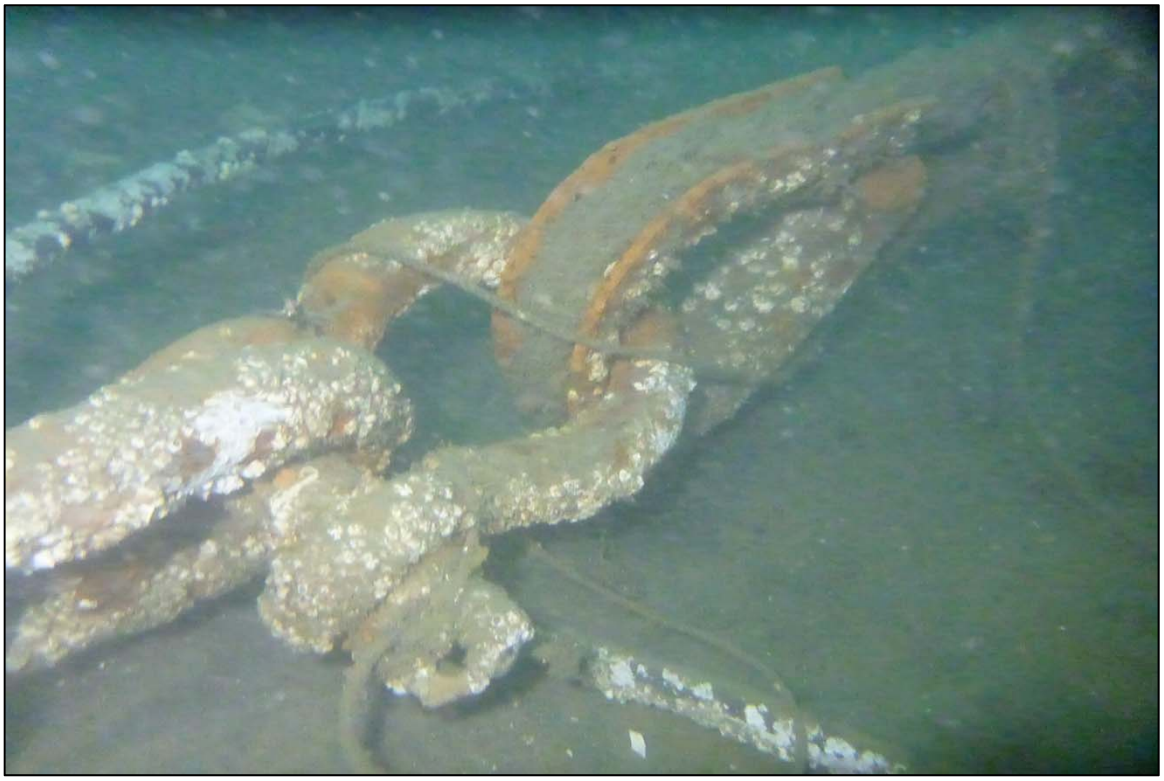


Photograph 12: View of the Termination of the Upper Anchor Chain at Site 1 Feed Barge South Anchor Line, Looking North.

Photograph 13: View of the Float to Upper Anchor Chain Connection at Site 1 Anchor Line 1, Looking East.



Photograph 14: View of the Rope and Random Piping on the Channel Bottom at Site 1 Anchor Line 1, Looking North.

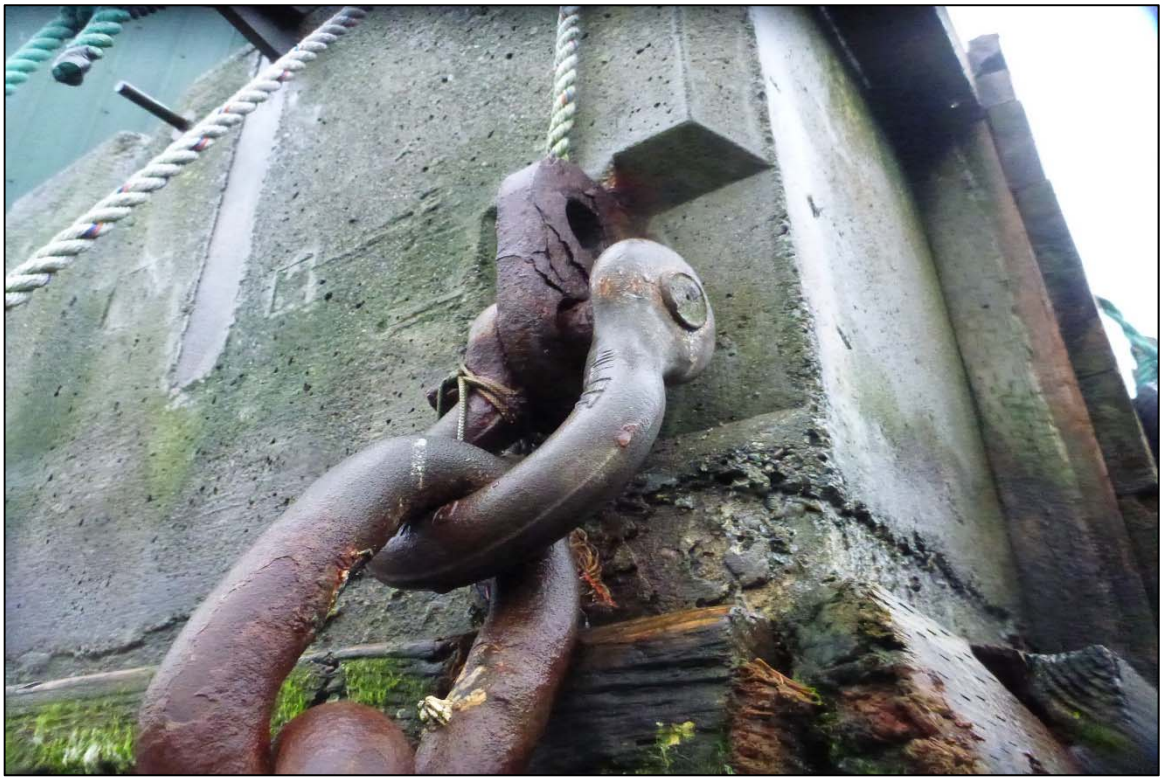


Photograph 15: View of the Rope to Anchor Chain Connection (Sleeve, Shackle and Thimble) and Random Piping at Site 1 Anchor Line 1, Looking North.

Photograph 16: View of the Upper Anchor Chain to Rope Connection (Thimble) at Site 1 Anchor Line 2, Looking North.

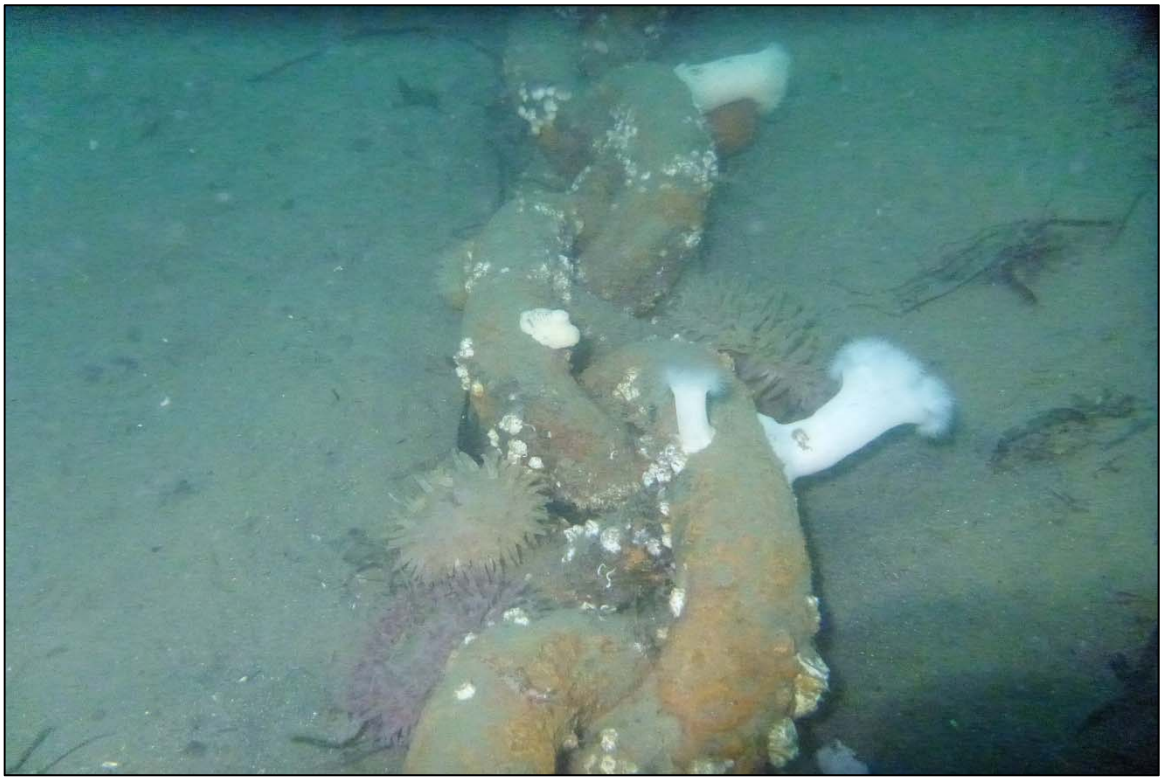
Photograph 17: View of the Rope to Anchor Chain Connection (Shackle and Thimble) at Site 1 Anchor Line 2, Looking Northwest.

Photograph 18: View of the Lower Anchor Chain on the Channel Bottom at Site 1 Anchor Line 2, Looking West.



Photograph 19: View of the Feed Barge to Upper Anchor Chain Connection at Site 1 Anchor Line 3, Looking East.

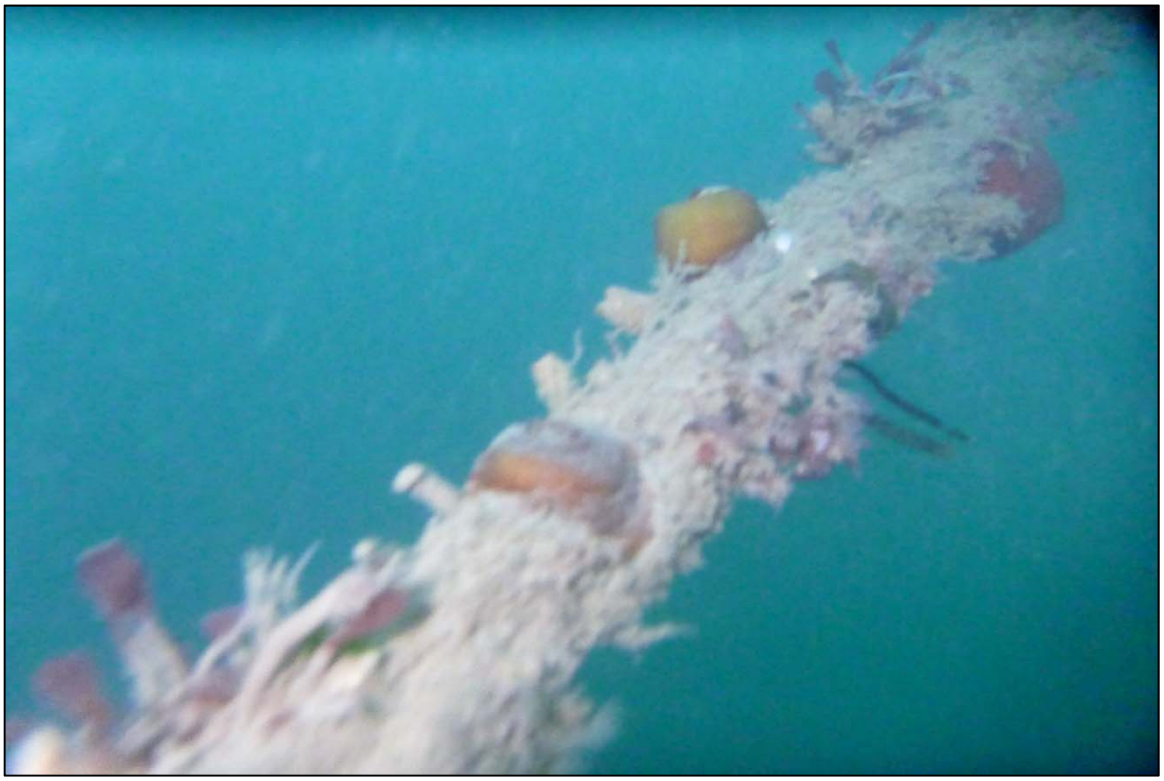
Photograph 20: View of the Rope to Lower Anchor Chain Connection (Thimble and Shackle) at Site 1 Anchor Line 3, Looking West.



Photograph 21: View of the Lower Anchor Chain on the Channel Bottom at Site 1 Anchor Line 3, Looking West.

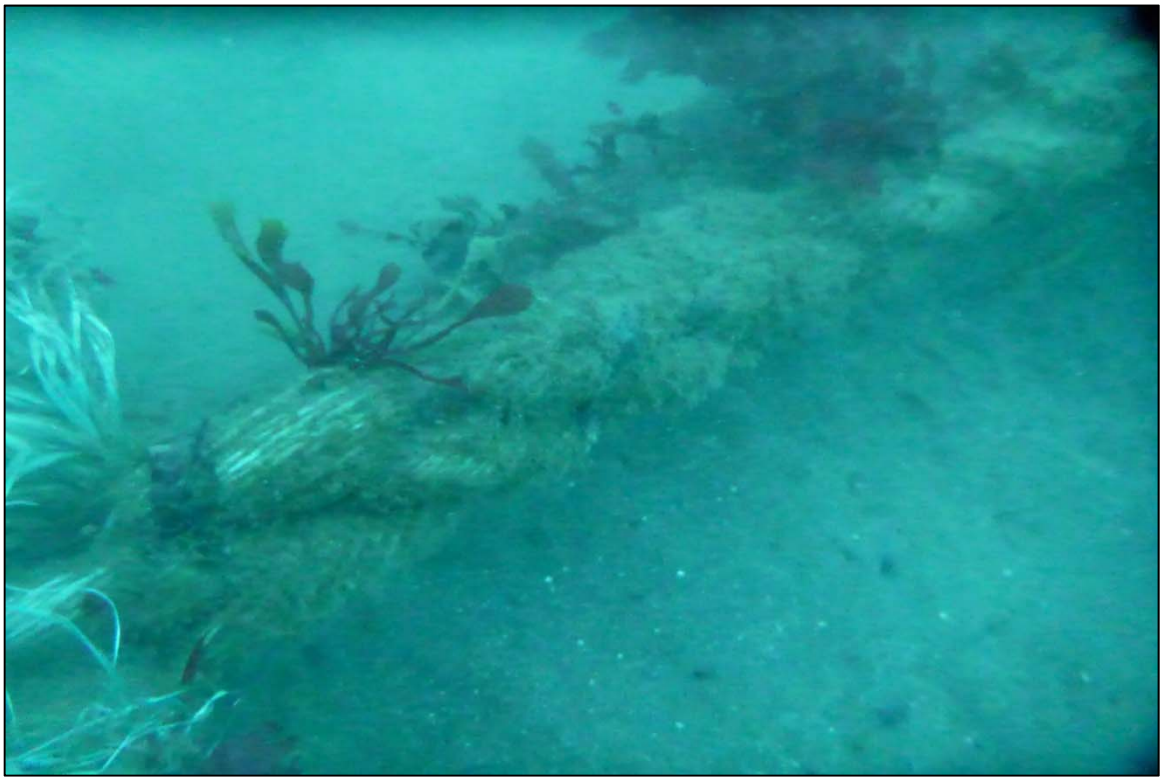
Photograph 22: View of Marine Growth and Light Corrosion on the Upper Anchor Chain at Site 1 Anchor Line 4, Looking Northeast.

Photograph 23: View of Upper Anchor Chain to Rope Connection (Shackle) at Site 1 Anchor Line 4, Looking Northeast.

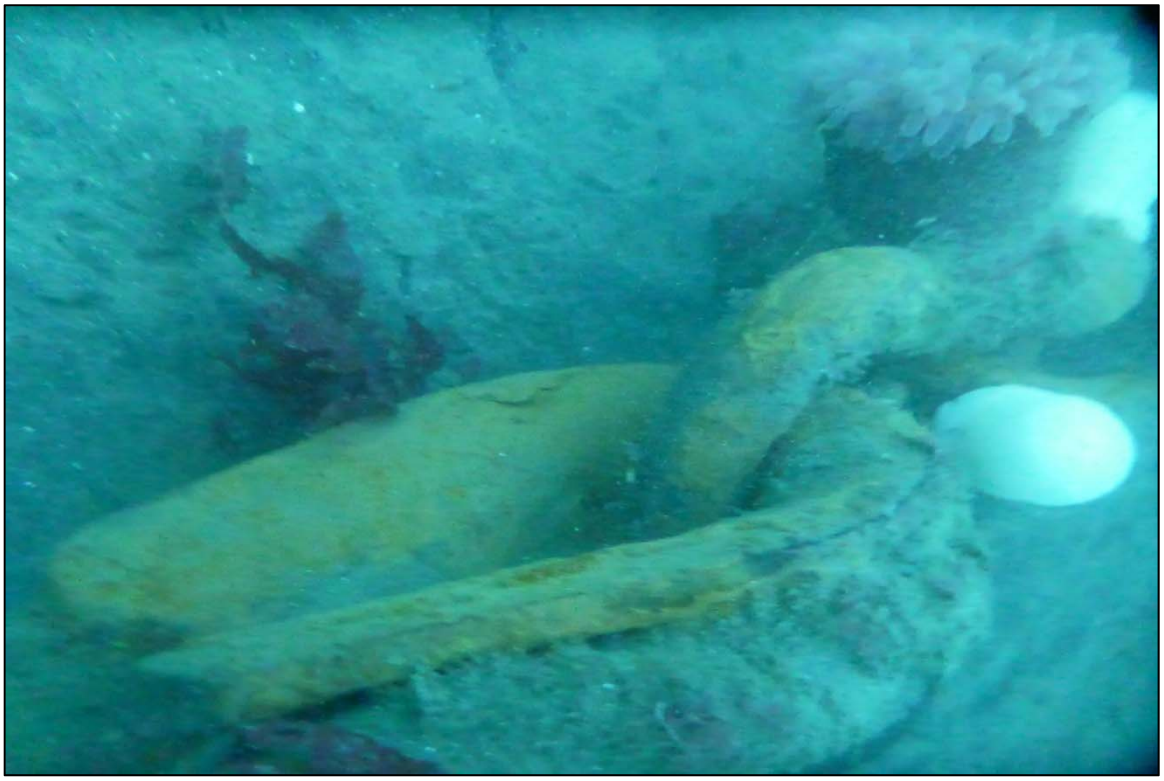


Photograph 24: View of Light Marine Growth on the Rope at Site 1 Anchor Line 4, Looking Northeast.

Photograph 25: View of Upper Anchor Chain Condition at Site 1 Anchor Line 5, Looking South.

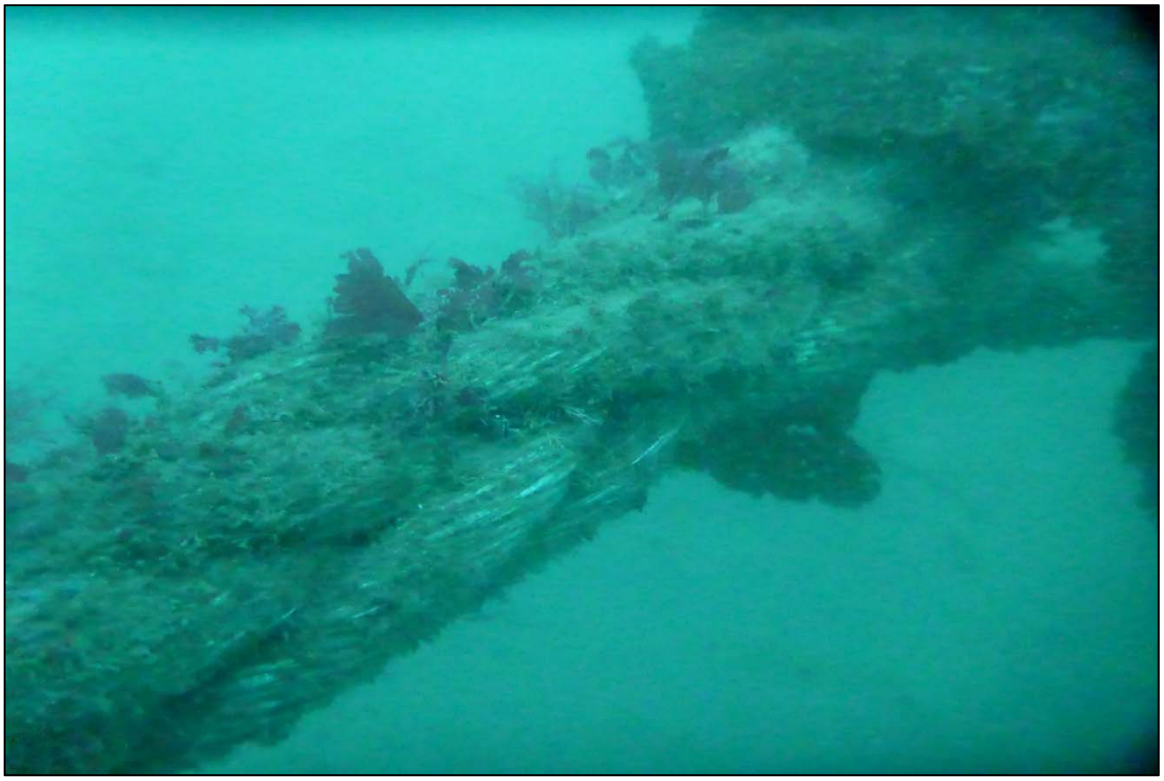


Photograph 26: View of the Rope on the Channel Bottom at Site 1 Anchor Line 5, Looking North.



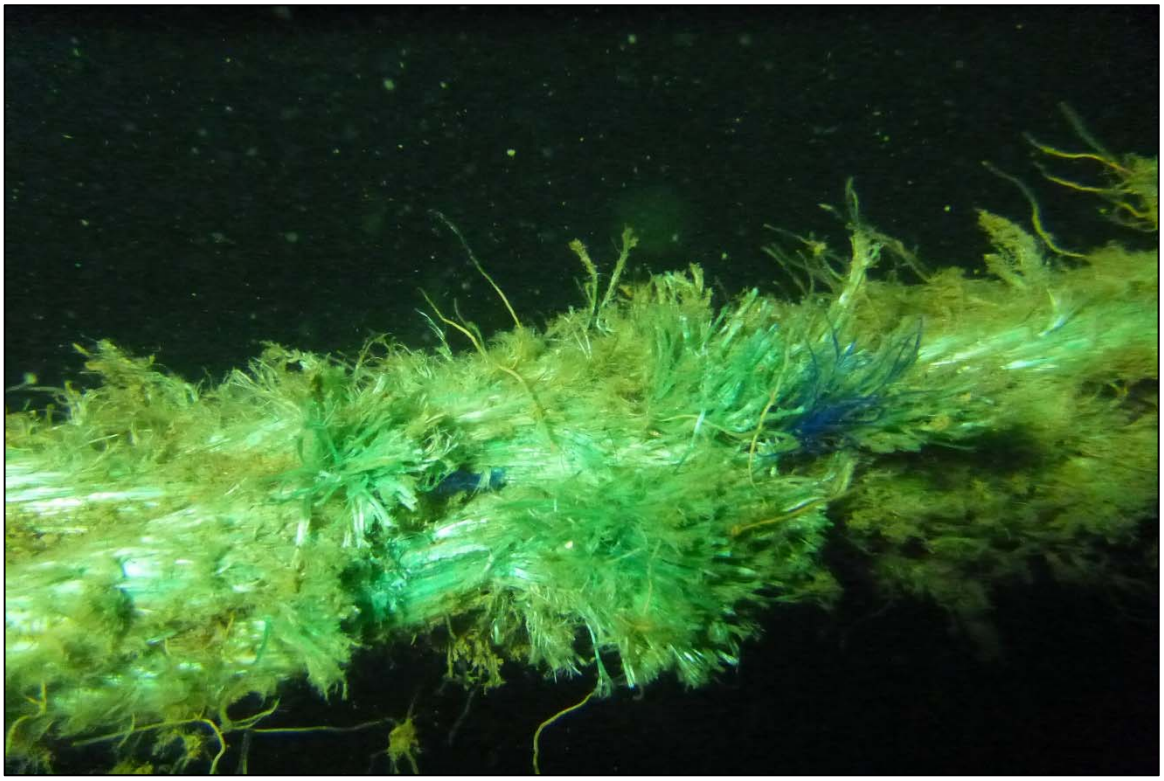
Photograph 27: View of the Rope to Lower Anchor Chain Connection (Thimble and Shackle) at Site 1 Anchor Line 5, Looking South.

Photograph 28: View of the Upper Anchor Chain to Rope Connection (Shackle) at Site 1 Anchor Line 6, Looking North.



Photograph 29: View of Light Marine Growth on the Rope (Typical) at Site 1 Anchor Line 6, Looking North.

Photograph 30: View of the Lower Anchor Chain on the Channel Bottom at Site 1 Anchor Line 6, Looking West.

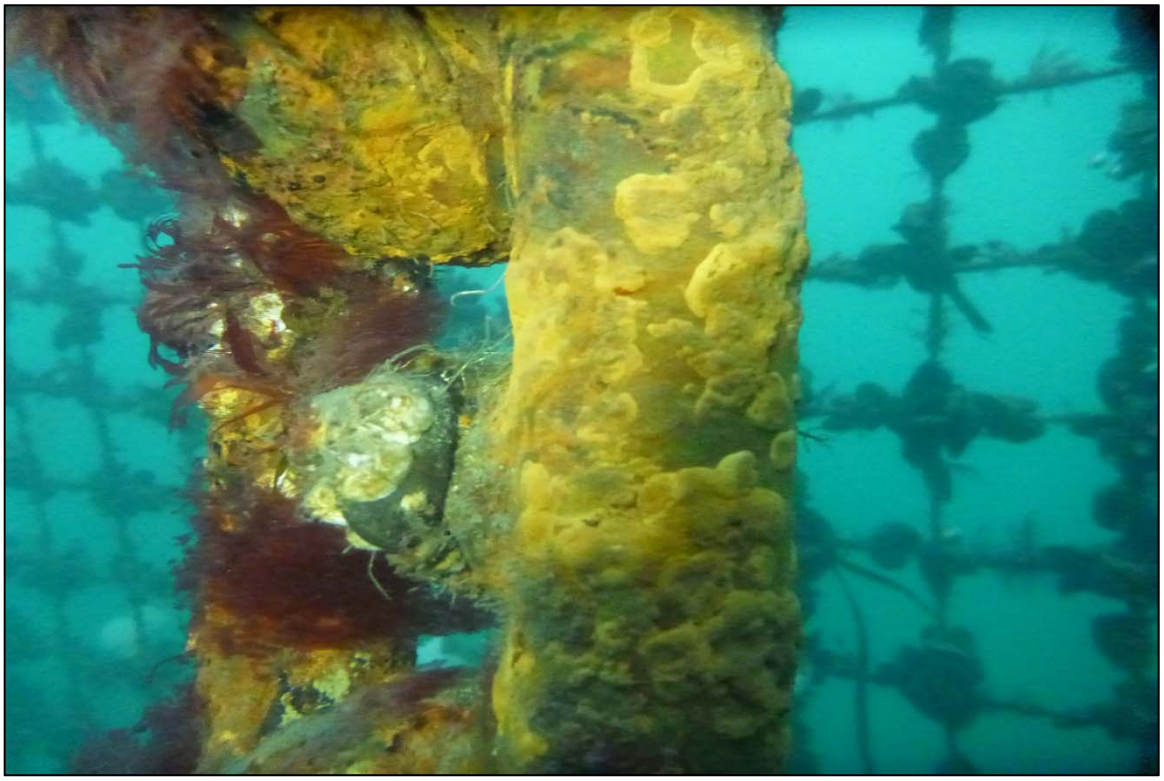


Photograph 31: View of Broken Strands in the Rope at Site 1 Anchor Line 7, Looking West.

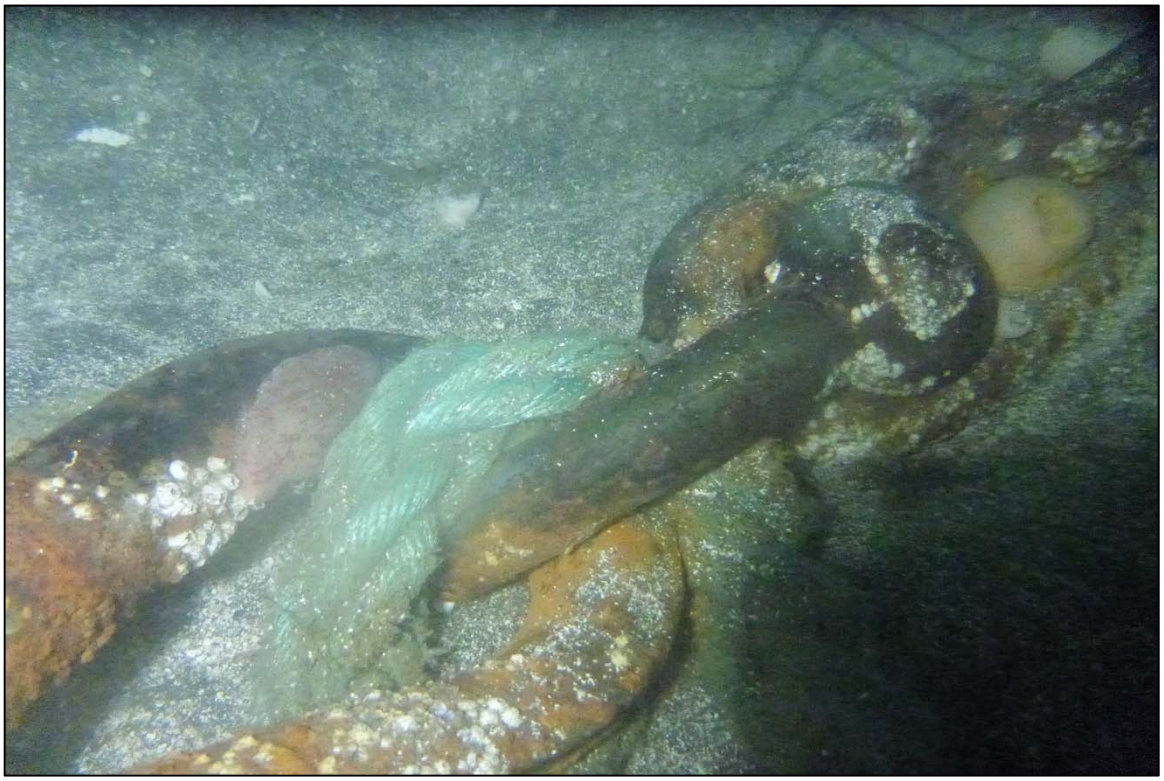
Photograph 32: View of the Loose Thimble at the Rope to Lower Anchor Chain Connection at Site 1 Anchor Line 7, Looking West.

Photograph 33: View of the Lower Anchor Chain Embedment in the Channel Bottom at Site 1 Anchor Chain 7, Looking North.

Photograph 34: View of the Anchor Embedment in the Channel Bottom at Site 1 Anchor Line 7, Looking East.



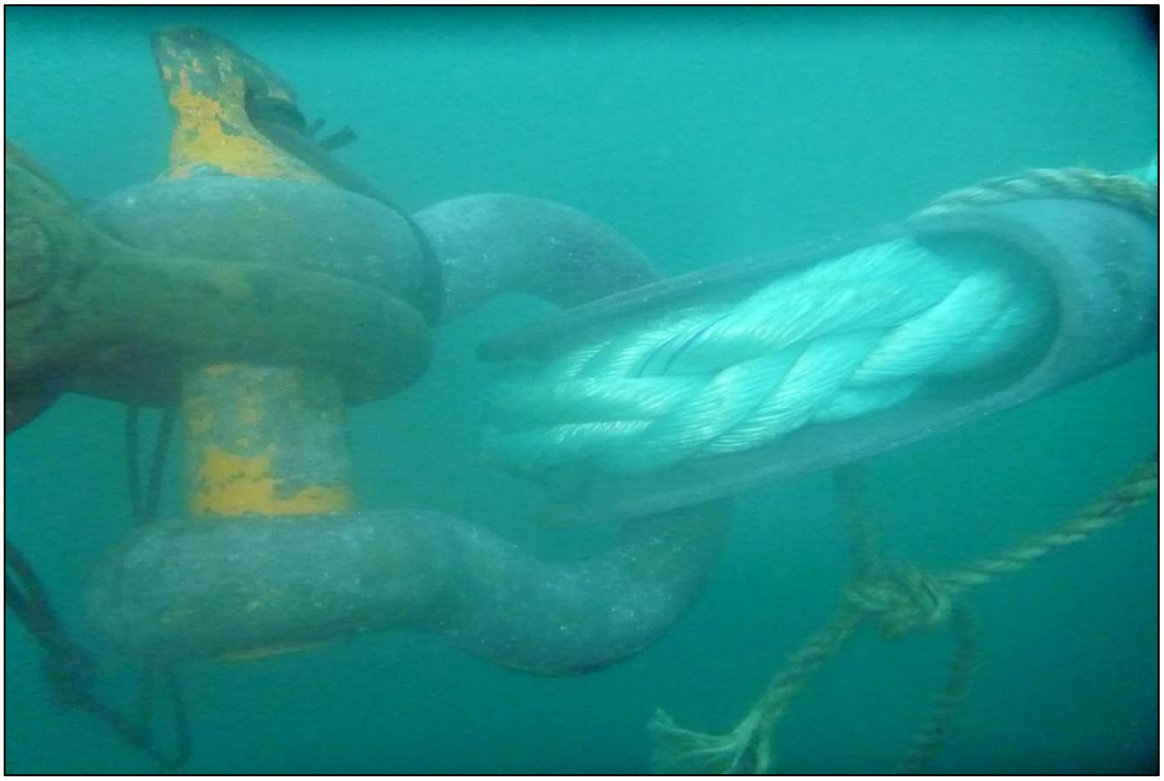
Photograph 35: View of Moderate Corrosion in the Buoy Chain at Site 1 Anchor Chain 8, Looking East.



Photograph 36: View of the Rope to Lower Anchor Chain Connection at Site 1 Anchor Line 8, Looking Northwest.

Photograph 37: View of Abandoned Rope and Net Debris Covering the Lower Anchor Chain at Site 1 Anchor Chain 8, Looking North.

Photograph 38: View of the Severe Corrosion and up to 75% Section Loss on the Buoy Chain at Site 1 Anchor Line 9, Looking East.



Photograph 39: View of the Upper Anchor Chain to Rope Connection (Shackle and Thimble) at Site 1 Anchor Chain 9, Looking West.

Photograph 40: View of the Lower Anchor Chain Embedment in the Channel Bottom at Site 1 Anchor Line 9, Looking North.

Photograph 41: View of Float to Upper Anchor Chain Connection at Site 1 Anchor Chain 10, Looking Southeast.

Photograph 42: View of Moderate Marine Growth on the Rope at Site 1 Anchor Line 10, Looking North.

Photograph 43: View of the Lower Anchor Chain on the Channel Bottom at Site 1 Anchor Chain 10, Looking North.

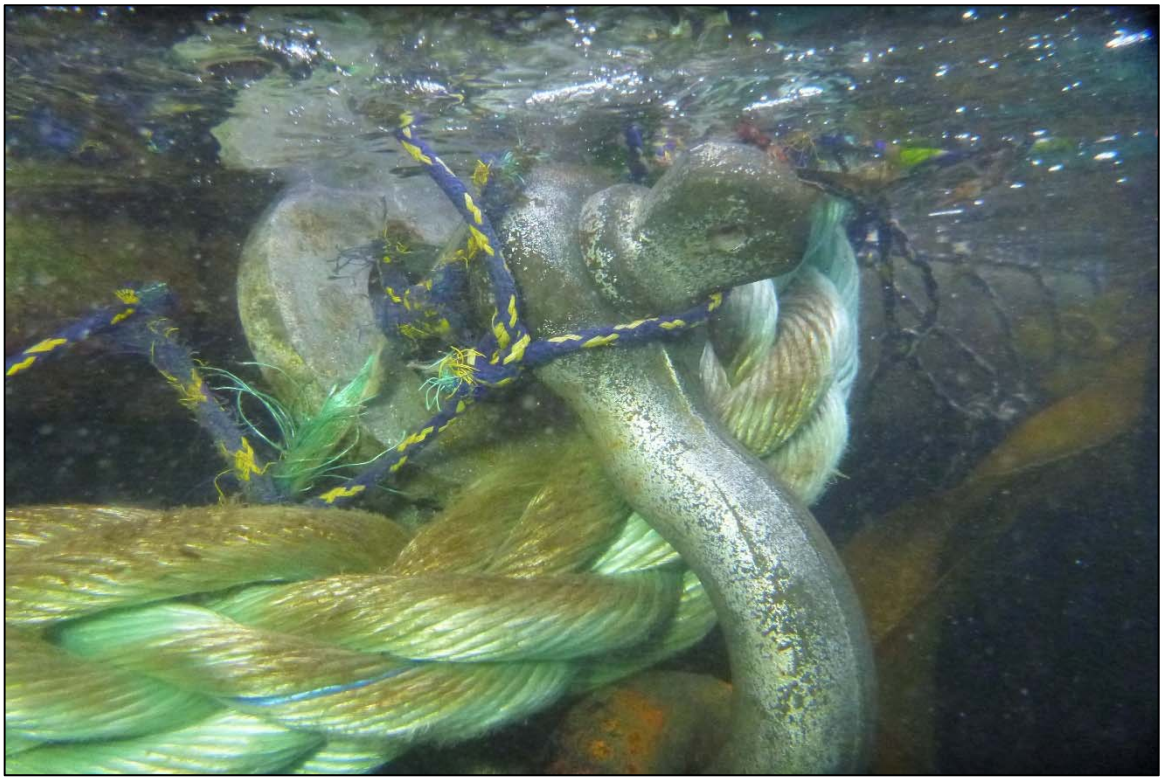
Photograph 44: View of Moderate Corrosion and Moderate Marine Growth on the Upper Anchor Chain to Rope Connection at Site 1 Anchor Line 11, Looking West.

Photograph 45: View of the Loose Thimble at the Rope to Lower Anchor Chain Connection at Site 1 Anchor Chain 11, Looking Northwest.

Photograph 46: View of Moderate Corrosion on the Lower Anchor Chain at Site 1 Anchor Line 11, Looking West.

Photograph 47: View of Moderate Corrosion on the Upper Anchor Chain at Site 1 Anchor Chain 12, Looking North.

Photograph 48: View of Light Marine Growth on the Rope at Site 1 Anchor Line 12, Looking East.



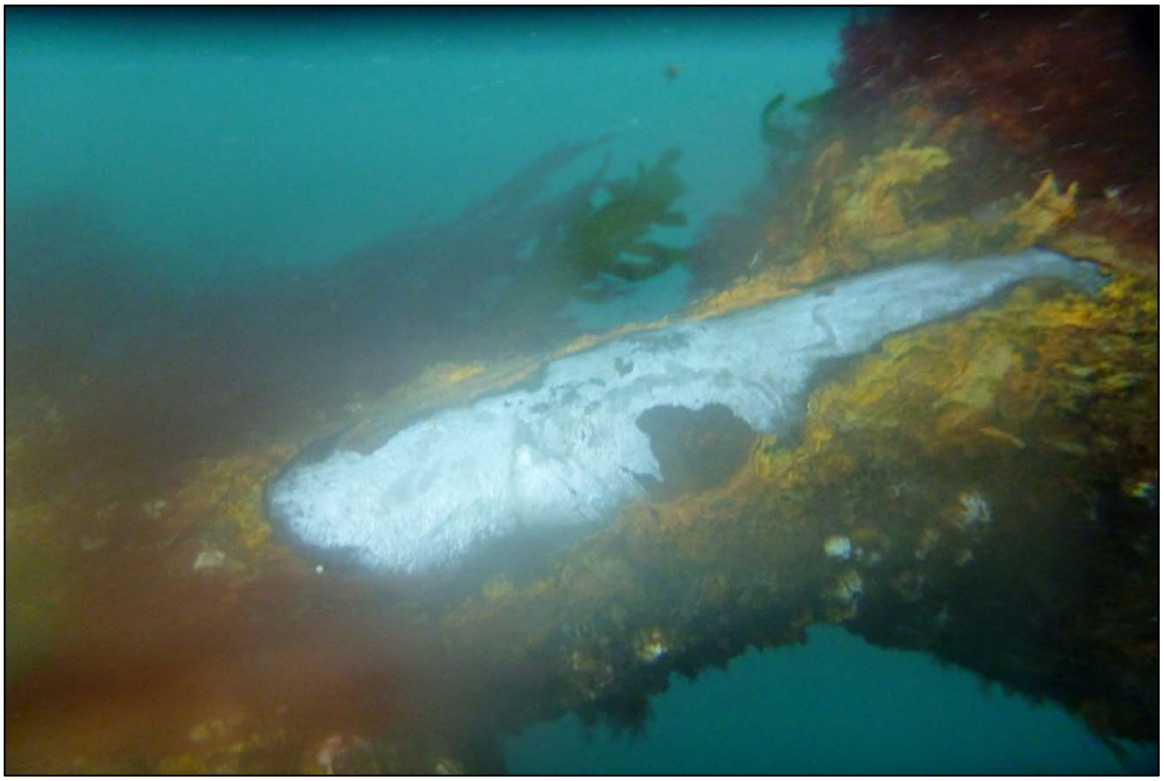
Photograph 49: View of the Float to Upper Anchor Chain Connection at Site 1 Anchor Chain 13, Looking Northwest.

Photograph 50: View of Light Surface Corrosion Upper Anchor Chain at Site 1 Anchor Line 13, Looking Northwest.

Photograph 51: View of the Exposed Anchor Resting on the Channel Bottom at Site 1 Anchor Line 13, Looking North.

Photograph 52: View of the Moderate Surface Corrosion on the Upper Anchor Chain at Site 1 Anchor Chain 14, Looking Northwest.

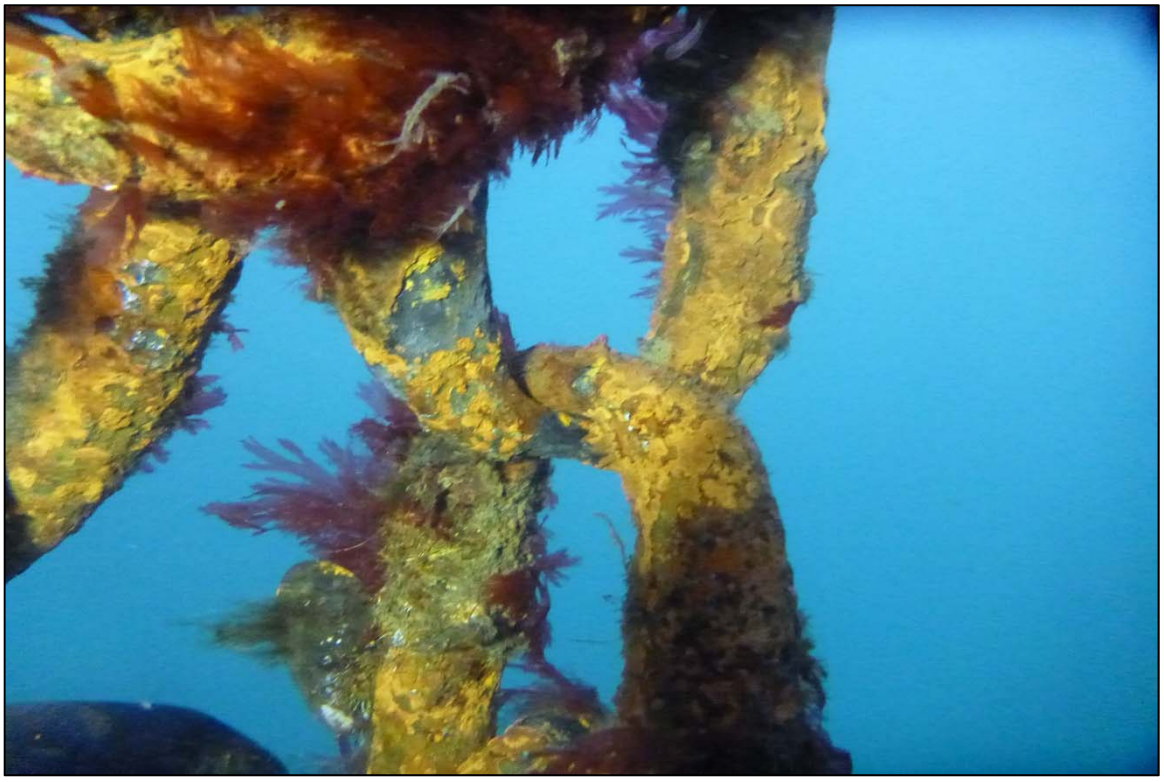
Photograph 53: View of the Upper Anchor Chain to Rope Connection (Shackle and Thimble) at Site 1 Anchor Line 14, Looking South.



Photograph 54: View of the Light Surface Corrosion on the Upper Anchor Chain at Site 1 Anchor Chain 15, Looking North.

Photograph 55: View of the Upper Anchor Chain at Site 1 Anchor Line 16, Looking Southwest.

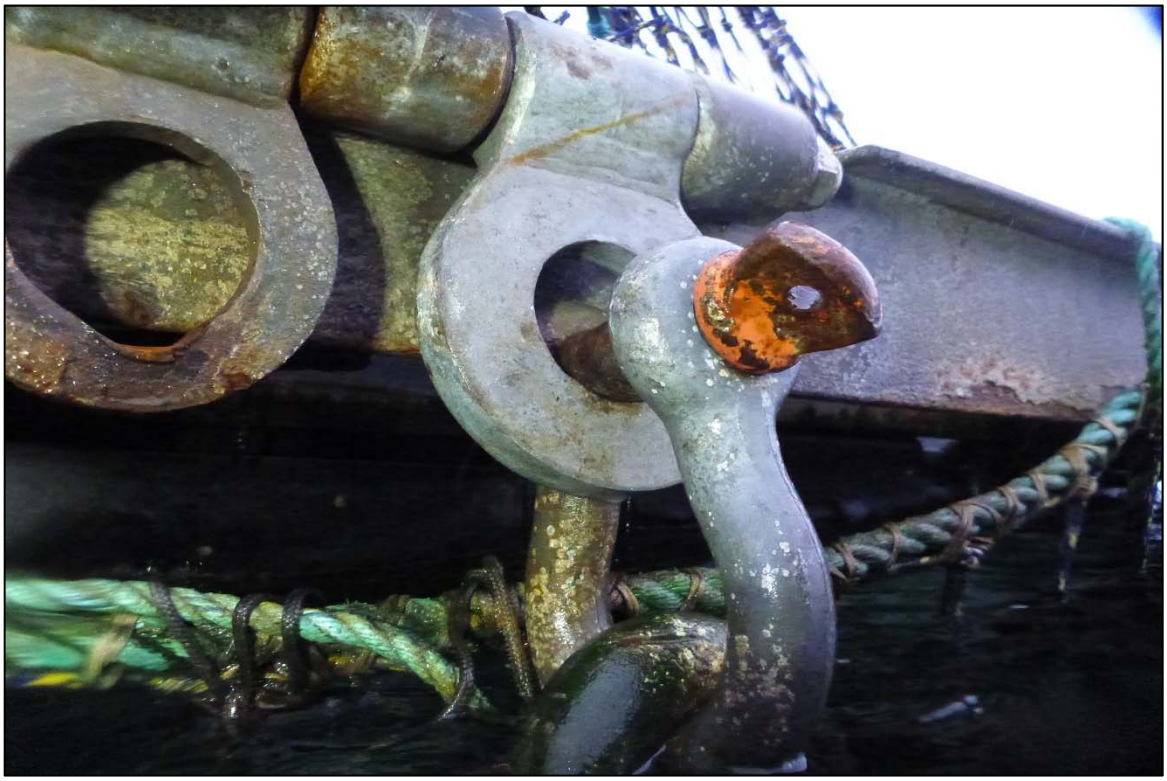
Photograph 56: View of Light Marine Growth on the Rope at Site 1 Anchor Chain 16, Looking South.



Photograph 57: View of the Severe Corrosion and Section Loss on the Buoy Chain at Site 1 Anchor Line 17, Looking North.

Photograph 58: View of Bowline Knot in the Rope at the Connection to the Lower Anchor Chain at Site 1 Anchor Chain 17, Looking Northeast.

Photograph 59: View of the Rope to Lower Anchor Chain Connection (Thimble and Shackle) at Site 1 Anchor Line 17, Looking Northeast.



Photograph 60: View of the Upper Anchor Chain to Float Connection (Shackle) at Site 1 Anchor Line 18, Looking Northeast.

Photograph 61: View of the Upper Anchor Chain to Rope Connection (Shackle and Thimble) at Site 1 Anchor Chain 18, Looking North.

Photograph 62: View of the Rope to Lower Anchor Chain Connection (Thimble and Shackle) at Site 1 Anchor Line 18, Looking Northeast.

Photograph 63: View of Severe Corrosion on the Lower Anchor Chain at Site 1 Anchor Line 18, Looking Northeast.

Photograph 64: View of the Pipe Anchor and Lower Anchor Chain at Site 1 Anchor Chain 18, Looking Southwest.

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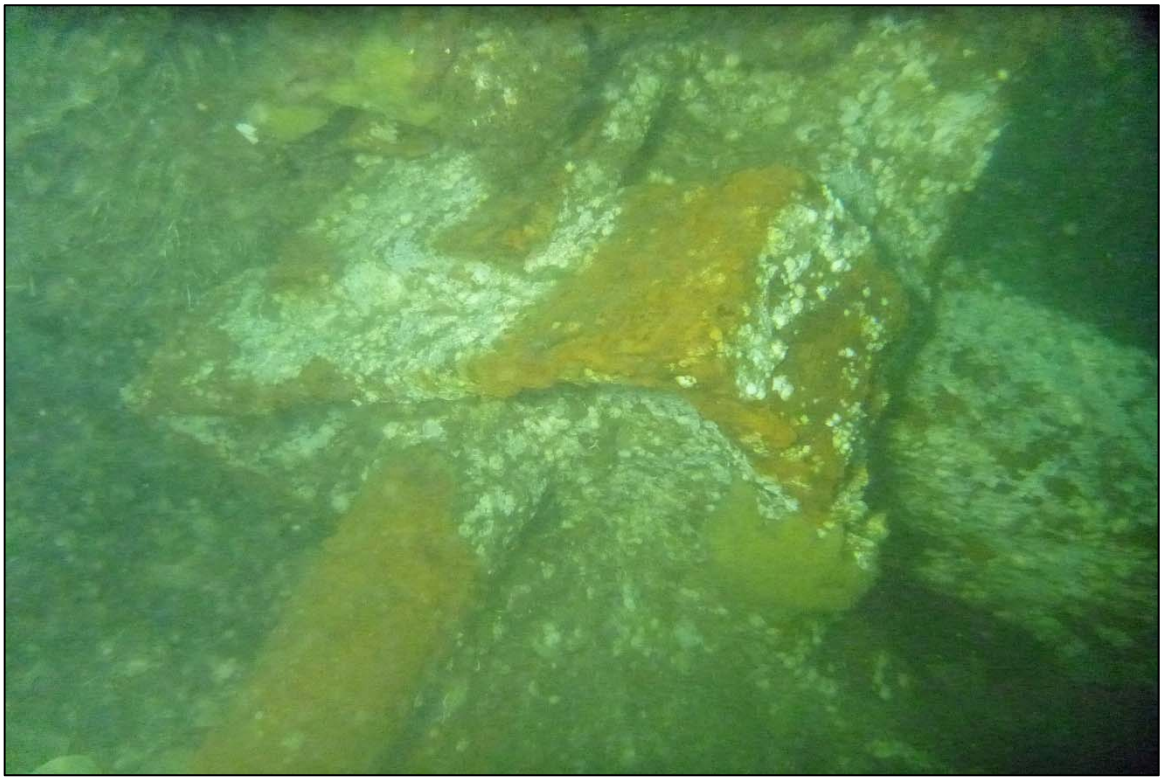
Photograph 66: View of the Rope to Lower Anchor Chain Connection at Site 1 Anchor Chain 19, Looking Northeast.



Photograph 67: View of the Anchor Embedded in the Channel Bottom at Site 1 Anchor Line 19, Looking Southwest.

Photograph 68: View of the Upper Anchor Chain to Rope Connection (Thimble and Shackle) with a Bowline Knot at Site 1 Anchor Chain 20, Looking Northwest.

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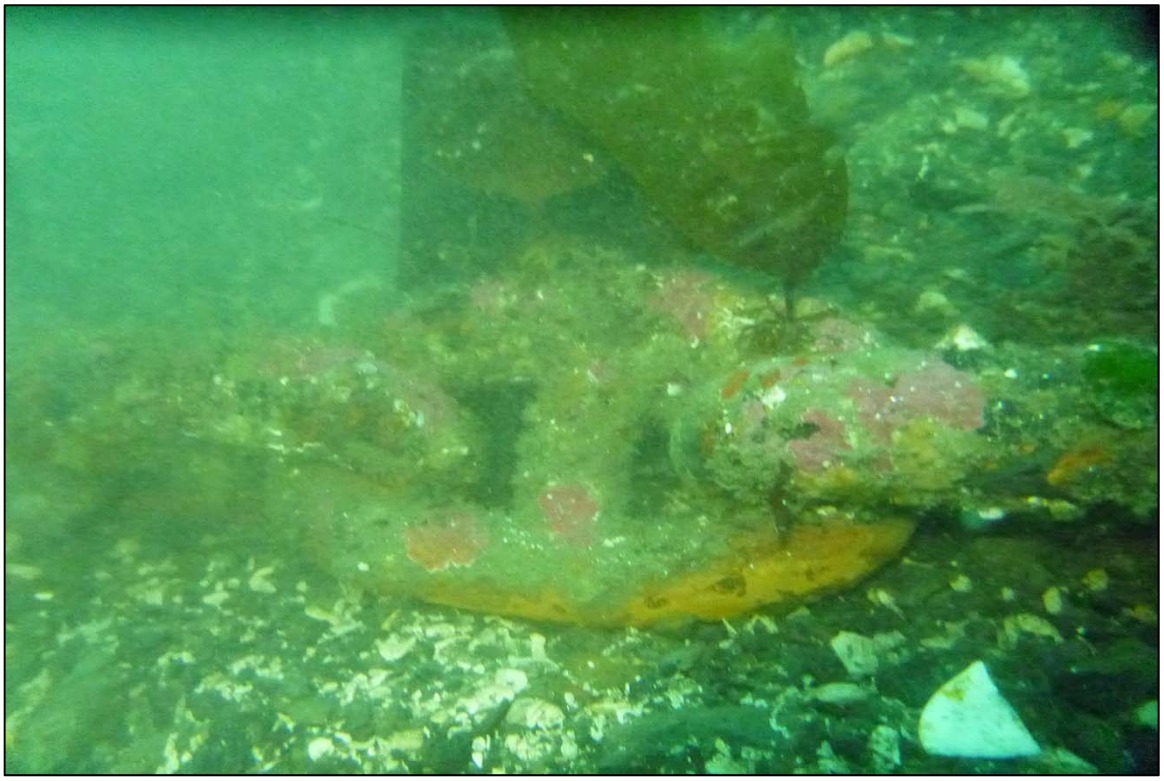

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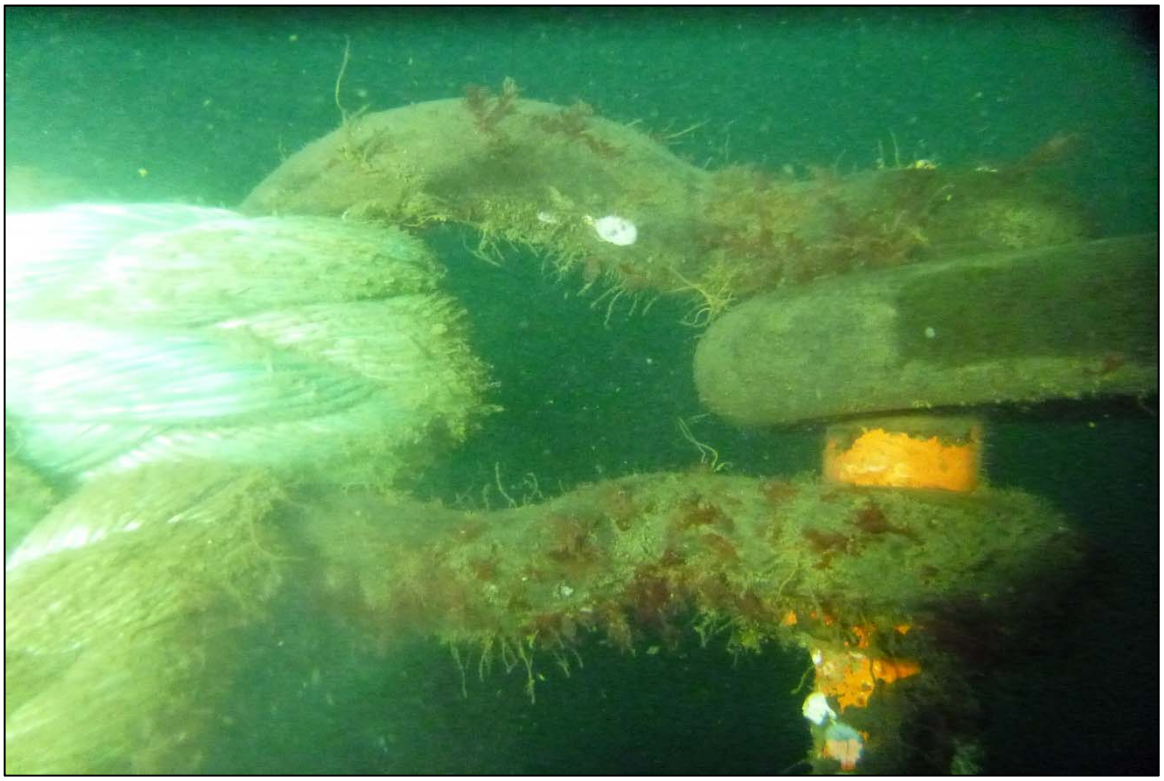
Photograph 79: View of the Lashings at the Upper Anchor Chain to Rope Connection at Site 1 Anchor Line 23, Looking South.



Photograph 80: View of the Upper Anchor Chain to Rope Connection (Shackle) at Site 1 Anchor Line 24, Looking West.

Photograph 81: View of the Rope to Lower Anchor Chain Connection (Thimble and Shackle) at Site 1 Anchor Line 24, Looking West.

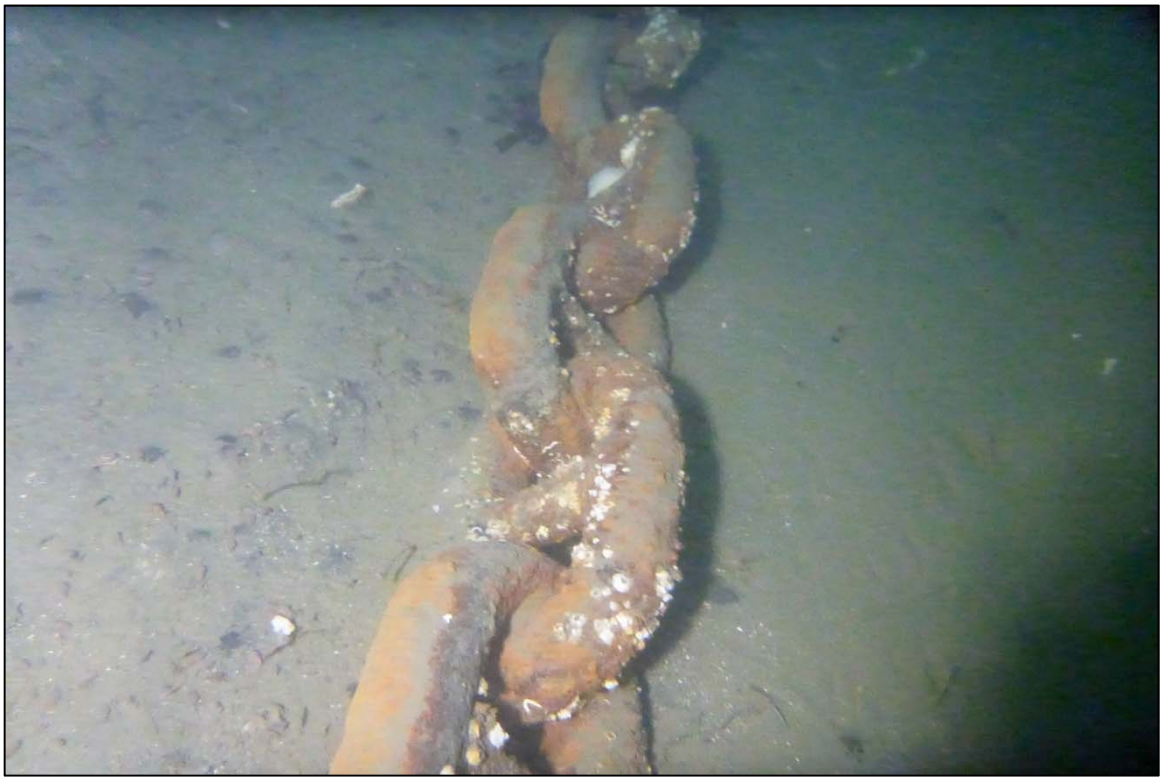


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Figure C-16: Cypress Island Net Pen Site 1 – Connection at Anchor Line 19

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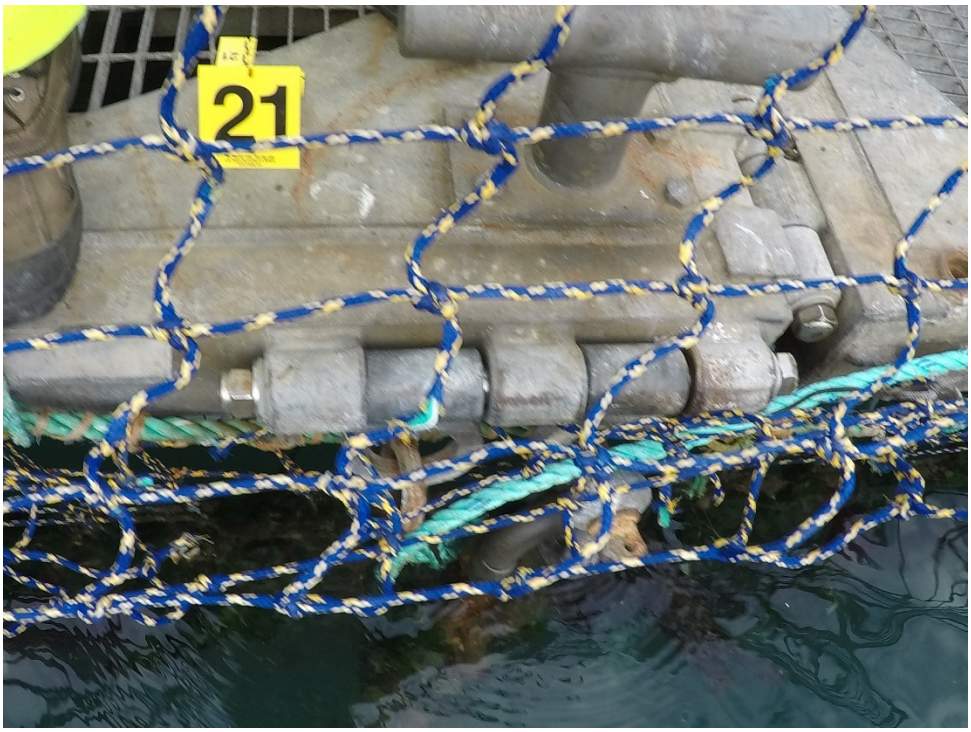

Figure C-18: Cypress Island Net Pen Site 1 – Connection at Anchor Line 21

Figure C-19: Cypress Island Net Pen Site 1 – Connection at Anchor Line 22

Figure C-20: Cypress Island Net Pen Site 1 – Severe listing of floats along west walkway

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Figure C-22: Cypress Island Net Pen Site 1 – Severe listing of floats along east walkway

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Figure C-24: Cypress Island Net Pen Site 1 – Severe corrosion in grating and framing members

Figure C-25: Cypress Island Net Pen Site 1 – Fiberglass grating overlaid on walkway

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