City of Ketchikan
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TRANSMITTAL MEMORANDUM

TO: The Honorable Mayor and City Council

FROM: Karl R. Amylon, City Manager
Bob Newell, Finance Director

DATE: January 18, 2017

RE: Contract No. 16-16 – Planning and Design of Port Improvements, Moffatt & Nichol

As indicated in the attached memorandum from Port & Harbors Director Steve Corporon, the City Council has scheduled a special meeting for Thursday, January 26, 2017, in order for Moffatt & Nichol to present the firm's final report for Contract No. 16-16, Planning and Design of Port Improvements. As Mr. Corporon notes in his comments, staff is seeking City Council direction regarding possible sequencing of Moffatt & Nichol's recommended improvements and proposed time frames for their implementation.

The Port & Harbors Director's technical summary of the report is self-explanatory and requires no additional elaboration by staff. In evaluating the various options put forward by Moffatt & Nichol, staff believes the City Council may want to take into account the following issues as it develops a strategy for moving forward.

1. During the public meetings that were conducted during Moffatt & Nichol's planning process, opposition was expressed from different constituent groups regarding the proposed alternatives to expand Berths I and II and Berth IV. The City Council will have to determine whether the need to address future berth capacity and the Port's ability to accommodate evolving vessel configurations outweigh the basis for the opposition that has been expressed to date.

2. If the City Council concurs that removal of the rock pinnacle within the Tongass Narrows is warranted, seeking federal and/or state funding will likely lead to unacceptable delays in moving the project forward. Staff believes this component of the project should be initiated at the local level and that funding the work independently of the federal and/or state governments is likely the preferred course of action.

3. If a long-range waterside development plan and associated timeline are endorsed, the City Council should consider whether additional uplands

planning is warranted to address the impacts that additional cruise ship passengers will have on the visitor experience and local residents. Moffatt & Nichol endorses such an effort, which could be undertaken as either an amendment to the firm's existing contract or through an independent solicitation.

4. The report establishes an implementation timeline that incorporates near-term, mid-term and long-term improvements totaling between \$52.5 million and \$72.7 million. Depending on the development plan that is endorsed by the City Council, City residents will likely be again asked to grant bonding authority for additional Port improvements. To that end, the City Council may wish to consider the following:

   As of December 31, 2016, the City's outstanding debt totaled \$109.2 million. Of this amount \$86.8 million was attributable to General Government and \$22.4 million was attributable to KPU. Three projects account for \$80.6 million, or 73.8% of the total outstanding debt. These projects are the Berth III Port Improvements - \$27 million, Ketchikan Medical Center Surgical and Clinical Annex - \$41.3 million and the Whitman Lake Hydroelectric Project - \$12.3 million. Most of the City's debt was issued through the Alaska Municipal Bond Bank, in order to take advantage of lower interest rates and issuance costs. Currently, \$97.8 million, or 89.6% of the City's total outstanding debt has been issued through the Bond Bank.

   Given the City's current debt status, the City Council needs to carefully consider all the ramifications of issuing any debt that might be required to implement the improvements proposed by the Moffatt & Nichol report. There is no question that the City's own financial position needs to be at the forefront of the discussion but it is also important to consider the impact of the State's current fiscal challenges and how those challenges may affect the City. One of the more pertinent concerns is the dynamics of the cruise ship industry. The industry is primarily driven by consumer demand and the mobility of the industry's infrastructures allows for a rapid response to changing consumer demand. For example, if the Alaska market is no longer desirable, the cruise ship industry has an obligation to its shareholders to reposition their ships in more favorable markets. Unfortunately, the issuance of debt becomes a fixed cost for the City that is dependent on a certain level of revenue streams from the industry in order to meet the debt service requirement. It is incumbent on the City to obtain long-term assurances that the revenues will be available to pay the debt service.

   Another important consideration is the future of the State's CPV Excise Tax "Revenue Sharing" Program. Under the State's current program, the City receives \$2.50 per passenger and the Borough receives \$2.50 per passenger. Since the program was initiated, the annual payments have ranged between \$2 million and \$2.3 million for each government. As the City Council is aware, this program has come under scrutiny by the Alaska Legislature and its future is uncertain. The fiscal challenges facing the State could also impact the future of the program. The loss of CPV Funds could have a negative impact on future Port development and would most likely increase the City's risk of issuing additional debt for Port improvements. The State's CPV Excise Tax is also subject to changes in market conditions.

Lastly, the City Charter requires voter ratification of any ordinance or resolution passed by the City Council to issue general obligation or revenue bonds. Since the City has significantly increased its outstanding debt over the past 10 years, staff anticipates that the voters of the City will require some level of comfort that any debt issued to finance the improvements proposed by the Moffatt & Nichols study would not result in tax increases.

Staff believes that Moffatt & Nichol's presentation is the beginning point to discuss these and other issues associated with expanding Port facilities to accommodate the next class of cruise ships that will be entering the Alaska market in the next five to fifteen years. Additional discussions will likely be required with representatives of the cruise ship industry, other Alaska Ports of Call such as Juneau and Skagway and other stakeholder groups before a final strategy can be formulated.

The Finance and Port and Harbors Directors will be attending the City Council meeting of January 26, 2016, in order to address any questions and/or concerns that Councilmembers may have.

A motion has been prepared for City Council consideration.

RECOMMENDATION

It is recommended that the City Council adopt the motion directing staff to take such action regarding Moffatt & Nichol's Planning & Design of Port Improvements Report as determined appropriate by the City Council.

Recommended Motion: I move the City Council direct staff to take such action regarding Moffatt & Nichol's Planning & Design of Port Improvements Report as determined appropriate by the City Council.

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MEMORANDUM

To: Karl Amylon, City Manager

From: Steve Corporon, Port & Harbors Director

Date: January 17, 2017

Re: **Update on Planning and Design of Port Improvements, Contract No. 16-16**

Attached is the final report on the Planning and Design of Port Improvements, Contract No. 16-16, which was recently completed by Moffatt & Nichol, for placing on the agenda for the special City Council meeting scheduled for Thursday January 26, 2017, at 7:00 pm in the council chambers. Shaun McFarlane of Moffatt & Nichol will be attending the meeting to provide a summary presentation, answer questions and assist in the Council's discussion as necessary.

The heart of the discussion will need to be centered within the summary of recommendations provided on page vii of the executive summary, especially the near term projects. A short synopsis of the major decision points are outlined as follows:

Berth 3 Expansion: The Berth 3 barge is scheduled for its 10-year overhaul commencing this fall, a decision on whether to lengthen it during this overhaul needs to be made soon. In discussions with representatives from Cruise Line Agencies of Alaska (CLAA), they are of the opinion they will be able to adequately accommodate vessels up to 1,100 feet at Berth 3 without lengthening the barge, which means Berth 3 option B would be acceptable for now. Lengthening the barge could then be considered in the long term to accommodate vessels up to 1,150 feet.

Berths 1, 2 & 3: Corrosion Maintenance and Cathodic Protection: As outlined in the inspection reports included with the final report, there is a need for maintenance of the corrosion protection coatings on Berths 1 and 2 and the installation of additional cathodic protection on Berth 3. This work should be programmed to be performed with the next few years.

Rock Pinnacle Removal: Beginning the planning and permitting for removal of the rock pinnacle should commence as soon as possible. Waiting for a Federal agency such as the Army Corps of Engineers to take the lead would likely lead to a frustratingly long process with no guarantee of achieving removal in a timeframe meeting the City's proposed long term goals for expansion of Berths 1 & 2.

Berth 4 Expansion: In discussions with representatives from CLAA and a representative from the owners of Berth 4, they are of the opinion that they will be able to adequately accommodate vessels up to 1,100 feet at Berth 4 if option C, lengthening the existing barge, was selected. Additional floats as depicted in options A and B could then be considered in the future to accommodate vessels up to 1,150 feet if necessary.

Berths 1 & 2 Expansion: The recommendation is to program the expansion of Berths 1 & 2 as a long term project, to follow the maintenance work, rock pinnacle removal and expansion work at Berths 3 and 4 as described above. If this recommendation is followed then it is not imperative that a decision be made at this time on whether to proceed with option A or B; however, a healthy discussion and direction would be helpful to ensure the goals that are set are compatible with the other projects under consideration.

of these improvements will allow Ketchikan to continue to operate four berths accommodating four large cruise ships. At least two of the berths will accommodate Type E vessels, and a third Type E vessel may also be accommodated depending on the total combined extension of Berths 1 and 2 that is implemented in the long term.

TABLE ES.1: SUMMARY OF RANGE OF BASE OPPC FOR RECOMMENDED FACILITY EXPANSION BY IMPLEMENTATION TIMELINE

	Near-term (2017-2019)	Mid-term (2020-2023)	Long-term (2024+)
Projects	• Berths 1 and 2 authorized and funded improvements[3] • Berth 3 Expansion while in drydock following 2017 cruise season (Options A or B) • Berths 1, 2 and 3 Corrosion Maintenance and Cathodic Protection • Subsurface investigations, bathymetric survey, and begin permitting process for Rock Pinnacle Removal	• Berth 4 Expansion (Options A, B or C) • Rock Pinnacle Removal	• Berths 1 and 2 Expansion (Options A or B)
OPPC	$5.5 to $12.5 Million	$10.0 to $20.7 Million	$37.0 to $39.5 Million

Phasing, and particularly the selection of preferred expansion options within each of these programmatic scenarios will need to consider available funding and the timely meeting of projected cruise market demand. Each development scenario will result in unique challenges to upland facilities in addition to collateral impacts, both real and perceived, to adjacent waterfront uses. Upland facility and passenger access/egress planning will be needed once an expansion development plan and associated project timelines are determined.

Once a long-range development plan is determined and its timeline projected, additional upland facility and cruise passenger access/egress/flow planning should be undertaken to highlight and address potential upland bottlenecks to the Ketchikan shore excursion experience, from the perspective of cruise passengers, tour providers, and local businesses and residents. By effectively balancing the waterfront and upland improvements, the City will be able to accommodate a significant increase in annual cruise visitors while providing a high quality experience to cruise passengers during their 6-7 hour visit to Ketchikan: Alaska's gateway port-of-call.

[3] Near-term costs do not include previously authorized and funded improvements to Berths 1 and 2.

CITY OF KETCHIKAN PLANNING AND DESIGN OF PORT IMPROVEMENTS

12/30/2016

Final Report

moffatt & nichol

LandDesign

CITY OF KETCHIKAN PLANNING AND DESIGN OF PORT IMPOVEMENTS

December 30, 2016 - Final Report

STATE OF ALASKA
49TH
12/30/2016
Shaun G. McFarlane
No. CE-10086
REGISTERED PROFESSIONAL ENGINEER

PREPARED FOR:

City of Ketchikan

PREPARED BY:

moffatt & nichol

LandDesign

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EXECUTIVE SUMMARY

Ketchikan, gateway to Southeast Alaska and one of its leading cruise destinations, welcomes nearly One Million passengers annually visiting on cruise ships from May through September. Strong passenger demand for cruises to Alaska coupled with the regional expansion of port infrastructure provide the basis for Alaskan ports-of-call to receive larger vessels than those currently in the market.

This new era of large cruise ships prompted the City of Ketchikan (City) in 2015 to proactively plan and design for improvements to three City-owned cruise ships berths (Berths 1, 2 and 3), and privately-owned Berth 4; under long term lease to the City. In May 2016, the City retained Moffatt & Nichol (M&N), in association with LandDesign and Sheinberg Associates (together, the M&N Team) to undertake a planning and preliminary engineering study for the identification and prioritization of port improvements necessary to accommodate the newest classes of cruise vessels expected to enter the Alaskan market over the next 10 to 15 years.

This report represents the results of the engineering and planning studies, including development of alternative and recommended port improvement concepts, Opinions of Probable Project Cost (OPPC), and a recommended phasing scenario for the proposed improvements.

Study Scope

The planning study comprised the following key tasks:

1. **Inspection and review of existing facilities**, including a Tier 1 (site condition assessment) and later, a more focused Tier 2 (structural repair assessment) inspection of Berths 1, 2 and 3.
2. **Cruise market and vessel assessment**, covering global and Alaskan markets to determine market trends in vessel size and the projected demand for cruise ship berthing at Ketchikan. This research and analysis of vessel characteristics include those currently in the Alaskan market and those likely to enter the Alaskan market over the next 10 to 15 years.
3. **Conceptual design alternatives and OPPCs** for the potential expansion of Berths 1, 2, 3 and 4 to accommodate larger vessels expected in Ketchikan over the next 10 to 15 years.
4. **Interface with cruise industry stakeholders and the Public-at-large** to gather input associated with the planning process and feedback on the initial conceptual development alternatives. Three community meetings were held in Ketchikan.
5. **A planning study report**, memorializing the planning process and presenting recommendations for implementing Ketchikan's expanded port facilities.

Condition of Existing Facilities

A detailed review of existing construction documents and recent inspection reports from Berths 1, 2 and 3 led to the conclusion that the facilities can safely accommodate the berthing and mooring of all cruise ships presently calling on Ketchikan. More detailed Tier 1 and Tier 2 inspections of Berths 1, 2, and 3 concluded that the facilities are in generally Fair condition and have been appropriately maintained by the City. The primary maintenance issue identified from these inspections was the repair of protective coatings and improved corrosion mitigation measures. Non-critical items included the repair and enhancement of lighting, bollards, safety ladders, fender transition plates, timber planks, bullrail and water lines. The inspection and evaluation of privately-owned Berth 4 was outside of the current scope of work.

An existing rock outcrop (commonly referred to as the rock pinnacle) located approximately 700 feet west of Berth 2 is the only known impediment to navigation limiting the size of vessel that can safely navigate to and from Berths 1, 2 and 3 under extreme wind conditions.

Global Cruise Market

The *Cruise Ship Order Book* is considered a barometer for the global cruise industry health and future growth. A total of 59 new vessels with a capacity of 182,000 lower berths are scheduled for delivery between 2016 and 2022; and more than half of these ships have a capacity of 3,200 or more. This represents a record number of ships on order at a single time and provides significant short-term guidance that the industry will experience strong growth in the years ahead. The industry is considered *supply lead*, whereby expansion in capacity results in a similar expansion in passenger growth. Thus, expansion to a level of 628,254 lower berths is expected to lead to significant growth in passengers worldwide. The long-term forecast is in the range of 36 to 42 Million passengers by 2030.

Existing vessels and those on order will require regions to sail and consumer markets to tap into. Supply expansion will thus place demands on existing and emerging cruise regions to provide new facilities and destination offerings. Cruise lines will subsequently focus operations around ports and destinations that can accommodate large vessels and meet other key deployment requirements.

Alaskan Cruise Market

Similar to other cruise regions worldwide, the Alaskan region is seeing passenger capacity levels increase while the overall number of vessels in the region decreases slightly. For example, total Alaskan cruise ship capacity in 2003 was recorded at 797,516 on 40 ships; by 2016, it's estimated that capacity will be 16% greater in the region while actual vessels operating decreased to 38. Conversations with cruise line representatives and with Cruise Line Agencies of Alaska (CLAA) suggest that growth over the next decade will occur primarily as a result of homeports and primary regional ports-of-call expanding to welcome larger vessels, without significantly increasing the number of vessels operating within Alaska.

The Alaskan cruise region is a balanced system, reliant on: (a) ships available to be deployed to the region; (b) the homeports of Seattle and Vancouver supporting their operations through the summer months; and (c) the ability of primary upstream Southeast Alaska and Canadian Inside Passage ports-of-call accommodate these ships and passengers. Of these, the greatest limiting factor to long-term growth is the expansion of port-of-call offerings. Cruise stakeholders—cruise lines, CLAA and the ports themselves—suggest this limiting factor can be overcome. The expansion of four berths for large cruise ships plus one or two tender locations is the most tenable approach to providing expanded cruise berthing facilities at the key Southeast Alaska ports of Ketchikan, Juneau and Skagway.

With a balanced system to welcome market growth, the estimated capacity to the Alaskan region could reach 1.5 Million lower berths by 2030, with a long-term forecast range between 1.3 (low) and 1.8 (high) Million. Assuming passenger levels run at an average of 110% of capacity, the Alaskan region could welcome 1.65 Million passengers by 2030.

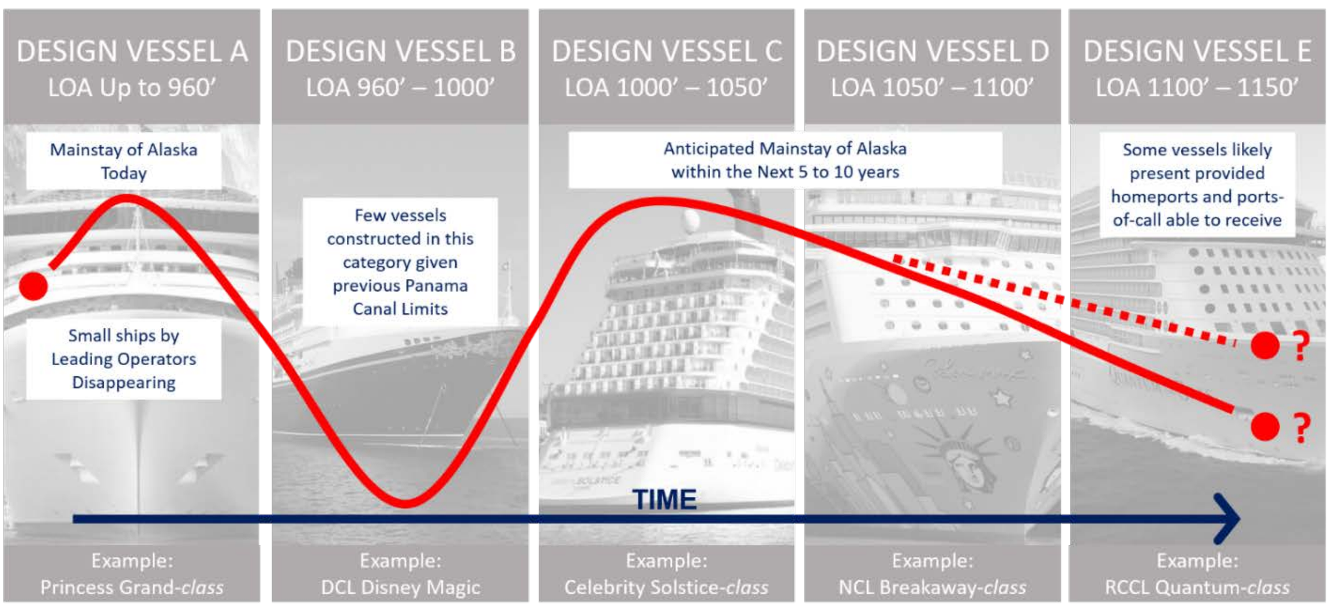
Expected Vessels in the Alaskan Market over the Next 10 to 15 Years

The average size of oceangoing cruise vessels operating within the Alaskan region has increased steadily over the past decade and this trend is expected to continue. Five primary typologies of cruise ships present and anticipated in the Alaskan market were identified through discussions with cruise line stakeholders (refer to Figure ES.1). Passenger capacities of these vessels range from 2,600 for Type A to more than 4,000 for Type E[1].

The principal operating vessels in the near term for the Alaskan region is considered to be Types C and D. However, destinations should consider at least one berth and possibly up to three berths that can accommodate up to Type E cruise ships in the long term.

FIGURE ES.1: ANTICIPATED DESIGN VESSEL TYPOLOGY PRESENCE IN THE ALASKAN REGION

Source: Cruise Industry Stakeholders, Moffatt & Nichol and LandDesign, 2016



Recommended Improvements

Table ES.1 summarizes the alternatives and Ketchikan's recommended approach to port improvements to accommodate larger vessels expected to enter the Alaskan cruise market over the next 10 to 15 years. Section 5 details and describes numerous options for Berths 1, 2, 3 and 4 expansion, and the costs presented therein represent the range of base OPPCs[2] of the alternative concepts for each item. The complete build-out

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[1] Design Vessel Types A through E are generic references to vessels within specified ranges of LOA and are not industry standard designations.

[2] Base OPPCs do not include project contingency. Refer to Table 5.1 and Appendix C for additional detail including estimated ranges of contingency for individual projects.

of these improvements will allow Ketchikan to continue to operate four berths accommodating four large cruise ships. At least two of the berths will accommodate Type E vessels, and a third Type E vessel may also be accommodated depending on the total combined extension of Berths 1 and 2 that is implemented in the long term.

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OPPC	\$5.5 to \$12.5 Million	\$10.0 to \$20.7 Million	\$37.0 to \$39.5 Million

Phasing, and particularly the selection of preferred expansion options within each of these programmatic scenarios will need to consider available funding and the timely meeting of projected cruise market demand. Each development scenario will result in unique challenges to upland facilities in addition to collateral impacts, both real and perceived, to adjacent waterfront uses. Upland facility and passenger access/egress planning will be needed once an expansion development plan and associated project timelines are determined.

Once a long-range development plan is determined and its timeline projected, additional upland facility and cruise passenger access/egress/flow planning should be undertaken to highlight and address potential upland bottlenecks to the Ketchikan shore excursion experience, from the perspective of cruise passengers, tour providers, and local businesses and residents. By effectively balancing the waterfront and upland improvements, the City will be able to accommodate a significant increase in annual cruise visitors while providing a high quality experience to cruise passengers during their 6-7 hour visit to Ketchikan: Alaska's gateway port-of-call.

[3] Near-term costs do not include previously authorized and funded improvements to Berths 1 and 2.

1.0 INTRODUCTION

1.1 Project Approach

Ketchikan is one of the leading cruise destinations in the Alaska. Passenger levels have grown steadily over the past several decades to their current level of 950,000 guests in 2016. Strong passenger demand for cruises coupled with the expansion of regional port infrastructure and other factors sets the stage for Ketchikan and other Alaskan ports-of-call to receive vessels longer that 960' length overall (LOA).

With an interest to ensure Ketchikan plans ahead for both the opportunities and challenges associated with the trend toward larger vessels entering the Alaskan cruise market, the City of Ketchikan (City) retained Moffatt & Nichol (M&N) in conjunction with LandDesign and Sheinberg & Associates (together, the M&N Team) to study approaches to welcome larger ships along its waterfront over the next 10 to 15 years. Commencing in May 2016, the scope of the study covered City-owned facilities at Berths 1, 2 and 3, but was later expanded to address opportunities at privately-owned Berth 4, which is under long-term lease to the City.

The planning study comprised the following key tasks:

1. **Inspection and review of existing facilities,** including a Tier 1 (site condition assessment) and later, a more focused Tier 2 (structural repair assessment) inspection of Berths 1, 2 and 3.
2. **Cruise market and vessel assessment,** covering global and Alaskan markets to determine market trends in vessel size and the projected demand for cruise ship berthing at Ketchikan. This research and analysis of vessel characteristics include those currently in the Alaskan market and those likely to enter the Alaskan market over the next 10 to 15 years.
3. **Conceptual design alternatives and Opinions of Probable Project Cost (OPPC)** for potential expansion of Berths 1, 2, 3 and 4 to accommodate larger vessels expected in Ketchikan over the next 10 to 15 years.
4. **Interface with cruise industry stakeholders and the Public-at-large** to gather input associated with the planning process and feedback on the initial conceptual development alternatives. Three community meetings were held in Ketchikan.
5. **A planning study report,** memorializing the planning process and presenting recommendations for implementing Ketchikan's expanded port facilities.

For each of the above tasks, M&N's scope was limited to waterfront structures only: the review and assessment of upland facilities and systems needed to address present and future in-water cruise facilities was not covered as part of scope of work, and is recommended as an important and complementary future planning exercise.

1.2 Organization of This Report

This Planning Study Report is divided into five main sections, memorializing Ketchikan's seven-month long cruise facility expansion planning effort:

- Section 2 describes current Ketchikan port facilities at Berths 1, 2, 3 and 4, including topside, under-pier and underwater inspections of Berths 1 and 2, the oldest of these facilities.
- Section 3 details the research to assess the current and projected state of the Alaskan cruise market, including the current state and nature of the cruise industry and projected future vessels in the region.
- Section 4 describes the parameters used for the planning and design of Ketchikan's cruise facilities, including specific cruise ship requirements, dock/wharf[4] space, navigation, mooring and berthing scenarios.
- Section 5 presents the iterative conceptual alternatives developed for Berths 1, 2, 3 and 4 along with budget-level OPPCs and feedback received from project stakeholders.
- Section 6 presents the vision for Ketchikan's port facilities addressing the cruise industry over the next 10 to 15 years, including near-, mid- and long-term improvements, appropriate implementation timelines, and recommendations for additional planning to confirm the recommended strategy.

[4] The terms dock and wharf are used interchangeably throughout this report.

2.0 EXISTING PORT FACILITIES

City-owned Berths 1, 2, and 3, and the privately-owned Berth 4 comprise the Port of Ketchikan, which is located within the Ketchikan Gateway Borough on Revillagigedo Island. The Berths are adjacent to downtown Ketchikan on the shore of Tongass Narrows. The infrastructure is primarily configured to receive cruise ships and passengers. Ketchikan receives as many as six ships daily from May through September, with over 950,000 annual cruise passenger visits.

FIGURE 2.1: KETCHIKAN TODAY (FRIDAY BERTHING SCENARIO)

Source: Moffatt & Nichol and LandDesign, 2016

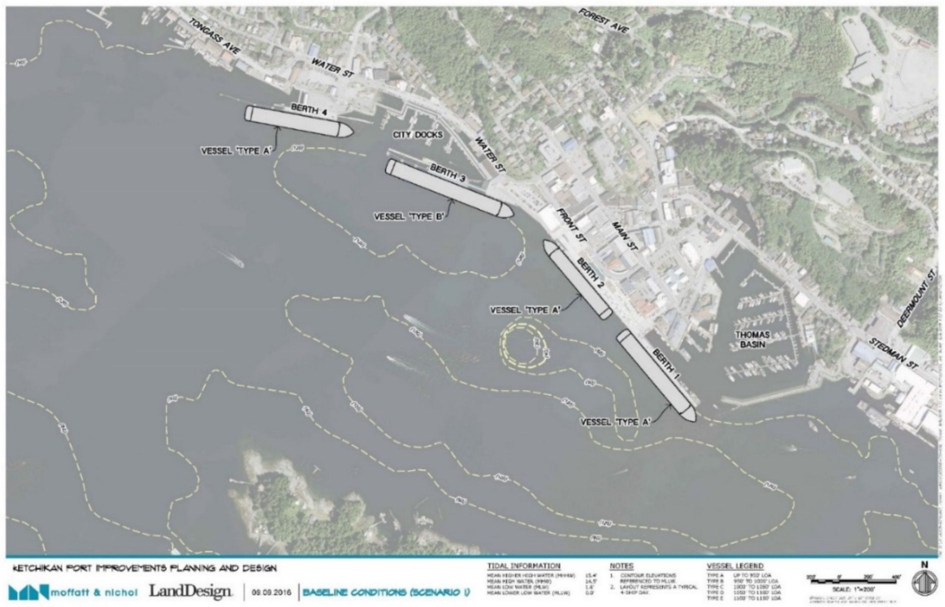
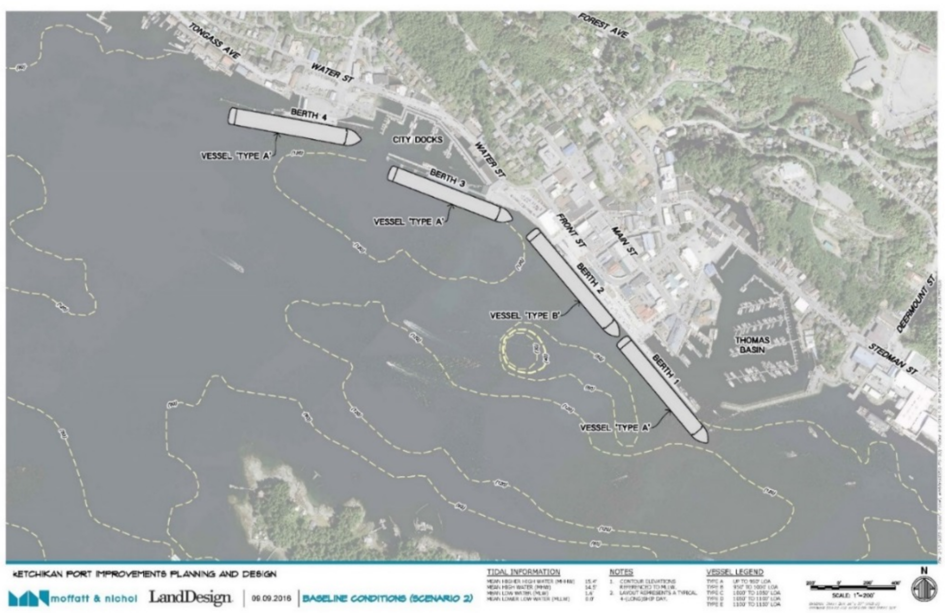


FIGURE 2.2: KETCHIKAN TODAY (THURSDAY BERTHING SCENARIO)

Source: Moffatt & Nichol and LandDesign, 2016



2.1 Overview and Context

The development of the Port of Ketchikan extends back many decades. A brief survey of the most recent efforts to modernize the Port facilities to support large cruise operations is provided to contextualize the present planning and preliminary engineering study. A brief summary of key port development projects follows below, and a more detailed summary of the principal docks is presented in Section 2.2.

Berths 1 and 2 Rehabilitation. In 1993, Ketchikan undertook a major improvement of what was then known as Berth 1. The dock was widened in the seaward direction: an expansion resulting in the realignment of nearly 400' of the berthing face, and an extension of nearly 600' of dock along the new alignment. While the existing dock was timber, the expanded section was constructed of structural steel piling and substructure, with precast concrete deck panels. This extended dock face allowed for the simultaneous berthing of two cruise vessels of modest size, end-to-end. While the project was originally referred to as Berth 1 South, this area is now commonly known as Berths 1 and 2[5].

In 2008, a series of timber dock repairs were undertaken at Berths 1 and 2, foreshadowing a more comprehensive renovation of those berths in the coming years. From 2011 through 2013, design of the first three of four phases of the Berths 1 and 2 Rehabilitation effort was performed. These three initial phases provided for the replacement of the remaining timber dock with structural steel piling and substructure, and cast-in-place and precast concrete construction. The improvements were followed in 2013 by the design of a new Port Security building at Berth 2 and a suite of site enhancements, including pedestrian benches, canopies and additional mooring bollards.

In 2015, the fourth and final phase of the Berths 1 and 2 Rehabilitation was undertaken. In addition to a new bus canopy, log benches, and expansion joint replacement, and a new grey water line was installed. The Ryus Float was also replaced as part of this phase.

In 2016 the City of Ketchikan engaged the M&N Team to compile contract documents for the design of several upgrades to Berths 1 and 2. The projects are expected to be financed from existing funding sources, and include: four new bollards; new and upgraded safety ladders; repairs to a number of berthing fender panel assemblies; the replacement of several water service lines; the replacement of several feet of damaged existing bullrail; and the replacement of damaged light fixtures.

FIGURE 2.3: EXISTING BERTHS 1 AND 2

[5] This report refers to Berths 1 and 2 jointly due to their continuous berthing alignment, and to the fact that any proposed modifications are considered for these facilities as a contiguous wharf.

Timber Dock Replacements and Infill. The Spruce Mill Dock replacement was designed in 2005 and the interstitial open spaces between the 1993 addition and the existing wharf face were subsequently infilled. Construction was of structural steel piling and substructure, with precast concrete panels and reinforced cast-in-place concrete doweled into existing construction.

Berth 3 Construction. In 2006, design was undertaken of a new cruise ship wharf that would come to be known as Berth 3. The project transformed the original Berth 2 area into an uplands staging area for a new floating dock facility. A nearby existing small boat harbor was replaced with the new Casey Moran Float. Other additions included a tendering float alongside the floating dock, a new portion of dock at Dock Street, the reconstructed Ryus Float, and a new restroom and covered shelter facility. The new dock facility included a steel barge-type float, held on station by two multi-steel-pile barge mooring dolphins. A series of steel catwalks extended from the north end of the float to two steel pile and steel cap breasting dolphins, and to a mooring dolphin at the extreme north end of the facility.

FIGURE 2.4: EXISTING BERTH 3

Berth 4 Construction. In 2007 construction drawings were issued for privately-owned Berth 4, located to the north of Berth 3. The layout of the facility is very similar to that of Berth 3, comprising a fixed dock transitioning to a floating dock. As with Berth 3, a number of breasting and mooring dolphins were built adjacent the floating dock. At present the City has a long-term lease with Survey Point Holdings, LLC to support cruise ship berthing and passenger loading and unloading at Berth 4.

FIGURE 2.5: EXISTING BERTH 4

2.2 Description and Capacity of Port Facilities

Berths 1 and 2 are pile-supported fixed wharf facilities, while Berths 3 and 4 are combination pile-supported dock and barge-style float facilities. A more detailed description of each of the four berths follows below.

2.2.1 Berths 1 and 2

The Berths 1 and 2 wharf is approximately 1,450' long. The northernmost 375', referred to in the original construction documents as the *Berth 1 Addition*, is nominally 26' wide as originally constructed. A series of recent rehabilitation projects (circa 2012) expanded the usable concrete deck area to a nominal width of approximately 66'. The intermediate 806', referred to in the original construction documents as *Berth 1 South*, is nominally 50' wide. The southern 271' (nominal) length of dock (referred to in the original construction documents as the *Berth 1 South Extension)* is nominally 26' wide. Available construction documentation indicates that Berths 1 and 2 were designed for a nominal 135 ft-kips of shoreward berthing energy, based on an 800' LOA x 125' beam x 70,000 DWT (displacement) design vessel. Mooring points, in the form of single- and double-bitt bollards are located along the lengths of Berths 1 and 2[6].

2.2.2 Berth 3

Berth 3 consists primarily of a steel barge-type float, laterally restrained by two reaction dolphins, referred to on the construction drawings as *Barge Float Mooring Dolphins*. Berth 3, constructed in 2007 is detailed in a design drawing set (circa 2006) entitled *Port Berth Reconfiguration*. The barge measures 300' long and 50' wide, and has a freeboard of approximately 10'; constructed of a steel plate shell, with internal angle truss framing. Two outboard pile hoops constructed of HSS 16x16 square tube frame assemblies are welded to the float, and each hoop assembly is compartmentalized to accommodate three 48" diameter steel guide piles. The inner surface of the guide pile compartments is lined on all sides by energy-absorbing arch fenders. Each arch fender has an Ultra High Molecular Weight Polyethylene (UHMWPE) low-friction shield at the pile contact face. Available construction documents indicate that Berth 3 was designed for a nominal 260 ft-kips of shoreward berthing energy, based on the quarter-point berthing at any one dolphin of a 1,000' LOA design vessel. Berth 3 was reportedly designed to resist a maximum net combined (seaward) pull of all lines totaling 1,250 kips: a 350 kip net seaward pull on each of three discrete breasting/mooring points; and 200 kips net seaward pull on one dock-mounted mooring dolphin.

2.2.3 Berth 4

Berth 4 consists primarily of a surplus, repurposed steel barge-type float, laterally restrained by two reaction dolphins, referenced on the construction drawings as *Floating Barge Dolphins*. Berth 4, designed in 2007 is detailed in a drawing set (circa 2007) entitled *Ketchikan Berth IV*. The barge measures 124' long and 34' wide, and is constructed of steel plate shell. Two outboard pile hoops constructed of HSS 8x8 square tube frame assemblies were retrofitted to the float, and each hoop accommodates a single 30" diameter steel guide pile. The inner surface of the guide pile compartment is lined on all four sides by energy-absorbing square fender units. Each fender has a UHMWPE low-friction shield at the pile contact face. Available construction documentation indicates that Berth 4 was designed for a nominal 268 ft-kips of berthing energy. Berth 4 was reportedly designed to resist a maximum net combined (seaward) pull of all lines totaling 900 kips: a 150 kip net seaward pull on each of six mooring points along the length of the vessel.

[6] The maximum allowable seaward mooring load for these bollards is reported as 200 kips, but based on a recent evaluation by M&N their capacity is believed to be somewhat less.

VIEWPOINT: MEETING THE CURRENT NEEDS OF THE INDUSTRY IN KETCHIKAN

Based on the current construction and the existing conditions, it is our opinion that the Berth 1, 2 and 3 facilities are sufficient to safely accommodate the berthing and mooring of cruise vessels presently calling on Ketchikan.

2.3 Results of Tier 1 and Tier 2 Inspections

2.3.1 Overview

In May 2016, The City retained the M&N Team to undertake an initial condition assessment of representative portions of Berths I, 2, and 3; referenced jointly in our scope of work as a *Tier 1 inspection*. This topside, under-pier and underwater condition assessment conformed generally to the American Society of Civil Engineers (ASCE) Manuals and Reports on Engineering Practice publication No. 130, *Waterfront Facilities Inspection and Assessment Manual (WFIAM)*. Berth 4, built less than 10 years ago by Survey Point Holdings, LLC and leased to the City, was not inspected under this scope of work.

The features of the existing components observed included, but were not limited to:

- Global vertical and lateral structural load-resisting pathways
- Secondary structural framing
- Dock fender system
- Mooring cleats, bollards and bullrail
- Berth 3 barge float
- Breasting and Mooring Dolphins
- Appurtenances
- Tendering Float

Moffatt & Nichol's *Port of Ketchikan Berths 1, 2 and 3: Condition Assessment Report (August 8, 2016)* summarized the findings of the Tier 1 field investigation. Included were a condition assessment of the structures, recommendations regarding items for immediate repair and/or replacement, and a Category 5 OPPC for repair and replacement items (refer to Appendix A). The City was advised at that time that addition inspection and testing (referred to in our scope of work as a *Tier 2 Inspection*, to follow the WFIAM) was advisable, based on certain apparent deficiencies. A focused Tier 2 inspection was subsequently commissioned by the City.

The Tier 2 topside and under-pier condition assessment was performed at Berths 1, 2, and 3 in October 2016. This effort involved a more detailed evaluation of those areas identified in the Tier 1 inspection as potentially deleterious to future safe operations of these facilities. For the Tier 2 Inspection, the effort focused on coating failure, corrosion, and cathodic protection at the Berths 1 and 2 steel superstructure and piling. Additionally, the steel pipe piles at the Berth 3 platform were inspected in greater detail.

Taku Engineering, LLC (Taku) was retained by M&N to serve as corrosion control and coating experts. Taku's National Association of Corrosion Engineers (NACE)-certified inspectors mobilized to Ketchikan with the support of M&N personnel to conduct the Tier 2 Inspection. Taku's inspection findings were detailed in a *Corrosion and Cathodic Protection Evaluation (CCPE) Report*, appended to a summary report by M&N, entitled *Port of Ketchikan Berths 1, 2 and 3: Tier 2 Inspection Report (December 16, 2016*; refer to Appendix B).

The scope of the Tier 2 Inspection included the selection of seven representative pile bents between Berths 1 and 2 for a detailed corrosion and coating assessment, including: visual examination; ultrasonic steel section thickness testing; manual pit gauging; and coating thickness measurements. Additional piles were also selected for detailed investigation as part of the field investigation. A cathodic protection survey was included to assess the functionality of existing cathodic protection. A representative sampling of the installed Sea Shield™ pile wraps were opened and inspected, to visually assess their condition and effectiveness in protecting the piling in the intertidal range.

2.3.2 Summary of Findings

Classifications of the condition of existing systems and individual elements of construction, as shown in Tables 2.1 and 2.2, generally conform to descriptions provided in Table 2-14 of the WFIAM. The Tier 1 inspection concluded that the facilities at Berths 1, 2 and 3 are in generally Fair condition, and it was deemed that the City had reasonably maintained the facilities over their service life. The WFIAM defines Fair condition as:

> *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.*

TABLE 2.1: KETCHIKAN DOCKS – INDIVIDUAL SYSTEMS

Sources: Moffatt & Nichol reports ***Port of Ketchikan Berths 1, 2 and 3: Condition Assessment Report*** *(August 8, 2016) and* ***Port of Ketchikan Berths 1, 2 and 3: Condition Assessment Report*** *(August 8, 2016)*

Facility Under Consideration	Recommendation
BERTHS 1 AND 2	
(a) Dock – Surface	Monitor potential voids in ground areas; regularly inspect expansion joint
(b) Dock – Substructure	Complete coating system repair.
(c) Dock – Support Piles	Complete coating system repair, replace/install pile jacketing system.
(d) Cathodic Protection (CP)	Eventual replacement of CP system
(e) Fender Systems	Repair damage, replace missing components; consider upgrades to reduce "stuck" fenders
BERTH 3	
(a) Floating Dock	Repair minor coating damage; eventual cathodic protection
(b) Transfer Span	Repair minor damage; modify ramp surface for improved traction

TABLE 2.1: KETCHIKAN DOCKS – INDIVIDUAL SYSTEMS (CONT.)

Facility Under Consideration	Recommendation
(c) Tendering Float	Repair spalled concrete and damaged connections; mitigate prop wash from cruise ships
(d) Fender Systems	Consider upgrade of dolphin fendering system to reduce "stuck" fenders
(e) Breasting Dolphins	Install cathodic protection on piling; eventual re-coating of steel in the intertidal zone
(f) Mooring Dolphins	Install cathodic protection piling; eventual re-coating of steel in the intertidal zone
(g) Reaction Dolphins	Install cathodic protection piling; eventual re-coating of steel in the intertidal zone
(h) Reaction Pile Hoops	Replace worn fender units; consider upgrading pile hoops

TABLE 2.2: KETCHIKAN DOCKS – APPURTENANCES

*Sources: Moffat & Nichol reports **Port of Ketchikan Berths 1, 2 and 3: Condition Assessment Report** (August 8, 2016) and **Port of Ketchikan Berths 1, 2 and 3: Condition Assessment Report** (August 8, 2016)*

Facility Under Consideration	Recommendation
BERTHS 1 AND 2	
(a) Bullrail	Repair/minor damage. Possible replacement of some bullrail
(b) Safety Ladders	Repair minor damage. Extend safety ladders to accommodate tidal range. Install accessible ladders at dock face adjacent to existing floating fenders.
(c) Bollards	Repair minor coating damage
(d) Lighting	Repair/replace moderately damaged light pole
(e) Dock Crane	Eventual re-certification by 3rd party
(f) Potable Water Systems	Repair minor damage
(g) Life Rings	Repair/replace critically damaged life ring cabinet
(h) Fire Extinguishers	Replace fire extinguisher cabinets. Recharge fire extinguishers, as needed.
BERTH 3	
(a) Guardrail	Repair minor coating damage
(b) Capstans	Repair minor coating damage
c) Bollards	Repair minor coating damage
d) Bullrail	Repair/minor damage. Possible replacement of some bullrail

The facility rating was based on the information and data collected during the Tier 1 inspection. The rating was based on: the presence of identifiable damage and potentially advanced deterioration in discrete locations throughout the structures; and the need for additional testing and inspection, possibly including material sampling, to better ascertain material condition.

The CCPE report by Taku addressed the potential structural impacts of the Tier 2 inspection findings in general, and provided recommendations based on those findings. The Tier 2 inspection did not uncover any deficiencies requiring immediate structural repair or modification. However, the CCPE report warns that should corrosion be allowed to continue unchecked (i.e., without repairs where the system coating has failed, or where no effective cathodic protection exists), steel section loss would eventually impact the structural capacity of the affected elements.

2.3.3 Synopsis and Conclusion

The facilities at Berths 1, 2 and 3 are in generally Fair condition, and are in need of attention, although not critically. Most of the necessary repair/mitigation work is not of a structural nature. In our opinion, the rate of deterioration of the existing elements requires restorative action, but the non-critical nature of the recommended mitigation effort will allow for multi-year planning and budgeting by the City. Elements of construction where section loss is categorized as *Minor to Moderate Damage* can be expected to become areas of *Major Damage* within the next three to four years. Within the same period of time, section loss could also occur at areas now experiencing total coating failure. In our opinion, the recommended repairs and mitigation measures should be implemented no later than 2020.

In terms of capacity for expansion, the existing Berths 1, 2 and 3 facilities offer a serviceable platform from which to build out to suitably accommodate larger cruise vessels in the future. The CCPE Report recommends the following work be assimilated into future expansion projects:

- Seal gaps between the pile caps and the box girders at Berths 1 and 2. Sealing out the sea water is a viable solution to reducing the future corrosion impacts.
- Repair failed coating at Berths 1 and 2. The CCPE recommends that the City begin planning activities for a coating repair project to repair the localized coating failures.
- Replace missing and damaged Sea Shield™ wraps. The missing pile wraps and sea shield jackets should be replaced to mitigate corrosion in the tidal zone.
- New pile wraps in the tidal zone for the fender, bollard and mooring dolphin piling, and at the Berth 3 platform to reduce the impacts of corrosion.
- Sacrificial anodes on the Berth 1 and 2 piling, at the piles that lack cathodic protection currently, or which are inadequately protected.
- Electrical bonding straps between Bents 7 and 8 at the dock width transition near the northern end of Berths 1 and 2; presently electrically isolated.
- Electrical bonding straps between fenders and bollard piles and the rest of the structure, generally wherever presently electrically isolated.
- An impressed current system or a passive sacrificial anode system at Berth 3. A passive system could be similar to that presently installed at Berths 1 and 2.

- In addition to the above recommended corrosion mitigation measures, the Tier 1 and Tier 2 inspections recommended a suite of general repairs, also summarized in Tables 2.1 and 2.2.

VIEWPOINT: FAIR CONDITION WITH ROOM FOR ENHANCEMENT

The M&N Team's Tier 1 and Tier 2 inspections of Berths 1, 2 and 3 concluded that Ketchikan's primary cruise facilities are generally in Fair condition and have been adequately maintained by the City. There is significant room for improvement, whether or not extensive wharf upgrades are pursued by the City as outlined in this report. Critical improvements include the repair of protective coatings and other corrosion mitigation measures. Recommended improvements of a non-critical nature include repair and enhancements to lighting, bollards, safety ladders and other elements (described later in this section).

3.0 CRUISE OPERATIONS IN ALASKA

3.1 State of the Cruise Industry

Cruise travel continues to rank as one of the fastest growing sectors of the global tourism industry. Once small and localized, the cruise industry has grown into a multi-Billion dollar enterprise with a wide assortment of products to offer vacation consumers.

The modern cruise industry's roots date back to the 1970s, where a combination of factors found traction with travel and leisure enthusiasts. From increased popularity of Transatlantic leisure oriented crossings on Cunard Line's Queen Elizabeth II and North America's enchantment with the original *Love Boat* series to innovative entrepreneurs developing short duration Caribbean holiday cruises for the masses, each element played a role in catapulting the industry into its present day success.

In 1970, only 500,000 North Americans embarked on a conventional cruise; by 2014, this level had increased to over 12 Million. Cruise travel now outpaces general leisure travel. Increasing contributions are made by Europe and Australasia passengers, growing the global total to its present day recorded levels of 24.0 million (refer to Figure 3.1).[7]

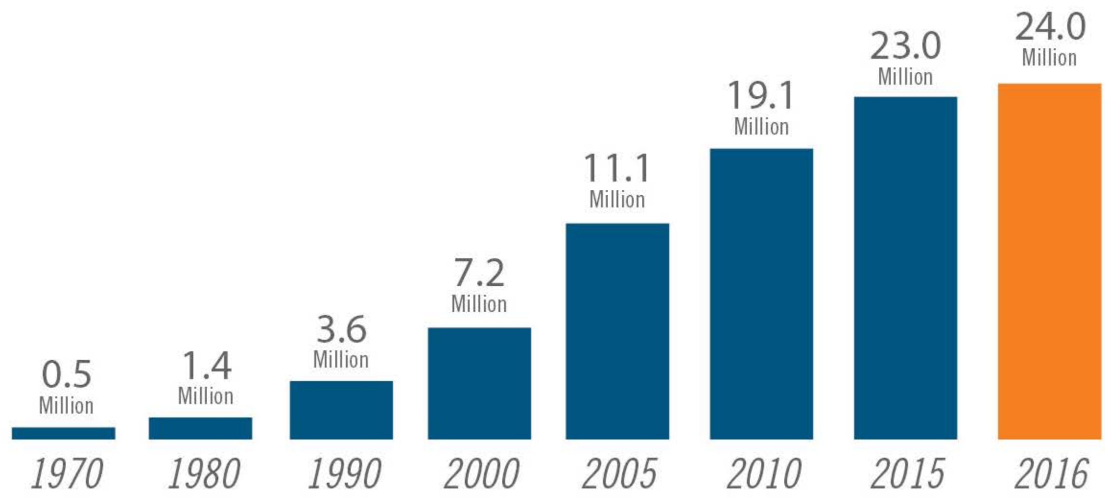
Several industry factors have contributed to the industry's success of the past several decades. These include:

- Cruise lines have successfully introduced new vessel inventory and on-board and landside products that generated sustained interest in cruising.
- Cruise lines create products that work to convert land- based resort guests into cruise passengers.
- Cruise industry products consistently deliver a high level of passenger satisfaction.
- The cruise model is adaptable to changing market conditions. Lines can adjust deployment location, length and other factors as well as adjust pricing to incentivize ticket sales while maintaining other revenue streams as part of the cruise vacation (on-board sales, shore excursions, etc.)
- Cruise lines have been very successful in translating the traditional North American cruise offering to consumer groups worldwide.
- Cruise operators have effectively controlled competition, operational costs, and generated revenue streams from several sources beyond net ticket sales.

[7] Statistics and data presented herein reflect conditions observed as of October 2016.

FIGURE 3.1: CRUISE INDUSTRY GROWTH WORLDWIDE, 1970-2016[8]

Source: Cruise Industry News and LandDesign, 2016



3.2 Cruise Industry Supply

3.2.1 Industry Operators

Four major cruise operators dominate the cruise industry worldwide (refer to Figures 3.2 and 3.3). Each is briefly described below:

- **Carnival Corporation**. Publicly held and traded, Carnival Corporation controls over 224,000 berths on 101 vessels and has significant additional capacity on order (refer to Figure 3.3). Carnival's portfolio of 10 brands is remarkable and includes: Carnival Cruise Lines, Holland America Line, Princess Cruises, P&O Cruises (UK and Australia), Cunard Line, AIDA Cruises (Germany), Costa Crociere and others. These brands combine to offer a range of vacation products to consumers with varied tastes, income levels and national origins.

- **Royal Caribbean Cruises, Ltd. (RCCL)**. Under its seven brands, RCCL operates a fleet of 48 ships and a total of 122,829 berths. RCCL is also a publicly held corporation.

- **Norwegian Cruise Lines (NCL)**. NCL is the third largest operator, with its fleet predominately serving the North American market. NCL, also a publicly held corporation, supports a total of 24 vessels across its NCL, Regent and Oceana brands.

- **MSC Cruises**. The only leading group that is privately held, MSC has made significant inroads in the business over the past decade. MSC currently operates 12 ships representing 31,860 berths and markets the majority of this capacity in Europe.

[8] 2016 figures are estimated.

FIGURE 3.2: CRUISE INDUSTRY MARKET SHARE BY OPERATOR, 2016

Source: Cruise Industry News and LandDesign, 2016

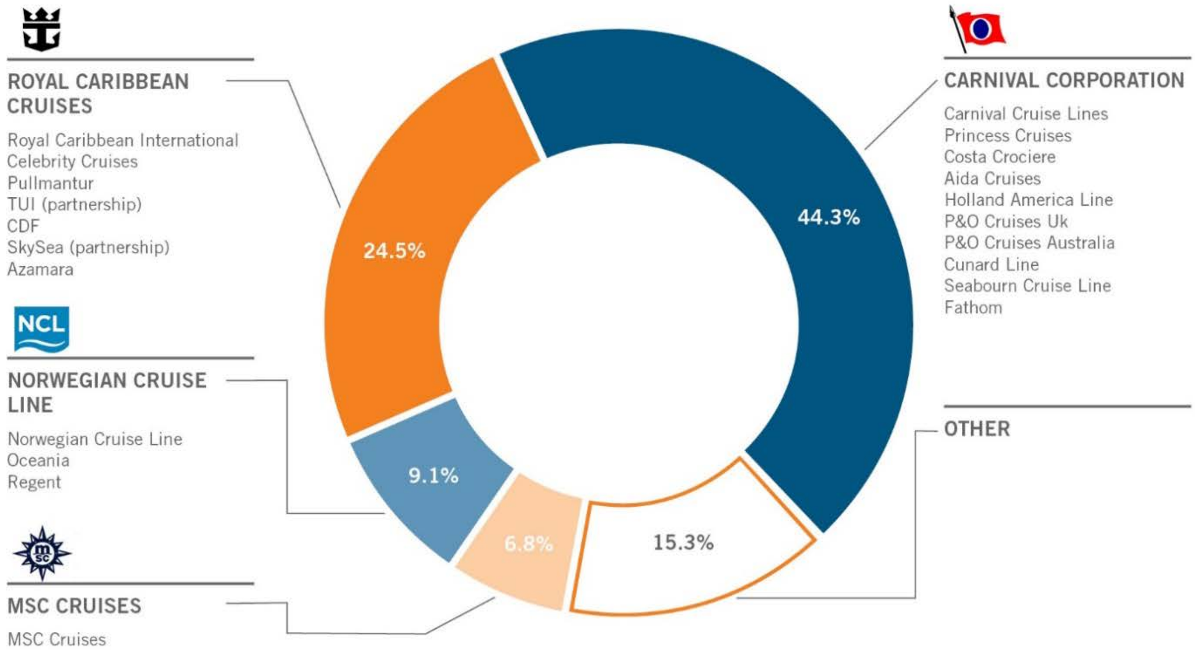
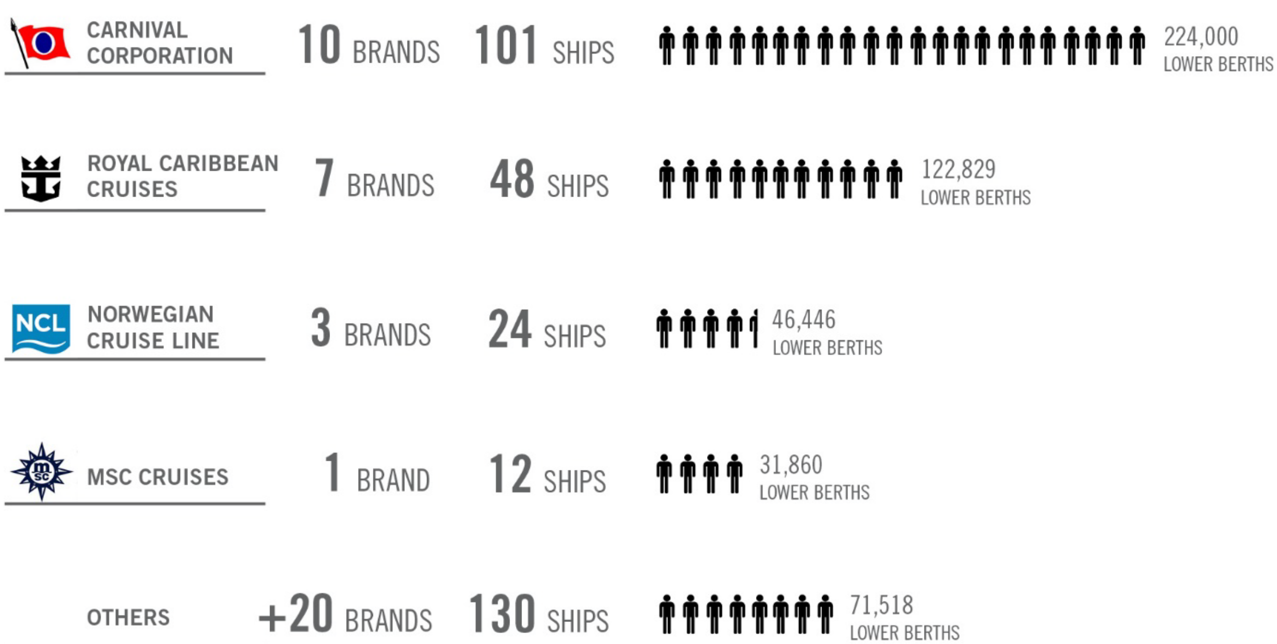


FIGURE 3.3: CRUISE INDUSTRY MARKET SHARE BY OPERATOR, 2016

Source: Cruise Industry News and LandDesign, 2016



While lines in the *Other* category are far smaller in terms of fleet size than the four major conglomerates, the remaining 15.3% of industry capacity includes a number of important and diverse brands. Representative lines include Disney Cruise Lines, Crystal Cruises, Silversea Cruises, and others.

Similar in composition to the hospitality industry, each major cruise group is comprised of several cruise line brands with ships positioned to appeal to different geographic markets and consumer tastes. The majority of cruise brands generally fall into one of the following four segments:

- **Contemporary** (76.0% of industry capacity by type). Ships in the contemporary segment appeal to passengers of all ages and income categories with a focus on middle income levels.
- **Premium** (15.9% of industry capacity by type). The premium segment is geared towards more experienced cruisers; often older and more affluent with time to vacation. Service and food quality are emphasized under the premium segment.
- **Budget** (3.7% of industry capacity by type). The budget segment tends to be a less expensive version of the contemporary market; with ships generally older, smaller and offering fewer amenities. Many of these operate in Europe.
- **Luxury** (1.8% of industry capacity by type). The luxury segment offers cruises of greater than seven days on high quality, small and medium-sized ships. Luxury vessels tend to sail worldwide and offer superior food and service.

Several other secondary market segments exist, including: exploration and soft adventure cruises; niche cruisers; river cruises; and coastal operations. Many of these specialty cruise operations are found within the Alaskan cruise region. In addition, several tour operators have chartered vessels for their niche market segments.

3.2.2 Growth in Industry Supply

The *Cruise Ship Order Book* has long been a barometer for industry health and future growth. The cruise industry is considered to be *supply lead*, with increases in capacity (e.g., ships and lower berths) leading to expansion of global passenger levels.

- A total of 59 ships with capacity of 181,993 lower berths are scheduled for delivery between the end of this year and 2022 (refer to Figure 3.4). This represents an expansion of total supply of over 30% and will push the total inventory of ships from 315 to 363 by 2022 (refer to Figure 3.5). By 2020, the total number of ships is forecast to grow by 15% and total industry supply of lower berths is forecast to grow by 25%.
- The *Cruise Ship Order Book* represents continued confidence by the industry over the near- and mid-term. The total estimated investment pledged by the cruise lines exceeds $44.2 Billion. Several of the individual vessels on order will cost an estimated $1 Billion.
- Thirty-one of the vessels on order—more than half—are at 3,200 lower berths or greater. The very large cruise vessel continues to be the industry mainstay.

FIGURE 3.4: CRUISE SHIP ORDER BOOK, AS OF Q4/2016

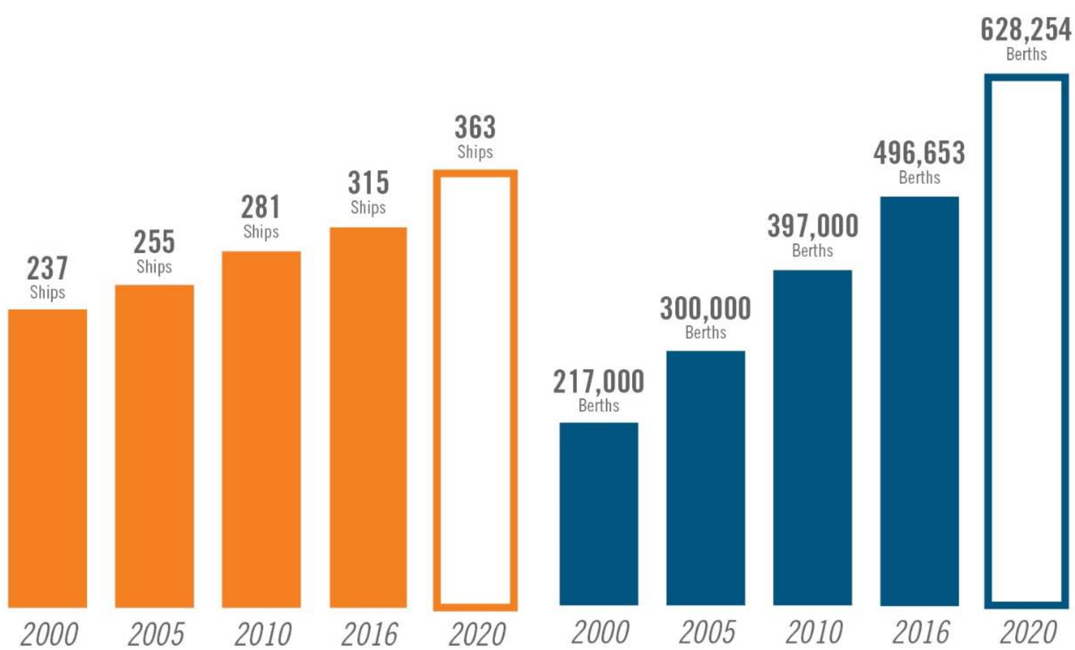
Source: SeaTrade and LandDesign, 2016

Year	Cruise Line	Ship Name	Lower Berths
2016	Dream Cruises	Genting Dream	3,364
2016	Seabourn	Seabourn Encore	604
		2 SHIPS	3,968 LOWER BERTHS
2017	TUI Cruises	Mein Schiff 6	2,534
2017	Star Clippers	Flying Clipper	300
2017	Viking Cruises	Viking Sky	930
2017	Norwegian Cruise Line	Norwegian Joy	4,200
2017	AIDA Cruises	AIDAAperta	3,250
2017	Silversea Cruises	Silver Muse	596
2017	Princess Cruises	Majestic Princess	3,560
2017	MSC Cruises	MSC Meraviglia	4,500
2017	Dream Cruises	World Dream	3,364
2017	Viking Cruises	Viking Sun	930
2017	MSC Cruises	MSC Seaside	4,140
		11 SHIPS	28,304 LOWER BERTHS
2018	Royal Caribbean Int.	Oasis 4	4,180
2018	Seabourn	Seabourn Ovation	604
2018	TUI Cruises	Mein Schiff 7	2,534
2018	Crystal Cruises	Crystal Endeavor	200
2018	Norwegian Cruise Line	Breakaway-Plus	4,200
2018	Carnival Cruise Line	Unnamed	3,954
2018	MSC Cruises	MSC Seaview	4,140
2018	Viking Cruises	Viking Spirit	930
2018	Scenic	Scenic Eclipse	228
2018	Holland America Line	Nieuw Statendam	2,650
2018	Celebrity Cruises	Edge-Class 1	2,900
		11 SHIPS	26,520 LOWER BERTHS
2019	MSC Cruises	Meraviglia 2	4,500
2019	TUI Cruises	Mein Schiff 8	2,500
2019	AIDA Cruises	Unnamed	5,000
2019	Costa Cruises	Unnamed	5,000
2019	Costa Asia	Unnamed	4,200

Year	Cruise Line	Ship Name	Lower Berths
2019	P&O Cruises Australia	Unnamed	4,200
2019	Crystal Cruises	Crystal Exclusive	1,000
2019	Royal Caribbean Int.	Quantum 4	4,180
2019	Star Cruises	Global-Class	5,000
2019	Saga Cruises	Unnamed	1,080
2019	Virgin Cruises	Unnamed	2,800
2019	Norwegian Cruise Line	Breakaway-Plus	4,200
2019	MSC Cruises	Meraviglia Plus	4,888
2019	Princess Cruises	Unnamed	3,560
		14 SHIPS	52,108 LOWER BERTHS
2020+	Celebrity Cruises	Edge-class 2	2,900
2020+	Royal Caribbean International	Quantum 5	4,180
2020+	AIDA Cruises	Unnamed	5,000
2020+	Costa Cruises	Unnamed	5,000
2020+	Virgin Cruises	Unnamed	2,800
2020+	Costa Asia	Unnamed	4,200
2020+	Crystal Cruises	Crystal Exclusive	1,000
2020+	Viking Cruises	Unnamed	930
2020+	Regent Seven Seas Cruises	Unnamed	738
2020+	Star Cruises	Global-class 2	5,000
2020+	Princess Cruises	Unnamed	3,560
2020+	MSC Cruises	Meraviglia Plus	4,888
2020+	Celebrity Cruises	Edge-Class 3	2,900
2020+	Disney Cruise Line	Unnamed	2,500
2020+	Royal Caribbean International	Oasis 5	5,497
2020+	Virgin Cruises	Unnamed	2,800
2020+	Crystal Cruises	Crystal Exclusive	1,000
2020+	MSC Cruises	World-Class	5,400
2020+	Celebrity Cruises	Edge-Class 4	2,900
2020+	Disney Cruise Line	Unnamed	2,500
2020+	MSC Cruises	World-Class	5,400
		21 SHIPS	71,093 LOWER BERTHS

FIGURE 3.5: GROWTH OF CRUISE VESSELS AND BERTHS, 2000-2020

Source: Cruise Industry News and LandDesign, 2016



VIEWPOINT: INVENTORY GROWTH WILL CREATE DEMAND FOR NEW DESTINATIONS

59 vessels represents a record number of ships on order at a single time and provides significant short term guidance that the industry predicts a strong growth period in the years ahead. The cruise industry is considered *supply lead*, whereby expansion in capacity results in a similar expansion in passenger growth. Thus, expansion to a level of 628,254 berths (refer to Figure 3.5) is expected to lead to significant growth in passengers worldwide.

Existing cruise vessels and those on order will need regions to sail and consumer markets to tap into. Supply expansion will thus place demands on existing and emerging cruise regions to provide new facilities and destination offerings. Cruise lines will focus operations around ports and destinations that can accommodate large vessels in addition to meeting other key deployment requirements.

3.2.3 Cruise Vessel Characteristics

The evolution of the cruise ship has been one of the principal mechanisms propelling industry growth. It has also required that cruise destinations—both the maritime port facilities handling homeport and port-of-call operations, as well as the destinations themselves—evolve to meet the challenges presented by these ships if they wish to continue participating in the growing cruise industry.

Cruise ships have advanced through a number of developmental phases, from the small, 500-passenger vessels of the 1970s to the rise of the Post-Panamax, 3,600-passenger ships of the late 1990s (refer to Figure 3.6). With the average length of cruise vessels delivered each year continuing to increase combined with the retirement of older, smaller vessels, over the course of this decade cruise ships with lengths of 984' will become the operational norm. The prospect of even more orders for larger cruise ships—possibly for vessels even beyond the size and capacity of RCCL's *Harmony of the Seas*—remains as the major operators continue to look to further exploit economies of scale and reduce unit costs while generating excitement around the development of the world's largest vessels. Carnival has already announced a new class of cruise vessel that will hold up to 6,600 passengers; roughly 300 more than the maximum capacity of RCCL's *Oasis*-class ships (currently the largest in the market).

FIGURE 3.6: CRUISE SHIPS THEN AND NOW: PACIFIC PRINCESS AND THE QUANTUM-OF-THE-SEAS

Pacific Princess (1975): 550' LOA | 626 Guests

Quantum-of-the-Seas (2016): 1,139' LOA | 4,180 Guests

In the past five years, the newest and most popular generation of ships continue to increase in length and draft to accommodate the height needed for large scale outside cabin development. These vessels range in length from 1,083' to 1,132' LOA and have passenger complements of between 2,500 and 4,100. Vessels of 5,000 lower berths and greater, however, remain a major force in the industry and will grow in fleet number by an additional 9 ships by 2022. These vessels place significant demands on ports and destinations to support their size and passenger/crew compliment.

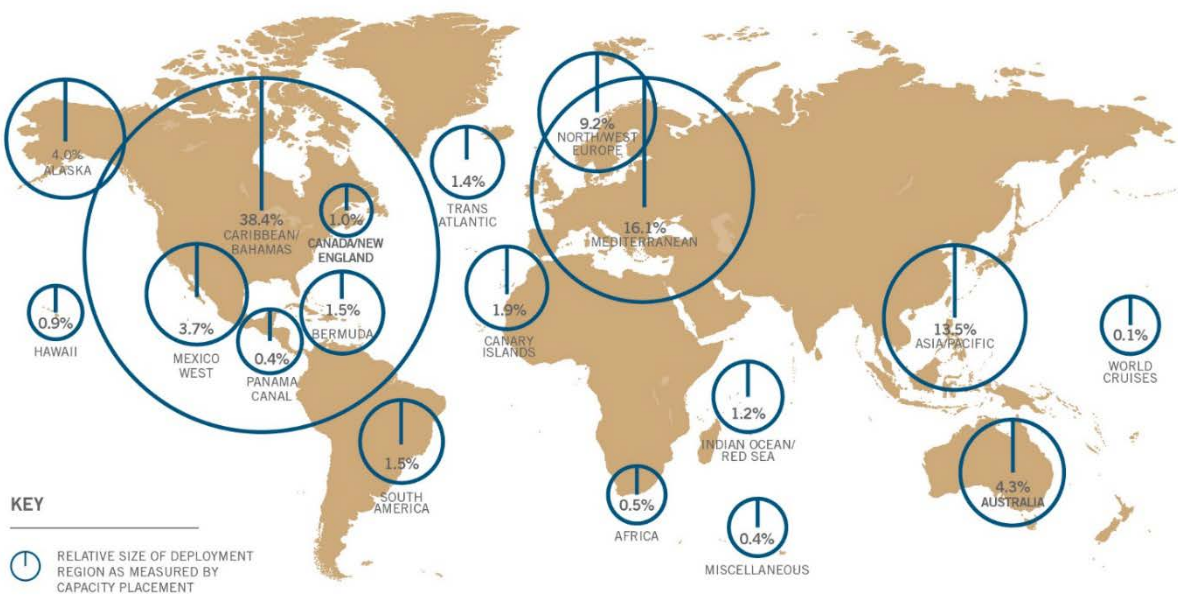
The average age of a North American cruise vessel is 10 years. Cruise lines continue to extend the life of vessels, using them for longer periods in the North American marketplace and/or shifting these vessels to new ventures and regions around the world. We expect the average age of North American cruise vessels as well as those operating around the world will continue to increase and lines will continue to find new ways to extend the useful life of vessels.

3.3 Operating Regions

Once focused primarily in the Caribbean and Mediterranean regions, cruise operations are now found around the world. Including all cruise operators, the Caribbean remains the principal location for cruise capacity placement (38.4%), followed by Asia/Pacific (17.8%), the Mediterranean (16.1%) and Northern/Western Europe (9.2%) (refer to Figure 3.7 and Table 3.1). In total, over 18 different primary cruise sub-regions are present within the global marketplace, with many of these comprising even smaller deployment characteristics and typical itineraries.

FIGURE 3.7: VESSEL DEPLOYMENT BY REGION, 2016

Source: Cruise Industry News and LandDesign, 2016



Over the period reviewed, the Asia/Pacific region has been expanding rapidly, from a 4.3% share in 2005 (which at that time also included the Australian region) to a 13.5% share in 2016. The Chinese cruise market grew by nearly 80% from 2012 to 2014 to nearly 700,000 passengers. At the current growth pace, China could quickly emerge to be the world's second-largest cruise market in the next 5 years. The Mediterranean and Northern/Western Europe regions have also seen strong growth over the last 10 years. As depicted, the stabilization of cruise capacity in the Caribbean between 2005 and 2016 suggests the region has reached maturity. It is expected that this region will continue to be the world's largest, and that it will continue to experience ongoing passenger and vessel growth along with its peers. Over time, major changes in the region—such as the opening of Cuba to cruise tourism—could lead to a renewal in Caribbean market share expansion. The Alaskan region has not experienced much significant growth; in fact, it has experienced a decrease in worldwide market share, declining gradually from a 4.6% share in 2013 to 4.0% in 2016. As other cruise regions increase their market share and deployment by region, the Alaskan region must react and plan accordingly to remain globally competitive.

TABLE 3.1: PRIMARY CRUISE REGIONS, 2005-2016

Source: Cruise Industry News and LandDesign, 2016; capacity measured as a percentage of lower berth placement

	2005	2010	2016	Change 2010-2016
Caribbean/Bahamas	48.0%	40.7%	38.4%	-2.3%
Mediterranean	15.3%	20.0%	16.1%	-3.9%
West Coast (Mexico)	7.7%	5.2%	3.7%	-1.5%
Asia/Pacific	4.3%	7.1%	13.5%	+6.4%
Australia	* included with Asia/Pacific	* included with Asia/Pacific	4.3%	unknown
Alaska	6.8%	4.50%	4.0%	-0.5%
Northern/Western Europe	5.0%	7.3%	9.2%	+1.9%
South America	1.9%	4.6%	1.5%	-3.1%
Transatlantic	1.5%	1.6%	1.4%	-0.2%
Canary Islands	1.5%	2.1%	1.9%	-0.2%
Bermuda	1.6%	1.6%	1.5%	-0.1%
New England/Canada	1.3%	1.6%	1.0%	-0.6%
Hawaii	2.6%	1.0%	0.9%	-0.1%
Panama Canal	1.2%	0.9%	0.4%	+0.5%
Indian Ocean/Red Sea	0.2%	1.1%	1.2%	+0.1%
Domestic Waterways	0.8%	0.1%	0.3%	+0.2%
Antarctica	0.1%	0.2%	0.1%	-0.1%
World	0.1%	0.1%	0.1%	0.0%
Africa	0.1%	0.3%	0.5%	+0.2%
TOTALS	100.0%	100.0%	100.0%	n/a

VIEWPOINT: A GLOBAL CRUISE INDUSTRY

The industry continues its expansion as a global industry, no longer constrained to the Caribbean cruising region and accommodating only North American passengers. Cruising is a global phenomenon. While the Caribbean will remain the deployment leader, Asia and Australia (which, combined held 17.8% of global market share in 2016) has already surpassed the Mediterranean as the second largest cruising region over the past few years.

3.4 Global Industry Outlook

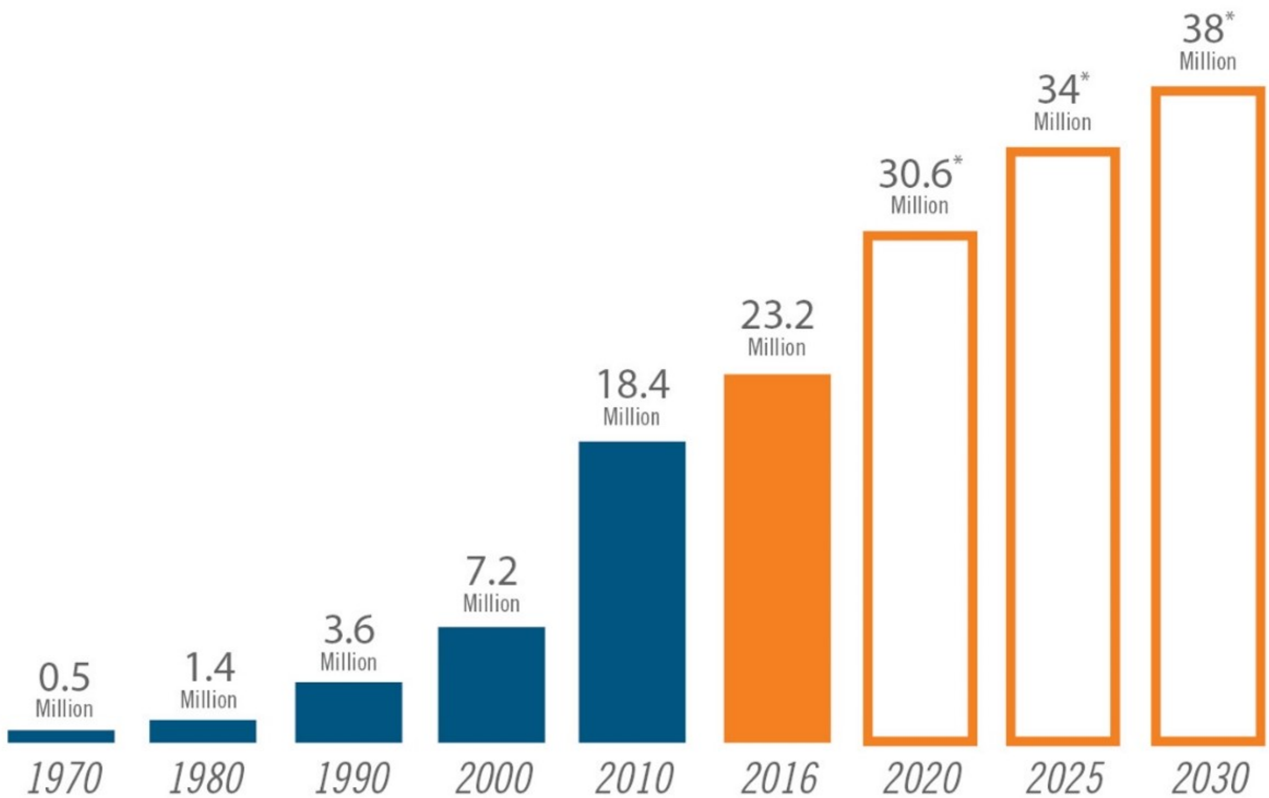
In considering both the near-, mid- and long-term planning horizons, most cruise lines and experts feel the industry's best days are still ahead. The broader cruise industry fundamentals responsible for its dramatic rise over the past two decades are expected to remain in place and continue to propel the industry forward in both passenger and financial expansion. As presented, lines will continue to take delivery of a significant amount of new capacity over the next seven years: over 181,000 new cruise ship berths are scheduled for delivery. Cruise industry orders are up significantly, setting the stage for an average annual growth rate of 8% in supply.

Measurement of consumer demand and sentiment for the cruise industry also remains very positive. The most recent *Cruise Market Profile Study* by Cruise Lines International Association (CLIA) indicates 69% of cruisers believe a cruise vacation to be a better value over land-based vacations, and ranked cruise vacations the highest as the *Best Overall Vacation*. 86% of the industry's target consumer segment is interested in taking a cruise in the next 3 years and of those, 62% of North American cruisers were repeat customers (3.8 trips on average). Cruise lines are also able to reach farther into global consumer markets, bolstering their overall upside potential for growth and reducing somewhat their exposure to downturns in the North American market. Cruise lines and their products are as diverse as ever, with many of the largest ships offering cabin categories at 30 to 40 different price points for the same cruise while also providing more onboard spending opportunities with bigger stores, spas and other revenue outlets.

In light of many positive components anticipated to propel the industry forward over the next 15 years, we forecast cruise passenger growth with expand from 23.2 Million passengers worldwide to an estimated 38 Million by 2030 (refer to Figure 3.8). This is a midrange projection scenario, with ultimate potential outcomes ranging between 36 and 42 Million by 2030.

FIGURE 3.8: HISTORIC AND PROJECTED CRUISE PASSENGER LEVELS, 1970-2030

*Source: Cruise Industry News and LandDesign, 2016; Figures for 1970-2010 are North American Passengers; *Projections by LandDesign, 2016*



VIEWPOINT: FACTORS CONTRIBUTING TO INDUSTRY GROWTH REMAIN IN PLACE

Each of the primary elements propelling growth forward over the past three decades remains in place. With 59 new ships scheduled for delivery by 2022 and continued positive industry fundamentals, the number of worldwide cruise passengers could reach 38 Million by 2030. The long term forecast range is between 36 and 42 Million passengers by 2030.

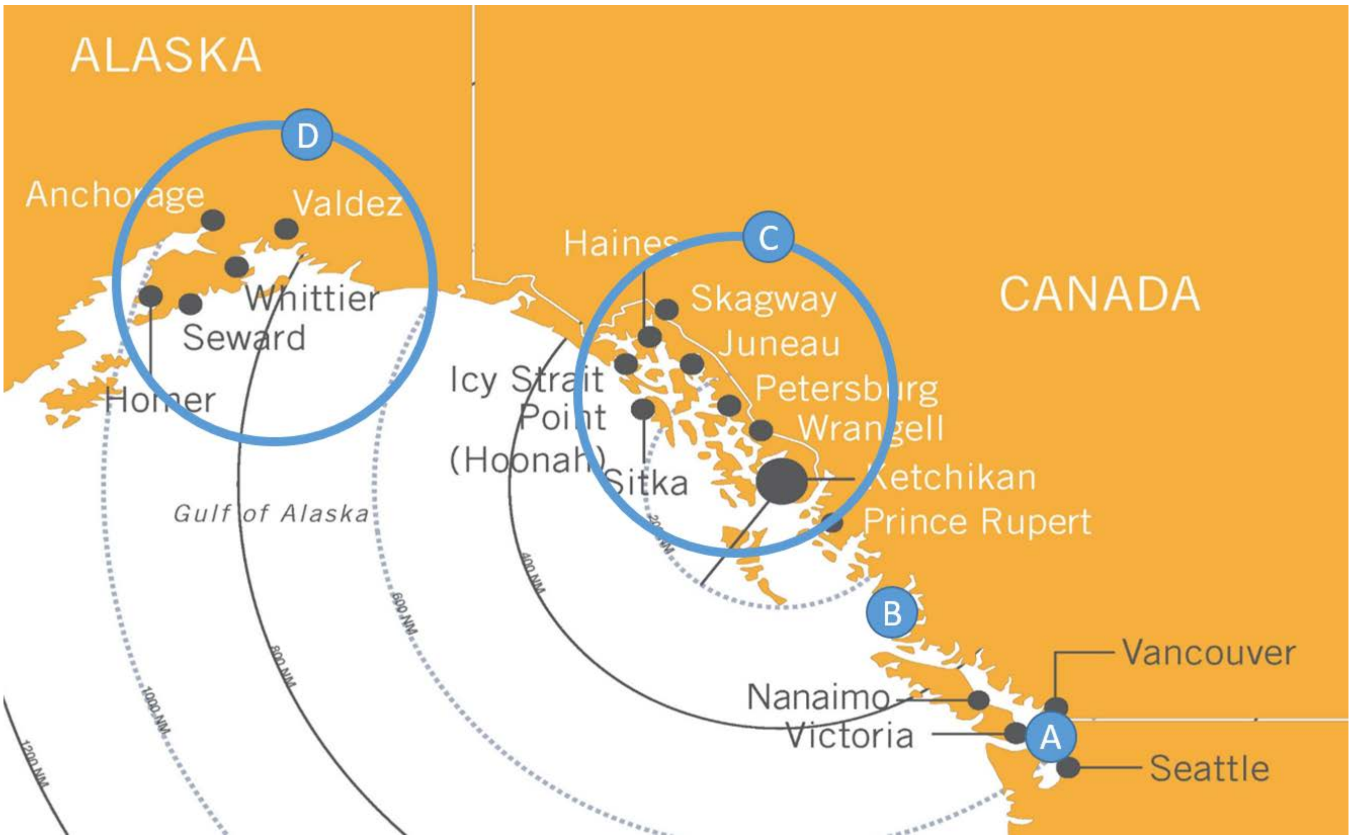
3.5 Overview of the Alaskan Cruise Region

3.5.1 The Alaskan Cruise Region Defined

The primary Alaskan cruise region is defined by deployment primarily originating from the homeports of Seattle and Vancouver and extending up through Canada's Inside Passage into Southeast Alaska and beyond to further north ports of Seward, Whittier and others (refer to Figure 3.9).

FIGURE 3.9: THE ALASKAN CRUISE REGION

Source: Cruise Industry Sources and LandDesign, 2016



A. **Homeports.** Core homeports of Seattle and Vancouver provide primary base of operations for the region. A combined six homeport berths with respective terminal facilities are available.

B. **Canada's Inside Passage.** A growing collection of ports-of-call that add to overall number of destinations and venues in the region. The ports Prince Rupert, Nanaimo (new in 2016), Victoria and Vancouver help meet far foreign port requirements for cruises embarking from the U.S. ports of Seattle, Seward and others.

C. **Core Southeast Alaska Region.** Mainstay ports-of-call (Skagway, Juneau, Ketchikan) and other supporting destinations (Sitka, Hoonah, Tracy Arm, Hubbard Glacier) comprise the primary offer for 7-day (+/-) cruises from Seattle and Vancouver. These mainstay ports welcome over 75% of all capacity in the region. New cruise facilities at Hoonah and expanded facilities in Juneau were key infrastructure expansion highlights of for 2015-16.

D. **Northern Alaska.** Destinations visited as part of longer, 14-day itineraries and/or open-jaw deployments from the region. Ports include Seward, Whittier, Homer, Anchorage and Kodiak. Anchorage and Seward also support land sightseeing options via rail by Princess Cruises and others. For example, Princess Cruises offers Princess Rail and coach service linking wilderness lodges in Denali, Talkeetna, Copper River and the Kenai Peninsula.

Cruises within the region are generally offered on deep-water cruise vessels, with some smaller niche expedition and soft adventure operations also present in the region. The former generally drive berth and facilities demand in Ketchikan and other Alaskan ports-of-call.

Operations within the Alaskan region are characterized as seasonal, typically occurring from May through September, with the high season typically running from June through August.

3.5.2 Alaska Deployment

Deployment within the Alaskan region has regained its positive footing since 2010, with capacity (as measured by vessel lower berths) expanding by 13.9% from 818,428 to over 932,324 in 2016.[9] This equates to over One Million cruise passengers in Alaska in 2016 as cruise ships tend to operate at between 105% and 115% of lower berth capacity. For 2015, 56% of Alaska's 1.78 Million visitors were cruise ship passengers.

Princess Cruises, followed by Holland America, were the regional deployment leaders in 2016, contributing 29.1% and 23.1% of total cruise capacity, respectively. The combined offering of RCCL and Celebrity contributed an estimated combined total of 21.9% of capacity for the same year.

The size of vessels in the region increased between 2010 and 2016 (refer to Figure 3.10). Comparison of vessels in the region over this period shows growth of gross register tonnage (GRT) (12.6%), LOA (4.6%) and passenger capacity (16.4%). Extrapolating these trends outward to 2030 suggests the average vessel in the region may be 129,000 GRT, 1,050 LOA and carry 3,500 passengers provided these vessels can be accommodated at the regional homeports of Seattle and Vancouver as well as upstream ports-of-call. This will discussed further in Section 3.6.

Recent cruise industry reports support projections for near-term growth in the Alaskan cruise market. *Bradner's Alaska Economic Report* (Issue 21/2016, December 20, 2016) reports:

> *Cruise ship visitors will increase again next year according to industry forecasts. Princess Cruises will increase its Alaska capacity by 15% by 2018. Its sister company, Holland America will increase capacity 3.5% in 2017. Royal Caribbean will increase its passengers mainly by filling its super-large Explorer of the Seas, which made its first trips to Alaska in 2016. Norwegian Cruise Line said it will send the new Norwegian Bliss, with capacity for 4,000 passengers, to Alaska in 2018.*

[9] In 2010, cruise companies cut capacity by about 14% in reaction to institution of $50/passenger head tax by the State of Alaska. A lawsuit filed by CLIA Alaska resulted in a reduction of the tax in 2011, and since that time, capacity and passenger levels in the region have rebounded to the regional highs experienced in 2007-09.

TABLE 3.2: SEASONAL CAPACITY IN ALASKA, 2016

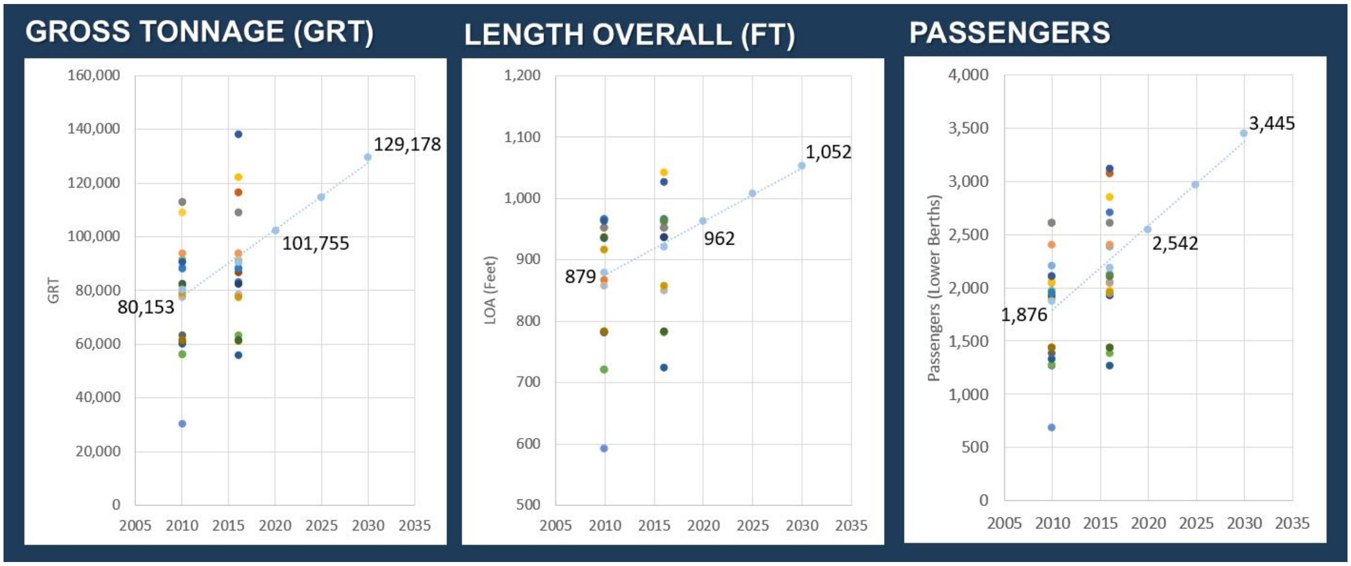
Source: Cruise Industry News and LandDesign, 2016

	Ships	Capacity	Market Share %
Princess	6	271,200	29.1%
Holland America	7	215,334	23.1%
Norwegian	3	138,400	14.8%
Celebrity	3	115,650	12.4%
RCCL	2	88,400	9.5%
Carnival	1	35,700	3.8%
Disney	1	22,750	2.4%
Regent	1	10,800	1.2%
Oceania	1	8,208	0.9%
Crystal	1	7,560	0.8%
Silversea	2	7,248	0.8%
Uncruise	6	6,294	0.7%
Lindblad	2	2,232	0.2%
Ponant	1	1,848	0.2%
ACL	1	700	0.1%
2016 TOTALS	38	932,324	100%
2010 TOTALS (% Change)	35 (+8.6%)	818,428 (+13.9%)	

All other major conglomerates are represented in the Alaskan region except MSC. With the expectation that this brand will emerge as the third largest cruise line worldwide over the next decade, their entry into the Alaska market seems inevitable.

FIGURE 3.10: GROWTH OF VESSELS IN THE ALASKAN REGION

Source: CIN, CLIA, CLAA, Cruise Lines Meetings and LandDesign, 2016



VIEWPOINT: CAPACITY RECOVERS WHILE CRUISE SHIP COUNTS STABILIZE

Similar to other destinations, the region is seeing capacity levels increase while the overall number of vessels in the region remains the same. This results from a limited number of homeports and ports-of-call in the region coupled with a growing number of larger cruise vessels operating in Alaskan waters. By example, cruise ship capacity in 2003 was recorded at 797,516 on 40 ships; by 2016, it's estimated that capacity will be 16% greater in the region while actual vessels operating will decline to 38. Conversations with cruise lines and Cruise Line Agencies of Alaska (CLAA) suggest that growth over the next decade will occur primarily as a result of homeports and primary regional ports-of-call being modified to welcome larger vessels, without significantly expanding the number of vessels operating within Alaska.

3.6 Cruise Vessels and Outlook in the Alaskan Region

The Alaskan cruise region can be described as a balanced system: its growth is not reliant on any single element, but rather, a combination of factors that overall and together allow this submarket to flex to welcome increasing passenger and vessel throughput. This somewhat unique feature of the Alaskan cruise region was confirmed though a series of discussions with cruise lines, CLAA and officials at the primary regional homeports of Seattle and Vancouver. In looking towards possible growth in the region, these cruise line stakeholders were questioned as to what pieces of this balanced system would need to adjust, and which could be practically adjusted.

One fundamental aspect of the market was addressed quickly by industry stakeholders, namely: *Is there passenger appetite for more cruises to Alaska?* Stakeholders agreed that consumer interest in the region was reaching all-time highs. Alaska remains a highly aspirational destination for North American and international visitors, and cruising remains one of the primary ways for these visitors to access the region. Cruise line revenues associated with Alaskan deployments were cited to be strengthening, especially with deployment challenged in competing seasonal markets of the Mediterranean and Northern Europe due to heightened security concerns in 2016.

Discussions with cruise line stakeholders also led to another near-unanimous conclusion: that Alaska would and could only grow through increasing the size of vessels deployed in the region, and not through a wholesale increase in homeports and ports-of-call along the Inside Passage. As previously noted, most cruise lines have grown their fleets by adding more and larger cruise vessels. In the past five years, the newest and most popular generation of ships range in length from 1,083' to 1,132' with passenger complements between 2,500 and 4,100. Smaller cruise vessels are increasingly being deployed for niche operations on more far-flung global deployments. The widening of the Panama Canal, once a major limiting factor in the seasonal movement of vessels to/from the Caribbean to Alaska, was completed in 2016. This widening allows near free movement of almost all of the industry's largest vessels to/from the Atlantic to the Pacific.[10]

Alaska and its homeports and ports-of-call, however, are not as flexible. As reported by cruise stakeholders and observed by the M&N Team, there exist limited opportunities for wholesale infrastructure expansion throughout the region. Seattle[11] and Vancouver will remain the primary homeports supporting the Alaskan cruise market, with Saturday and Sunday slots remaining fully in-demand throughout the cruising season. Any growth in the region will rely on: (a) an expanded number of large (1,100' +/-) cruise berths and related terminals able to support deployment; and (b) increased utilization of Seattle and Vancouver homeport berths on non-weekend days. Of these, the latter is more practicable given airlift and hotel room availability as well as consumer preference to vacation and travel weekend-to-weekend.

Current and anticipated future homeport expansion is expected to support larger cruise vessels, and as such will help facilitate growth of the Alaskan cruise market. Seattle currently offers facilities capable of welcoming very large vessels and is in the initial planning stages of considering an additional berth and possibly a fourth cruise terminal[12]. Bell Street at Pier 66 has a current berthing length of 1,600', with terminal modification and expansion underway. NCL has signed a long-term agreement to operate from Bell Street and modifications will allow homeport for *Breakaway-*, and likely, *Breakaway-plus*-class vessels. Smith Cove at Pier 91 has two berths, both 1,200' long with upland facilities to support large vessels. These facilities are able to welcome larger RCCL vessels, including the *Quantum*-class. Vancouver also has larger vessel capabilities but has air draft limitations at the Lion's Gate Bridge and at Seymour Narrows for very large cruise vessels. Vancouver's Canada Place offers a 1,663' (East) and 1,060' (West) berth for larger vessels.

The geography of Alaska's coastline and the limited waterfront area in the three key ports-of-call (i.e., Ketchikan, Juneau and Skagway) presents a greater challenger to long range growth. In discussions with cruise industry stakeholders, there are few opportunities to develop additional new ports in the region. The additional of a fifth and possibly sixth large berth at key ports is not justified, given the required waterfront area and development cost, and the understanding that a single port adding an additional berth offers limited appeal if other key ports-of-call do not follow suit. Cruise lines and CLAA are confident that if key Southeast Alaska ports-of-call will focus on retrofitting current wharves to accommodate vessels of over 1,100', that over time this will prove a sustainable approach to growing the Alaskan market. Juneau is in process of constructing its second of two adjacent 1,000' and 1,100' berths through an infrastructure upgrade program, and potential exists for one or two existing facilities to be expanded to 1,150'. Skagway is beginning to study long term expansion: a project underway by the M&N Team. They will need to reach agreement with local waterfront landowners, facility operators and lessees, as well as build local consensus as to the best way to move forward for the future of their waterfront. The most suitable approaches to expanding Ketchikan's cruise facilities are the subject of this report.

With all of these factors in mind, and barring any significant changes in Alaska's cruise passenger head tax policy, we anticipate the region will have very positive prospects for cruise capacity and passenger growth

[10] Air draft (i.e., the required vessel clearance above water level) under Panama's Bridge of the Americas (201') limits RCCL's *Oasis*-class and other very large cruise ships from transiting the canal. Specific lifeboat configurations on some ships also present challenges. The traditional terminology *Panamax* and *Post-Panamax* to describe cruise vessels has largely disappeared. Panamax vessels have been, and will remain, the primary vessels operating in Alaskan waters.

[11] Vessels deploying from Seattle are reliant on touching a far foreign-port.

[12] Recent discussions between M&N and Port of Seattle cruise facility representatives indicated the Port's desire to mobilize the capacity of existing cruise facilities on non-weekend days prior to any serious consideration of developing a fourth cruise terminal: perhaps by increasing Seattle's attraction as a regional port-of-call.

over the next 15 years. Larger cruise vessels can be more easily be deployed to the region via the expanded Panama Canal. The homeports of Seattle and Vancouver are able to support larger vessels in their current configurations, with plans being discussed to provide additional homeport capacity in the future. Ports-of-call in Alaska are advancing key improvements to welcome larger cruise vessels. While this will take time, a willingness by cruise lines and host communities like Ketchikan seems to be increasingly aligned toward the strong economic prospects associated with industry growth.

As a result, we forecast that Alaskan cruise capacity could reach 1.5 Million berths by 2030. The long term forecast range is between 1.3 (low) and 1.8 (high) Million lower berths in 2030 (refer to Figure 3.11 and Table 3.3). Assuming passenger levels run at an average of 110% of capacity, Alaska could foreseeably welcome 1.65 Million cruise passengers by 2030.

FIGURE 3.11: HISTORIC AND PROJECTED CRUISE CAPACITY LEVELS FOR THE ALASKAN REGION

*Source: Cruise Industry News and LandDesign, 2016; *Projections prepared by LandDesign, 2016*

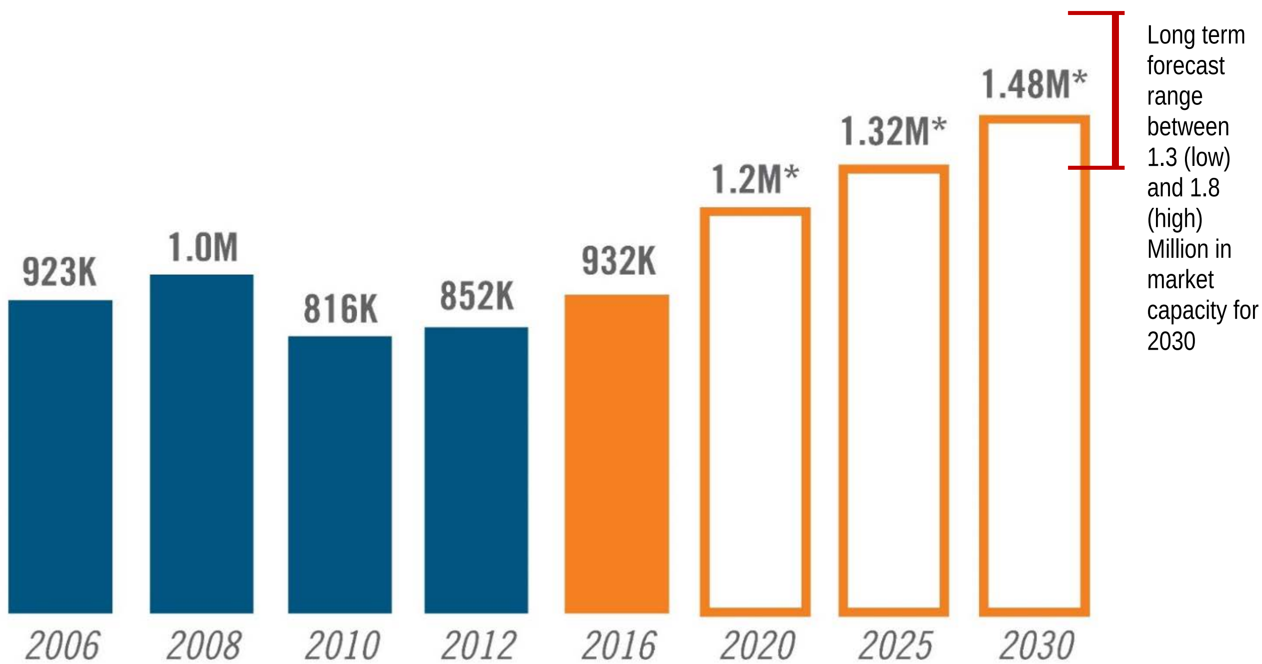


TABLE 3.3: PROJECTED CRUISE CAPACITY FOR THE ALASKAN REGION

Source: LandDesign, 2016

	Low Forecast (Lower Berths)	Medium Forecast (Lower Berths)	High Forecast (Lower Berths)
2015/16		932,000	
2020/21	1,000,000	1,200,000	1,500,000
2030/31	1,300,000	1,500,000	1,800,000

VIEWPOINT: THE BALANCED SYSTEM CAN FLEX TO WELCOME LONG TERM GROWTH

The Alaskan cruise region is a balanced system, reliant on: (a) ships available to be deployed to the region; (b) the homeports of Seattle and Vancouver supporting operations through the summer cruise season; and (c) primary upstream Southeast Alaska and Canadian Inside Passage ports-of-call to welcome them. Of these, the greatest limiting factor to long-term growth is the expansion of port-of-call offerings. Cruise stakeholders—cruise lines, CLAA and the ports themselves—suggest this limiting factor can be overcome, with the expansion of four large berths plus one or two tender locations as being the most tenable approach to providing larger facilities at the key Southeast Alaska ports of Ketchikan, Juneau and Skagway.

With the likelihood of this balanced system to flex to welcome market growth, we estimate capacity to the Alaskan region could reach 1.5 Million berths by 2030. The long-term forecast range is between 1.3 (low) and 1.8 (high) Million lower berths in 2030. Assuming passenger levels run at an average of 110% of capacity, Alaska could welcome 1.65 Million cruise passengers by 2030.

4.0 PLANNING AND DESIGN PARAMETERS

4.1 Overview

Cruise lines and their respective decision-making groups—marketing and sales, marine operations, logistics, and finance—expend significant effort evaluating a destination, and congruently, an itinerary to ensure it meets the various criteria established to differentiate their product offering and sell desirable and profitable cruise products. A general list of cruise line decision-making groups and their primary focus in the destination selection process is provided in Table 4.1. The primary questions informing the planning and design of any cruise facility are:

- What types of cruise vessels will operate from the facility?
- What kinds of operational activities will be supported?

For Ketchikan, the first question has significant influence on the range and timing of investments needed to meet market opportunities and community desire; the second, less so. The following section addresses both key questions and sets the stage for the framework needed to support cruise berthing options under a long-range development plan.

4.2 Cruise Ship Design Templates

As presented in Section 3.5.2 and Figure 3.10, the average size of oceangoing cruise vessels operating within the Alaskan region has increased steadily over the past decade. The components are increasingly in place to continue this trend and overall growth of the regional market, namely: (a) the ability to move vessels into the region; (b) large cruise vessel berths and terminal facilities at key homeports; and (c) expansion of facilities available to welcome vessels calling to regional ports-of-call. Cruise line stakeholders support the approach of retrofitting existing berths to accommodate larger vessels in key Alaskan ports-of-call versus building new facilities.

Under this approach, the question then turns to: What types of cruise vessels should Ketchikan (and other key Alaskan destinations) plan for over the next 15 years? Through our research and in discussions with cruise line stakeholders, five primary typologies of cruise vessel sizes, designated as Design Vessel Types A through E[13], were identified that provide insights into, and guide the planning options of Ketchikan's port facilities (refer to Figure 4.1 and Table 4.2).

[13] Design Vessel Types A through E are generic references to vessels within specified ranges of LOA and are not industry standard designations.

TABLE 4.1: DESTINATION SELECTION – WHAT'S IMPORTANT TO CRUISE LINES

Source: LandDesign and Various Cruise Lines, 2016

CRUISE LINE GROUP / DEPARTMENT	EVALUATION CRITERIA
Marketing and Sales	▪ Consumer awareness and marketability of a cruise destination: *Is this where our guests are asking us to take them?* ▪ Access to consumers ▪ Fit with cruise brand philosophy ▪ Fit with consumer vacation patterns
Marine Operations, Shoreside (Terminal) Operations and Security	▪ Marine navigation and access ▪ Berth, apron and terminal features ▪ Ground transportation area and parking ▪ Provisioning and security ▪ History of operations from the port/destination
Logistics, Air-Sea and Shore Excursions	▪ Landside access ▪ Airlift ▪ Lodging ▪ Shore excursion availability, participation rates and destination venues/sights
Deployment, Finance and Legal	▪ Vessel speed and distance considerations ▪ Itinerary strength ▪ Port charges ▪ Cost of operations (labor, etc.) ▪ Fuel availability and cost ▪ Regulatory issues ▪ Maritime laws

FIGURE 4.1: DESIGN VESSEL TYPOLOGIES FOR THE ALASKAN REGION

Source: Cruise Industry Stakeholders, Moffatt & Nichol and LandDesign, 2016

TABLE 4.2: DESIGN VESSEL TYPOLOGIES FOR THE ALASKAN REGION

Source: Cruise Industry Stakeholders, Moffatt & Nichol and LandDesign, 2016

	DESIGN VESSEL TYPE A	DESIGN VESSEL TYPE B	DESIGN VESSEL TYPE C	DESIGN VESSEL TYPE D	DESIGN VESSEL TYPE E
Cruise Line / Class	Princess *Grand*-class	Disney *Magic*-class	Celebrity *Solstice*-class	NCL *Breakaway*-class	RCCL *Quantum*-class
Tonnage	109,000 - 116,000 GT	83,338 GT	122,000 GT	146,600 GT	168,666 GT
LOA	951'	964'	1,040'	1,069'	1,142'
Beam	118'	106'	120.7'	130.2'	162' max 136' water line
Height	201'	171.5'	206.5'	179'	208'
Draft	26'	25.3'	27.9'	29'	29'
PAX Capacity	2,600 - 3,114	2,700	2,850	3,963	4,180
Crew	1,200	945	1,500	1,657	1,500

These vessels typologies are described as follows:

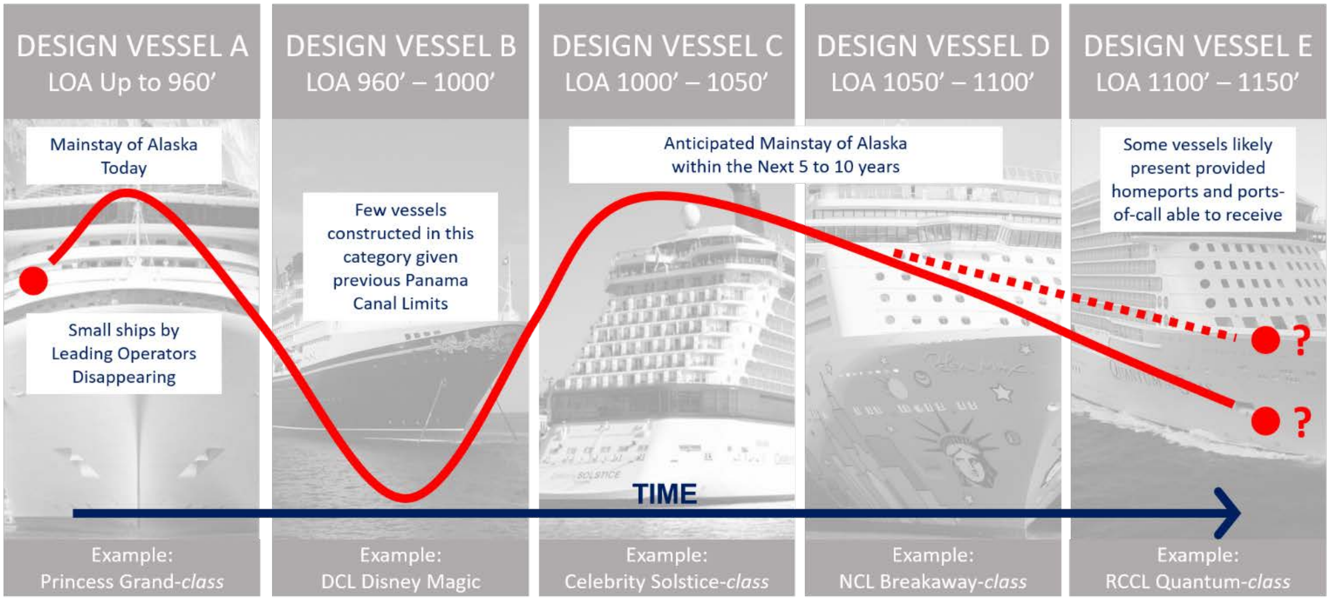
- **Design Vessel Type A.** Vessels from up to 960' LOA and primarily ships designed to transit the Panama Canal (a.k.a. *Panamax* ships). These vessels, such as Princess' *Grand*-class and Holland America's *Vista*-class, are the most prevalent in the Alaskan marketplace.
- **Design Vessel Type B.** While few vessels were constructed in this range, vessels between 960' and 1,000' LOA constitute Design Vessel Type B. Disney Cruise Lines' *Disney Magic* is an example of vessels in this range.
- **Design Vessel Type C.** Celebrity's *Solstice*-class is indicative of vessels within the group measuring between 1,000' and 1,050' LOA.
- **Design Vessel Type D.** Vessels from 1,050' to 1,100' LOA, such as NCL's *Breakaway*-class and Princess' *Royal*-class comprise Design Vessel Type D. This group, along with Design Vessel C are expected to be the most prevalent in the Alaskan Region within the next 10 to 15 years.
- **Design Vessel Type E.** Vessels from 1,100' to 1,150' LOA comprise this classification and should be considered the upper limit for vessels operating in the foreseeable future within the Alaskan cruise region. RCCL's *Quantum*-class is indicative of a very recent arrival in this category and it is expected that other lines will continue to push the development of vessels within this range.

Vessels beyond 1,150' LOA, such as RCCL's *Oasis of the Seas*, were not considered by cruise industry stakeholders as being suitable for the Alaskan cruise region.

Of the five vessel typologies considered, cruise line stakeholders and other industry analysts consider Design Vessel Types C and D as the most likely candidates for future operations in the Alaskan region (refer to Figure 4.2). Vessels in these size ranges, along with their respective passenger complements, form the foundational target for berth design moving forward in Alaska, and should be planned for at existing facilities within key Alaskan ports-of-call to the extent possible. Industry stakeholders indicated that destinations should also work toward a minimum of one berth capable of accommodating a Design Vessel Type E, with the potential to modify a second berth over the long term for an additional Type E vessel.

FIGURE 4.2: ANTICIPATED DESIGN VESSEL TYPOLOGY PRESENCE IN THE ALASKAN REGION

Source: Cruise Industry Stakeholders, Moffatt & Nichol and LandDesign, 2016



4.3 Wharf Space Design

As described previously, Ketchikan serves as a key port-of-call—alongside Juneau and Skagway—in the Alaskan cruise region. This principal cruise activity type is not expected to change for Ketchikan, as the key features needed for offering homeport operations (i.e., airlift, hotel rooms, access to consumer markets, terminal facilities, and others) are not available in suitable quantities. Ketchikan may be able to support a modicum of smaller vessels originating from the area on expedition and soft adventure cruises, but these types of deployment require little in the way of infrastructure and can likely be welcomed at any of several of the City's side-tie floats.

The main elements needed to support port-of-call activities are:

- In-water facilities needed to support navigation and maneuvering to the vessel berth.
- Cruise berths and operational aprons suitable to accommodate design vessels described in Section 4.2. Berth and apron length and width should be geared to meeting the various needs of primary passenger access (PAX) doors, as opposed to luggage and provisioning shell doors.
- Shoreside and/or ship's passenger gangways linking guests from PAX doors to the vessel dock. In the case of Ketchikan and other Alaskan destinations, gangways need to adjust to large variations in tidal range and multiple gangways to fixed berthing facilities are not manageable due to their need for frequent repositioning and adjustment throughout the tide cycle.
- A positive and welcoming arrival experience, including weather protection, signage, visitor information, tour participant collection, restrooms and other elements.
- Security facilities that satisfy *International Ship and Port Facility Security (ISPS)* Code requirements, including separating unauthorized individuals and vehicles from moored vessels.

- Ground transportation zones (on land and in-water) scaled to meet the breadth of shore excursion offerings and provide other mobility options (e.g., taxi, shuttle, and bicycle rental) for guests to explore the destination.
- Logical (i.e., following desire lines) and safe pedestrian connections linking guests to adjacent shopping and destination activities.
- Corridors to allow authorized provisioning and emergency services to access the ship and berthing area.

For Ketchikan, each of these elements are prevalent to varying degrees and quality at Berths 1 through 4. Expansion of the berthing facilities to accommodate the larger cruise vessels described in Section 4.2 will require investment in these elements to ensure a positive guest experience, and to mitigate any consequences associated with larger ships releasing greater numbers of guests to their onshore destinations.

As noted previously, a study of upland support and landside improvements to each of these elements in Ketchikan is beyond the scope of this planning study, but is strongly recommended as a future undertaking, once a programmatic approach to berth extension and/or reconfiguration is adopted.

4.4 Navigation, Mooring and Berthing Considerations

4.4.1 Navigation and Maneuvering Considerations

In evaluating potential facility improvements, the M&N Team considered the maneuverability of existing and future cruise ships to and from the berths, as well as the mooring and berthing characteristics and challenges inherent to each berth. Cruise ship vessels approach Ketchikan along Tongass Narrows from the north and south depending on wind conditions and the direction of travel of the cruise itinerary. Existing vessel movements were analyzed based on historic vessel traffic data available from *Automatic Identification System (AIS)* record archives. For the Port of Ketchikan, the U.S. Coast Guard (USCG) dataset provided good coverage and was therefore used for this analysis.

Each data record includes the location of the AIS transmitter in relation to the vessel's bow, stern and extreme port/starboard limits. The records also include the vessel heading, among many other details, providing sufficient information to plot a generic vessel profile for each berth and its approach and departure (refer to Table 4.3). Figures 4.3 to 4.10 illustrate the typical general arrival and departure path at Berths 1, 2, 3 and 4, respectively for the southbound and northbound approaches based on the 2014 dataset (i.e., the most recent complete year available) for cruise ships 900' and longer. Figures 4.11 to 4.13 illustrate atypical arrival and departure paths when vessels require turning in the Tongass Narrows channel offshore of the cruise berths. USCG data was filtered to provide one data point per minute for each vessel: thus, the profiles in each figure represents vessel positioning at one-minute intervals throughout their arrival and departure.

The findings from the AIS analysis, in addition to anecdotal observation made during visits to Ketchikan, were discussed and validated with the cruise companies, captains, pilots and CLAA. Additionally, the existing channel and berthing areas were reviewed in consideration of national and international navigation guidelines such the PIANC (2014) *Harbor Approach Channels Design Guidelines* and the U.S. Army Corps of Engineers (2006) *Hydraulic Design of Deep-Draft Navigation Projects*.

FIGURE 4.3: VESSEL MANEUVER TO BERTH 1 (SOUTHBOUND ARRIVAL)

Source: Moffatt & Nichol, 2016

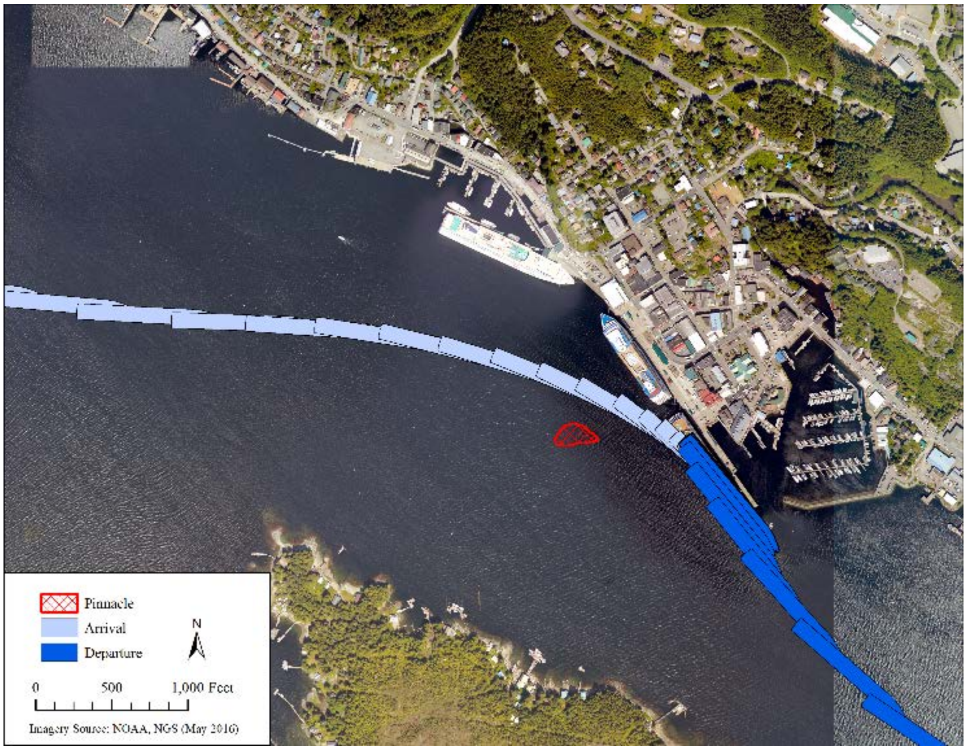


FIGURE 4.4: VESSEL MANEUVER TO BERTH 2 (NORTHBOUND ARRIVAL)

Source: Moffatt & Nichol, 2016

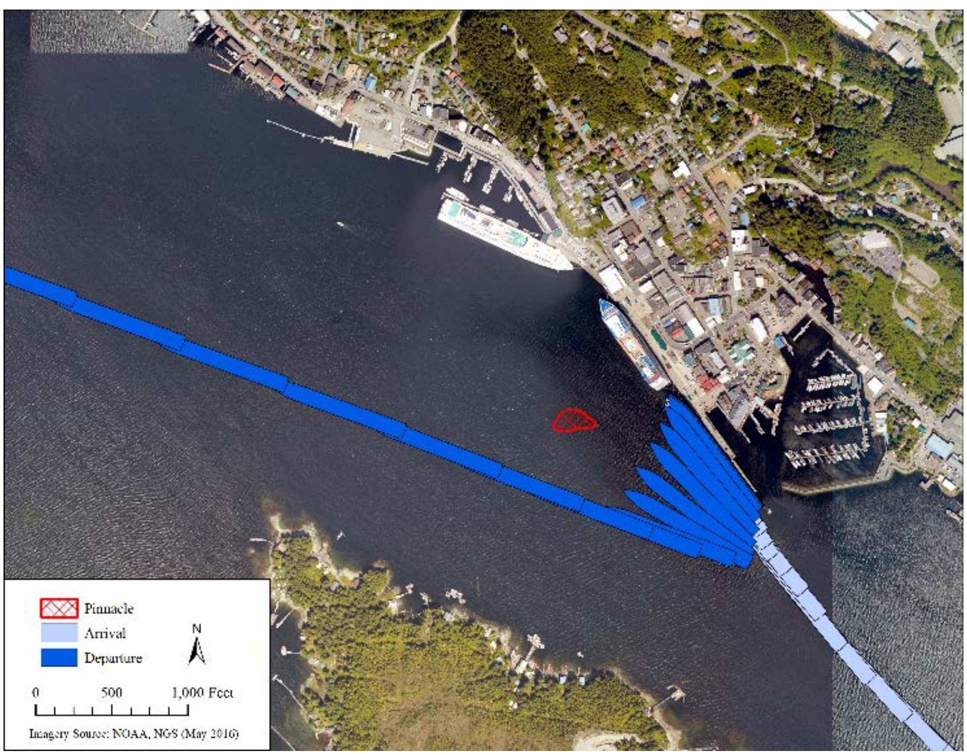


FIGURE 4.5: VESSEL MANEUVER TO BERTH 2 (SOUTHBOUND ARRIVAL)

Source: Moffatt & Nichol, 2016

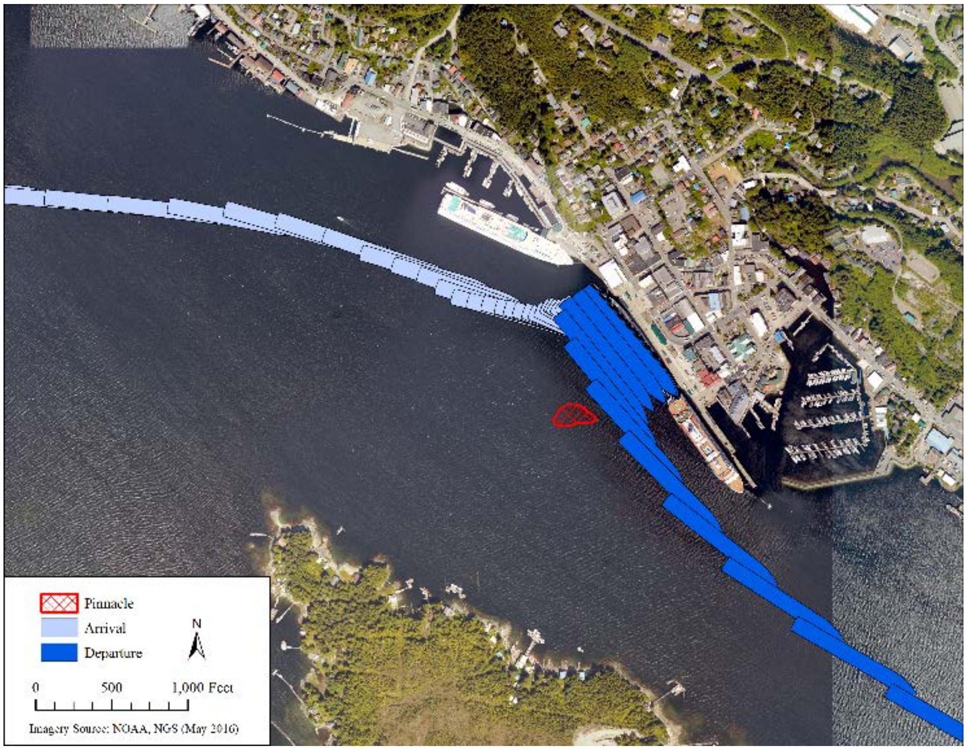


FIGURE 4.6: VESSEL MANEUVER TO BERTH 2 (NORTHBOUND ARRIVAL)

Source: Moffatt & Nichol, 2016

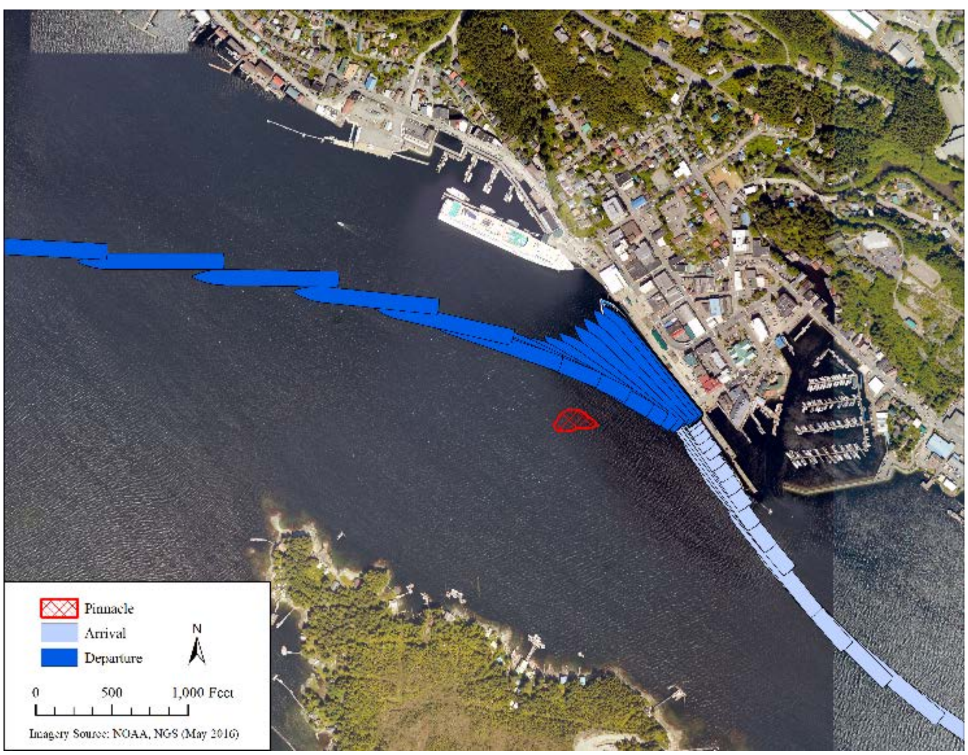


FIGURE 4.7: VESSEL MANEUVER TO BERTH 3 (SOUTHBOUND ARRIVAL)

Source: Moffatt & Nichol, 2016

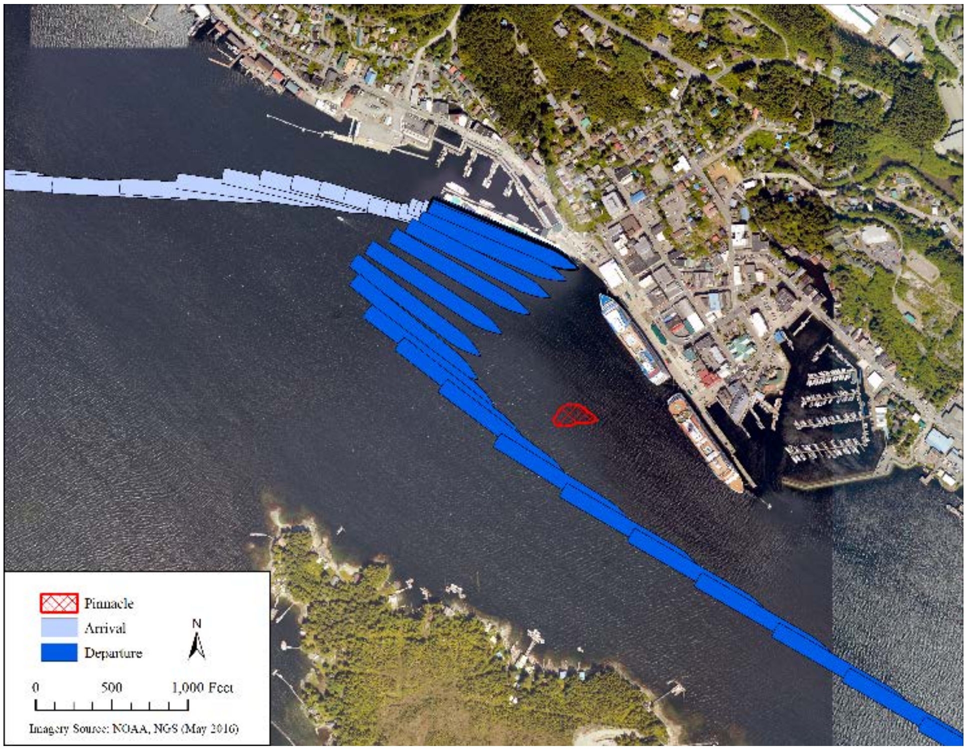


FIGURE 4.8: VESSEL MANEUVER TO BERTH 3 (NORTHBOUND ARRIVAL

Source: Moffatt & Nichol, 2016

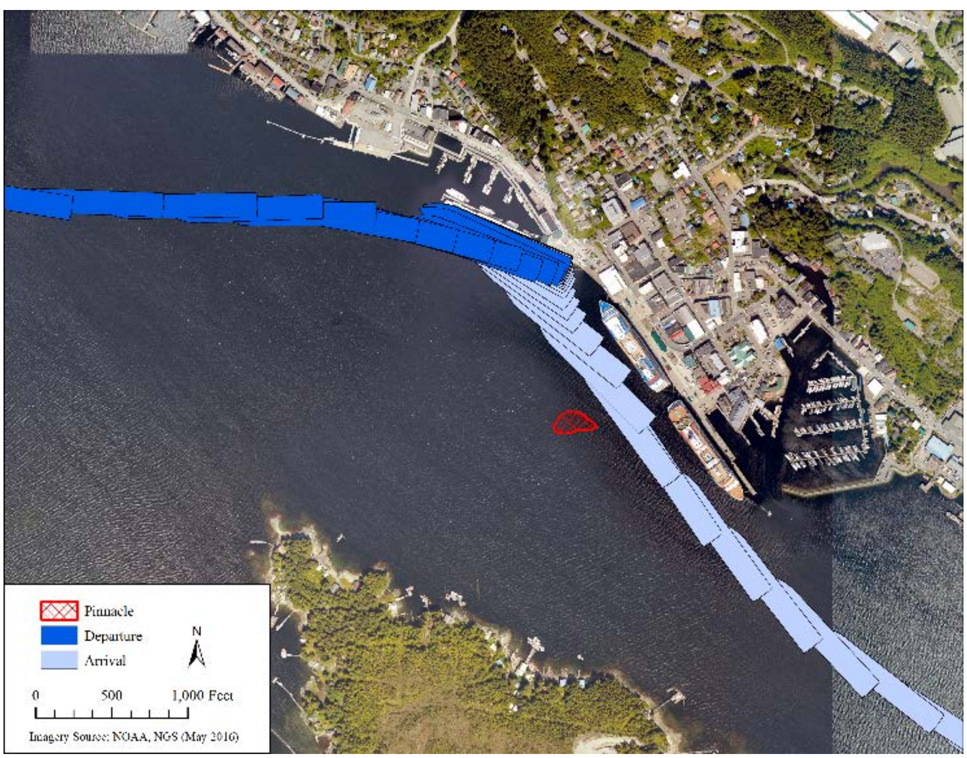


FIGURE 4.9: VESSEL MANEUVER TO BERTH 4 (SOUTHBOUND ARRIVAL)
Source: Moffatt & Nichol, 2016

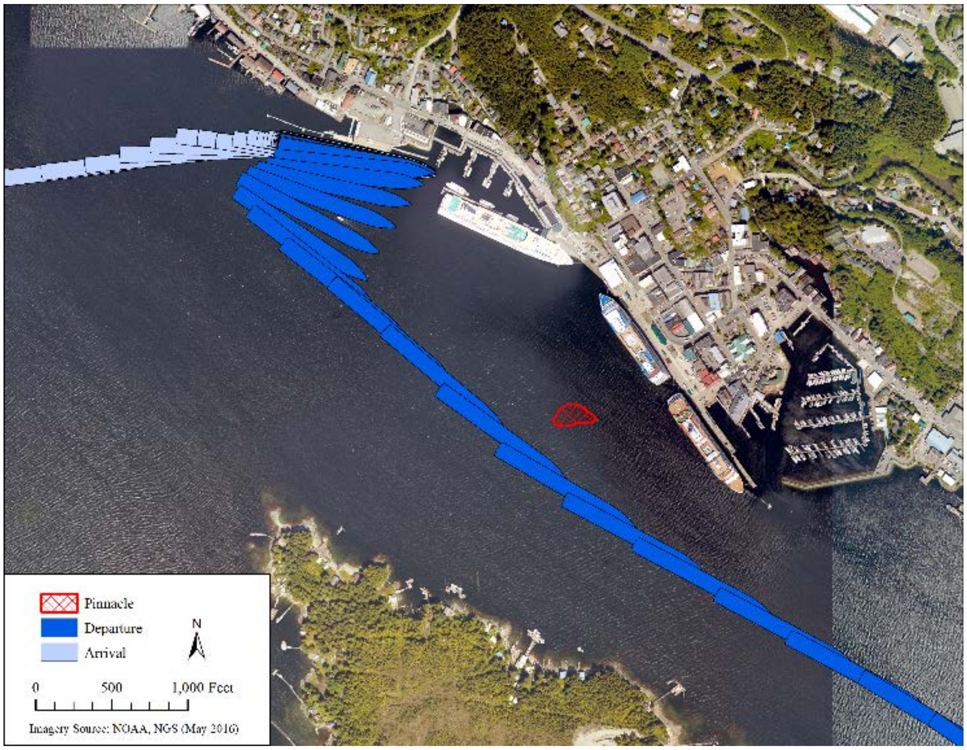


FIGURE 4.10: VESSEL MANEUVER TO BERTH 4 (NORTHBOUND ARRIVAL)
Source: Moffatt & Nichol, 2016

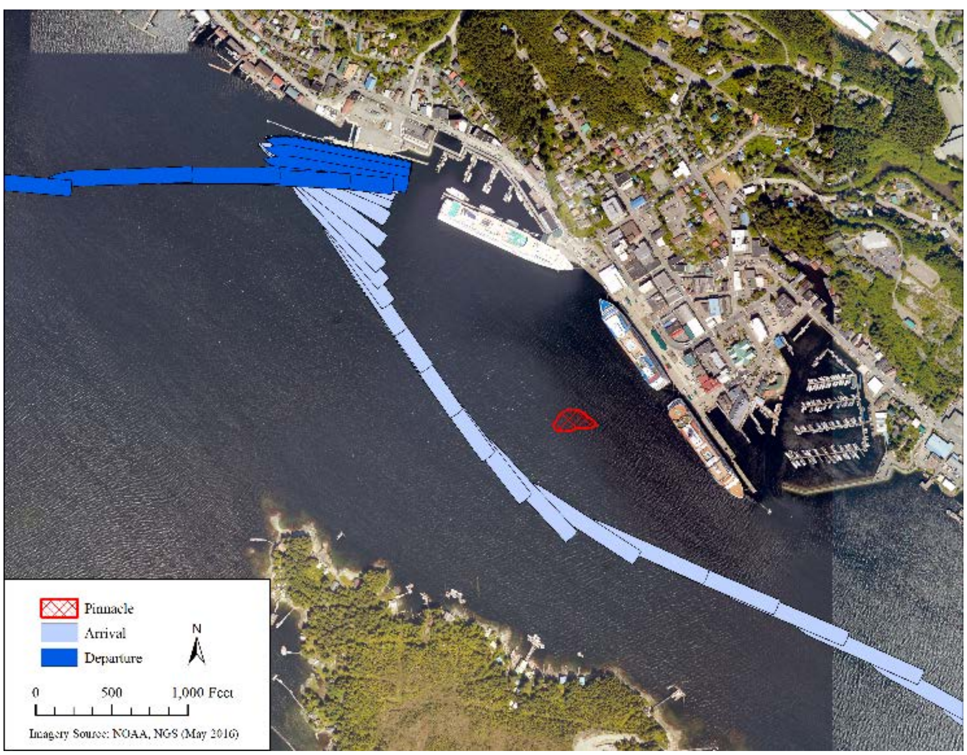


FIGURE 4.11: VESSEL MANEUVER TO BERTH 3 (SOUTHBOUND ARRIVAL WITH TURNING MOVEMENT)

Source: Moffatt & Nichol, 2016

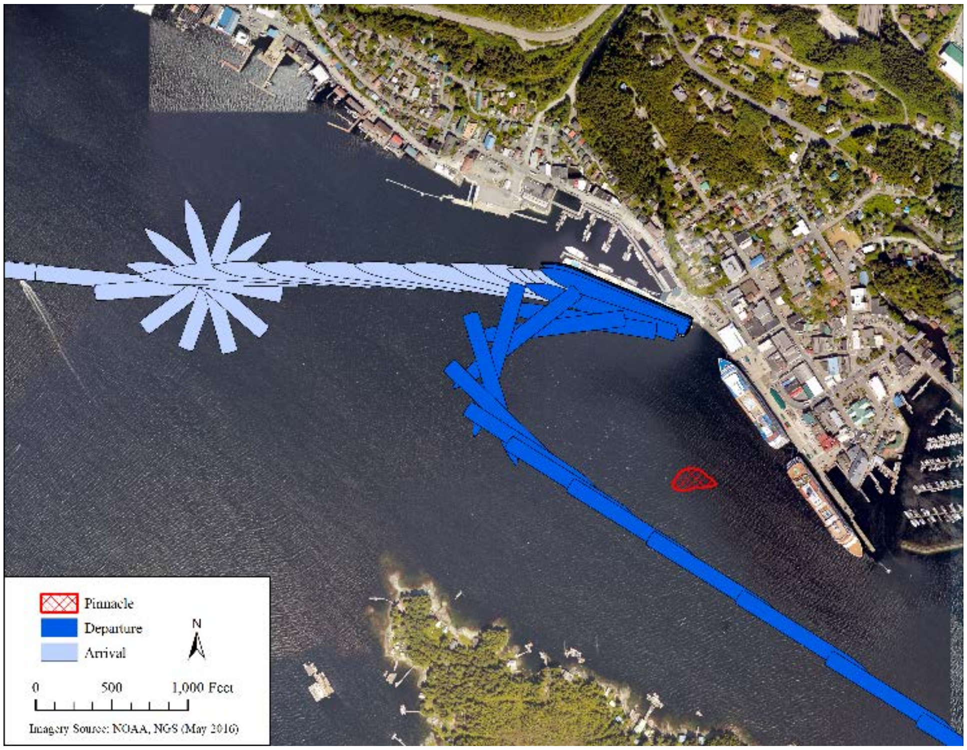


FIGURE 4.12: VESSEL MANEUVER TO BERTH 3 (NORTHBOUND ARRIVAL WITH TURNING MOVEMENT)

Source: Moffatt & Nichol, 2016

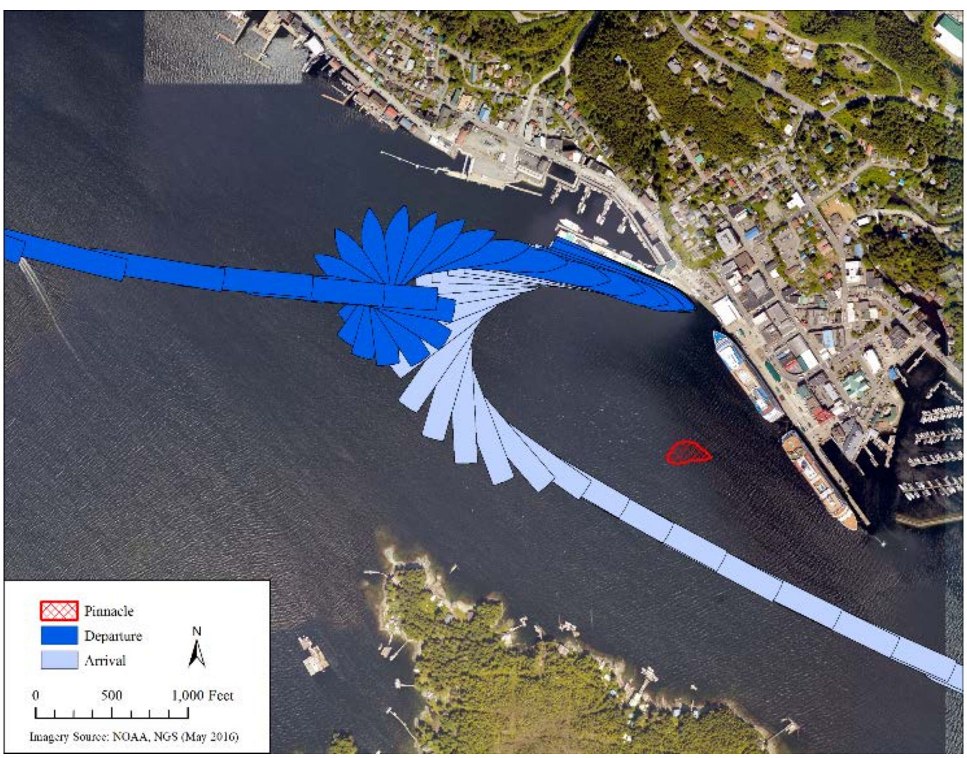
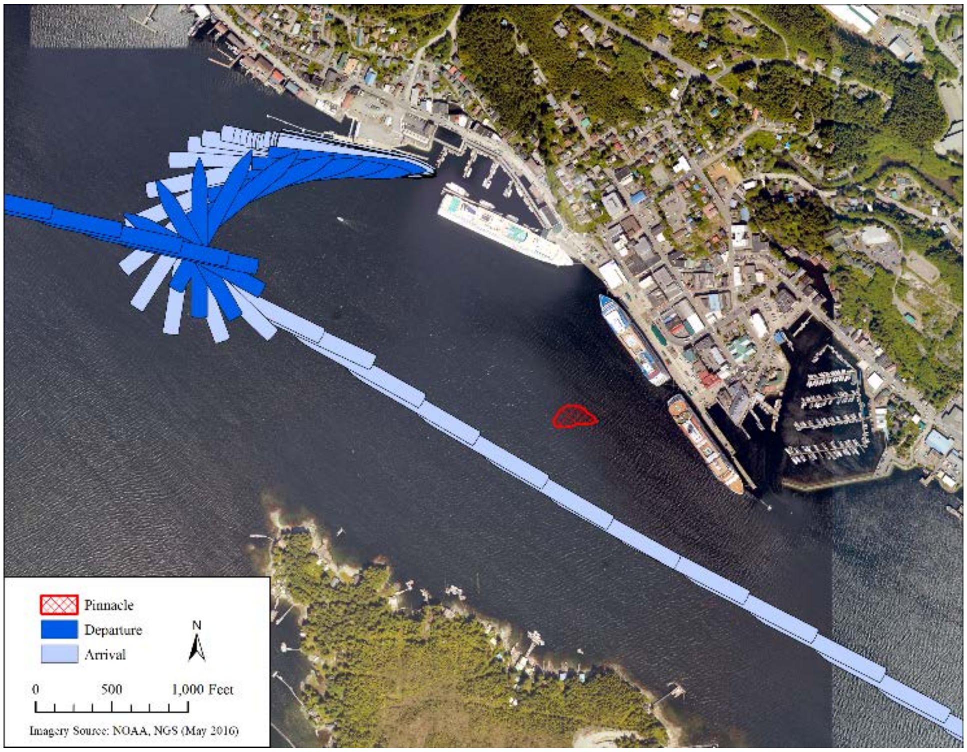


FIGURE 4.13: VESSEL MANEUVER TO BERTH 4 (NORTHBOUND ARRIVAL WITH TURNING MOVEMENT)
Source: Moffatt & Nichol, 2016



Following is a summary of the findings of the analysis and discussions relating to cruise ship vessel navigation to and from Berths 1, 2, 3 and 4:

- Ships arrive at and depart from each berth from both the north and south, depending on wind conditions and whether on a northbound or southbound itinerary. The channel to the west of Berths 3 and 4 is used as a turning basin as illustrated in Figures 4.11 through 4.13. Table 4.3 provides the approximate distribution of northbound and southbound arrival/departure vessel direction for each berth as well as the distribution of ship calls at each berth based on the 2014 AIS data set. Ideally, the goal is to provide equitable distribution of passengers at each berth (i.e. 25% of total passenger disembarkation per berth).

- An existing rock outcrop (a.k.a. *rock pinnacle*) is located approximately 700' west of Berth 2. The peak elevation of this pinnacle is approximately -27' MLLW according to the most recent bathymetric survey in 2000[14]. A single lighted navigation buoy marks safe passage around the rock pinnacle. Water depths in the remainder of the channel and berthing area range from -50 to -125 feet MLLW.

- The approach channels range from approximately1,000' for southbound vessels and 1,200' for northbound vessels. Occasionally, a cruise ship may anchor offshore on the ship's anchor in the designated anchorage area across from Berth 4 on days when all four berths are occupied, thereby reducing the available channel width to the north without impacting navigation and maneuvering to the existing berths.

[14] Source: TerraSond Limited, under contract to the National Oceanic and Atmospheric Administration (NOAA).

TABLE 4.3: PERCENTAGE OF CRUISE SHIPS AND APPROACH/DEPARTURE DIRECTION BY BERTH[15]

Source: AIS Dataset, 2014 and Moffatt & Nichol, 2016

	Direction of Travel		
Port Facility	**Ship Calls At Berth**	**North to South**	**South to North**
Berth 1	23%	72%	28%
Berth 2	28%	77%	23%
Berth 3	26%	74%	26%
Berth 4	23%	33%	67%

- With the exception of the rock pinnacle, there are no natural channel depth, width or air draft limitations, or any other unusual navigational constraints that would inhibit existing and anticipated larger cruise ships from safely maneuvering to and from Berths 1, 2, 3 and 4. Thus, dredging (with the exception of removing the rock pinnacle) is not required to accommodate vessels expected to call at Ketchikan within the next 10 to 15 years.
- Although today's cruise ships are very maneuverable in most weather conditions, the rock pinnacle is an impediment to navigation that limits the size of vessel that can safely navigate to and from Berths 1, 2 and 3 under extreme wind conditions. According to vessel pilots and CLAA, the rock outcrop should be removed to a minimum of -40' MLLW to allow for sufficient all-tide, under-keel clearance for safe access to the aforementioned berths by vessels in typical and extreme wind conditions.
- Removal of the rock pinnacle is considered a priority to allow the larger vessels expected to enter the Alaskan market to safely maneuver to and from Berths 1, 2 and 3, regardless of their direction of travel. This is the primary navigation improvement desired by ship captains, pilots and cruise industry representatives that should be implemented as part of Ketchikan's facility expansion program.
- In June 2016, the cruise vessel Celebrity Infinity allided with Berth 3 on approach, resulting in damage to both the ship and berth. Winds at the time of the incident were reported to be in excess of 45 mph and the cause is under investigation. This is considered to be a rare and unusual event and does not appear to be attributable to any navigation hazards (e.g., the rock pinnacle).

4.4.2 Vessel Berthing and Mooring Considerations

The cruise facilities at Ketchikan consist of two fixed berths (Berths 1 and 2) and two combined fixed/floating berths (Berths 3 and 4). A mooring dolphin exists approximately 165' offshore to the south of Berth 1. In general, the linear/alongside berthing at Berths 1 and 2 allow for flexibility in accommodating a range of vessel lengths totaling up to 1,860' of available berth length, combining the fixed length of Berths 1 and 2

[15] Based on 2014 AIS dataset for all cruise ships greater than 900' LOA. There were two events that cruise ships arrived from and departed to the south at Berth 1: this is considered atypical.

with the mooring dolphin. Section 2.2 provides the capacity and detailed description of each berth along with its associated mooring hardware.

Limiting factors for accommodating existing and future, larger vessels alongside Berths 1 and 2 include:

- The encroachment of the stern or bow of the vessel at Berth 3 onto Berth 2 due to the angle of Berth 3 with Berth 2 as illustrated in Figures 4.3 through 4.13.
- The clearance between vessels at Berths 1 and 2 (and at Berth 3 due to encroachment). The recommended guidelines allow for a minimum clearance of 10% of the vessel length at both bow and stern. For Ketchikan's cruise ships, this would typically range between 95' and 110'. Some vessel operators prefer to use clearances between vessels between 0.5 x beam and 1.0 x beam to provide a better focus on the line geometry at the bow and stern of the vessel (PIANC, *Guidelines for Cruise Terminals, Report No. 152, 2016*). Discussions with CLAA indicated that in Ketchikan, the distance between vessels may be as little as 60' in common practice and as little as 30' under very congested berthing scenarios.
- The distance that the mooring dolphin extends from the end of Berth 1 to allow for sufficient scope to moor the bow or stern of the vessel at Berth 1. Vessels moored at Berth 1 may occasionally extend past the mooring dolphin, and concerns were expressed at Community Meeting #2 concerning possible impacts to the entrance to Thomas Basin Harbor and offshore moorage for floating tenderers serving fish processing operations at Trident Seafoods and other business interests on the adjacent uplands.
- With the extreme tidal range at Ketchikan, fixed Berths 1 and 2 may not accommodate the overhanging decks, overhanging lifeboats, and hull geometries sometimes found on the cruise ships currently and anticipated entering the Alaskan market. This is of special concern during minus-tides.
- The 26-foot width of the fixed wharf at the east end of Berth 1 limits the length of gangway to accommodate the passenger access doors on the vessel. At high tide conditions and depending on the elevation of the ship's PAX doors, the gangway slope may thereby become too steep to safely access the vessel, thus requiring modifying the ramp's geometry to run parallel to the vessel. The relatively narrow width also limits available apron use alongside the vessel for passenger and vehicle flow.

The limiting factors for accommodating existing and future, larger vessels at Berths 3 and 4 include:

- Although Berth 3 consists of a floating barge, the fixed pile located at the west end of the barge has the potential to interfere with the overhang of some future cruise ships—primarily their lifeboats—during minus-tide conditions.
- The 300-foot length of the floating barge at Berth 3 and the 124-foot length at Berth 4 may require positioning the vessel at berth to accommodate the PAX door on the ship. The floating barge length, specifically at Berth 4, will also limit the number of doors that can be accessed, especially with the larger passenger capacity vessels expected to enter the Alaskan cruise market in the near future.
- The length and position of the vessel that can be accommodated at Berths 3 and 4 may impact access to Casey Moran City Float, especially in the case of larger vessels.

5.0 INITIAL PLANNING AND DESIGN CONCEPTS

All of Ketchikan's cruise ship berthing facilities share a common intended function: to facilitate the safe, secure, efficient and expedient disembarkation and subsequent re-boarding (a.k.a. access and egress) of cruise ship passengers. It is essential that this minimum functionality be maintained as the cruise ship berths are expanded to accommodate larger vessels. Additionally, potential improvements in functionality should be identified wherever possible in the process of planning for facility expansion and improvement.

As previously noted in Section 2.2, the berthing facilities in Ketchikan can be categorized as one of two general types: fixed docks (Berths 1 and 2); and combination floating/fixed docks (Berths 3 and 4).

There is a significant operational advantage of floating facilities over fixed dock configurations. Vessels berthed at a fixed dock move vertically relative to the dock surface. In Ketchikan's extreme tidal range, this requires a significant effort to maintain gangway slopes to accommodate safe, comfortable and accessible passenger access. The effort includes periodic interruptions in passenger flow in order to adjust gangway bearing elevations at the dock end. On the other hand, since a vessel and a floating dock move vertically with little change in relative elevation, the required gangway adjustment and consequent passenger interruption for floating facilities is very minor to nonexistent.

For these reasons, two determinations have been made regarding any proposed expansions of the Ketchikan cruise ship terminals: (1) that consideration be given to retrofitting existing fixed docks with floating docks for more efficient passenger access and egress; and (2) that existing floating docks be lengthened, to the extent practicable, to provide access to additional PAX ramps[16]. These considerations were vetted and are strongly endorsed by Cruise Line Agencies of Alaska (CLAA) and cruise line representatives.

This section outlines the basis for conceptual development alternatives for Berths 1, 2, 3 and 4; presents the alternatives in detail including options for each; summarizes Class 4 OPPCs for each alternative developed; presents a sample design-build schedule for facility expansion project execution; and summarizes feedback received on the various alternatives from cruise industry stakeholders and the Public-at-large.

[16] Simultaneous access to three PAX ramps is considered ideal for the very large cruise vessels under consideration; ideally with no more than one PAX ramp on the fixed portion of the berth.

5.1 Technical Basis of Concept Development

Based on current standards of care in the marine industry, the seismic design of publicly accessible docks, wharves, piers and similar marine structures typically falls under one of two nationally-recognized standards: the American Association of State Highway and Transportation Officials (AASHTO) publication *Standard Specifications for Highway Bridges* or the American Society of Civil Engineers (ASCE) Standard 7, *Minimum Design Loads for Buildings and Other Structures*. ASCE 7 has included design requirements specific to marine structures for the past fifteen years, while the marine-specific provisions of AASHTO's bridge specifications are intended for application to highway bridge design and construction. As such, we recommend that ASCE 7-10 (i.e., 2010, or later edition) be referenced as the basis of design for the design and analysis of Ketchikan's cruise facility design, as pertains to wind, seismic and snow loading.

The following preliminary design values exemplify the transient environmental conditions specific to Ketchikan, based on ASCE 7-10 and other relevant technical sources:

Wind Effects on Structures *(strength level, mapped 3-second duration gust):*

- 145 mph
- Exposure Category "D"
- Shape factors selected as appropriate to elements of construction
- Topographical effects considered, as appropriate

Wind Effects on Moored Vessels[17] *(service level, maximum 5-minute duration):*

- Broadside: 40 mph
- Bow/Stern: 52 mph

Seismic Effects on Structures, Mapped Accelerations *(strength level):*

- $S_S = 0.302$ g
- $S_1 = 0.247$ g
- Site Class B or C, as determined by geotechnical evaluation of existing subsurface data
- Response modification factors selected as appropriate to lateral force-resisting system

Ground Snow Load, 50-year event *(service level; extrapolated):*

- 65 psf
- Exposure, thermal and importance factors selected as appropriate
- Drifting effects considered as appropriate

Maximum Current *(dock-adjacent):*

- National Oceanic and Atmospheric Administration *(NOAA, 2001) (depth/velocity):*
  - 16' / 1.50 knots
  - 55' / 1.38 knots
  - 95' / 1.50 knots
  - 135' / 1.41 knots

[17] Wind-on-vessel values are as reported in previous construction documents for Ketchikan's cruise ship berthing facilities. These design values are presumed to have resulted from a statistical analysis of wind data available at the time. Confirmation of these values, and a similar effort to update them with more recent data, is beyond the scope of work of this planning study.

- Nobeltech Tides and Currents™ Modeling:
  - Maximum predicted: 1.50 knots
- Historic:
  - Maximum recorded: 2.0 knots (airport-adjacent)

Annual Tidal Predictions *(NOAA Tidal Bench Marks, published 9/27/2011):*

- Highest Observed Water Level (EHW): +21.31' MLLW (12/2/1967)
- Mean Higher High Water (MHHW): +15.45' MLLW
- Mean Tide Level (MTL): +8.06' MLLW
- Lowest Observed Water Level (ELW): -5.27' MLLW (12/14/2008)

Maximum Expected Wave Height:

- Based on 3-mile minimum fetch (after Stevenson): 3.78'
- Based on averaged fetch lengths, and 50 mph hourly wind speed (after ASCE):
  - From North and West: 2.08'
  - From South and East: 3.11'

5.2 Conceptual Development Alternatives

A series of conceptual development alternatives, with multiple options, were developed iteratively through the cruise facility planning process, as presented and described below:

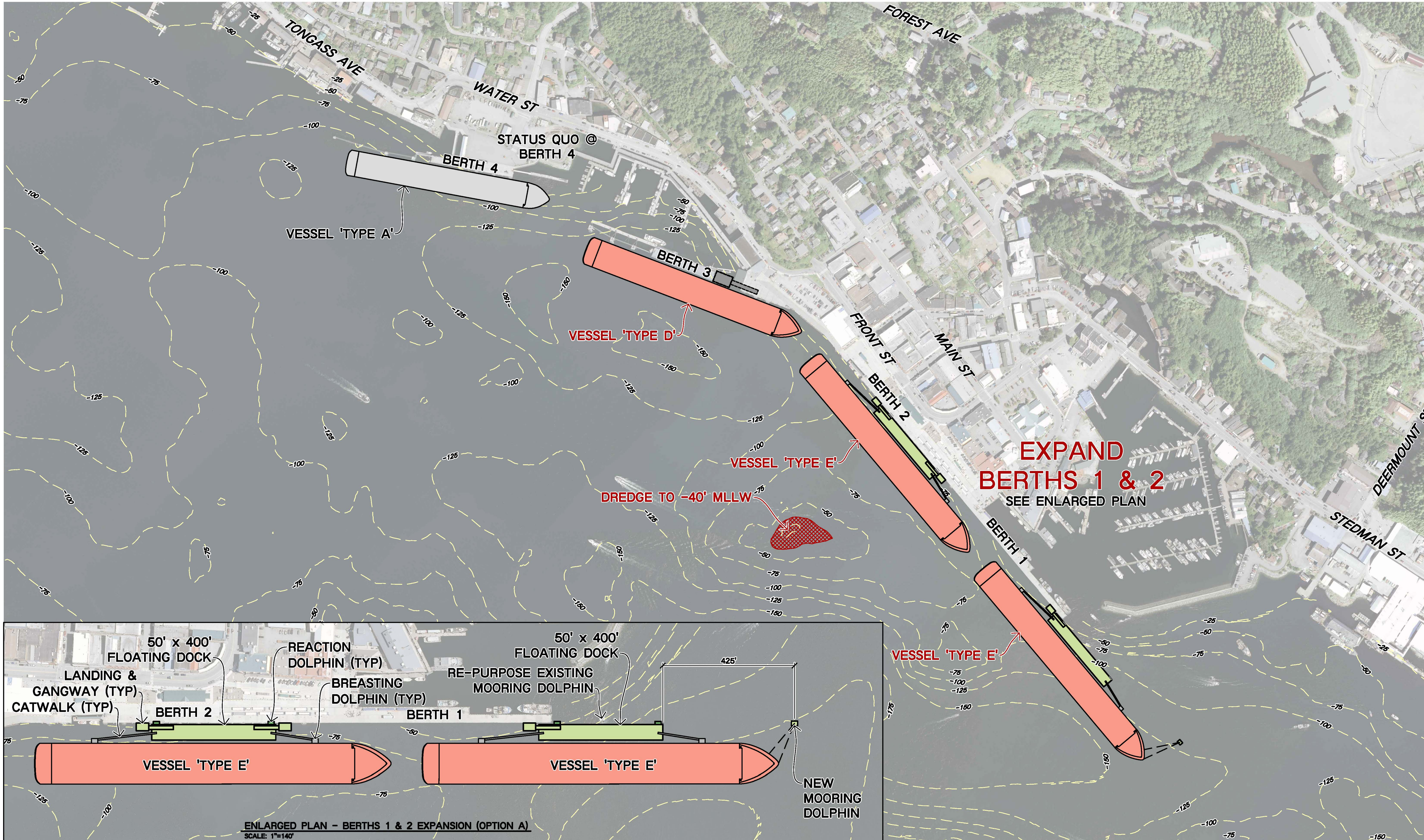
5.2.1 Berths 1 and 2 Expansion and Rock Pinnacle Removal

At Berths 1 and 2, two concepts were developed to add floating docks to the seaward side of the existing fixed, pile-supported docks. These concepts vary only by the degree to which they would extend the berthing line further south, across the existing entrance to Thomas Basin Harbor (i.e., with Option A extending 255' further past the existing mooring dolphin than Option B).

Option A for Berths 1 and 2 will accommodate a maximum of two Type E vessels. Option B for Berths 1 and 2 would only extend the dock by 120', accommodating a combined maximum of one Type A vessel and one Type E vessel (refer to Figures 5.1 and 5.2, respectively).

In order to support either of these alternatives, additional in-water work would be required to remove an existing outcropping commonly referred to by local vessel pilots as the *rock pinnacle*. An existing hazard to navigation and berthing for large cruise vessels, the removal of this underwater feature currently peaking at approximately -27' MLLW, down to a depth of -40' MLLW, is critical to improvements made to Berths 1 and 2 to accommodate larger vessels in the future, as the construction of boarding floats seaward of the current Berths 1 and 2 fixed dock will move the pier head line seaward towards the pinnacle. This, combined with longer, "beamier" cruise ships, will further exacerbate an already significant obstruction to navigation.

The design of this underwater excavation will require bathymetric survey and subsurface exploration for material characterization and will ultimately require underwater demolition. Significant effort is anticipated to secure the necessary environmental permits for the work, and assuming the City intends to initiate the work through the U.S. Army Corps of Engineers (USACE) as an improvement to navigation, the planning and procurement process can be very time consuming: perhaps as long as 5-8 years, even if accelerated. Refer to Figure 5.3 for details of the proposed rock pinnacle removal.



KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

FIGURE 5.1

moffatt & nichol LandDesign

12.09.2016

BERTHS 1 & 2 EXPANSION - OPTION A

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

1. CONTOUR ELEVATIONS REFERENCED TO MLLW.

VESSEL LEGEND

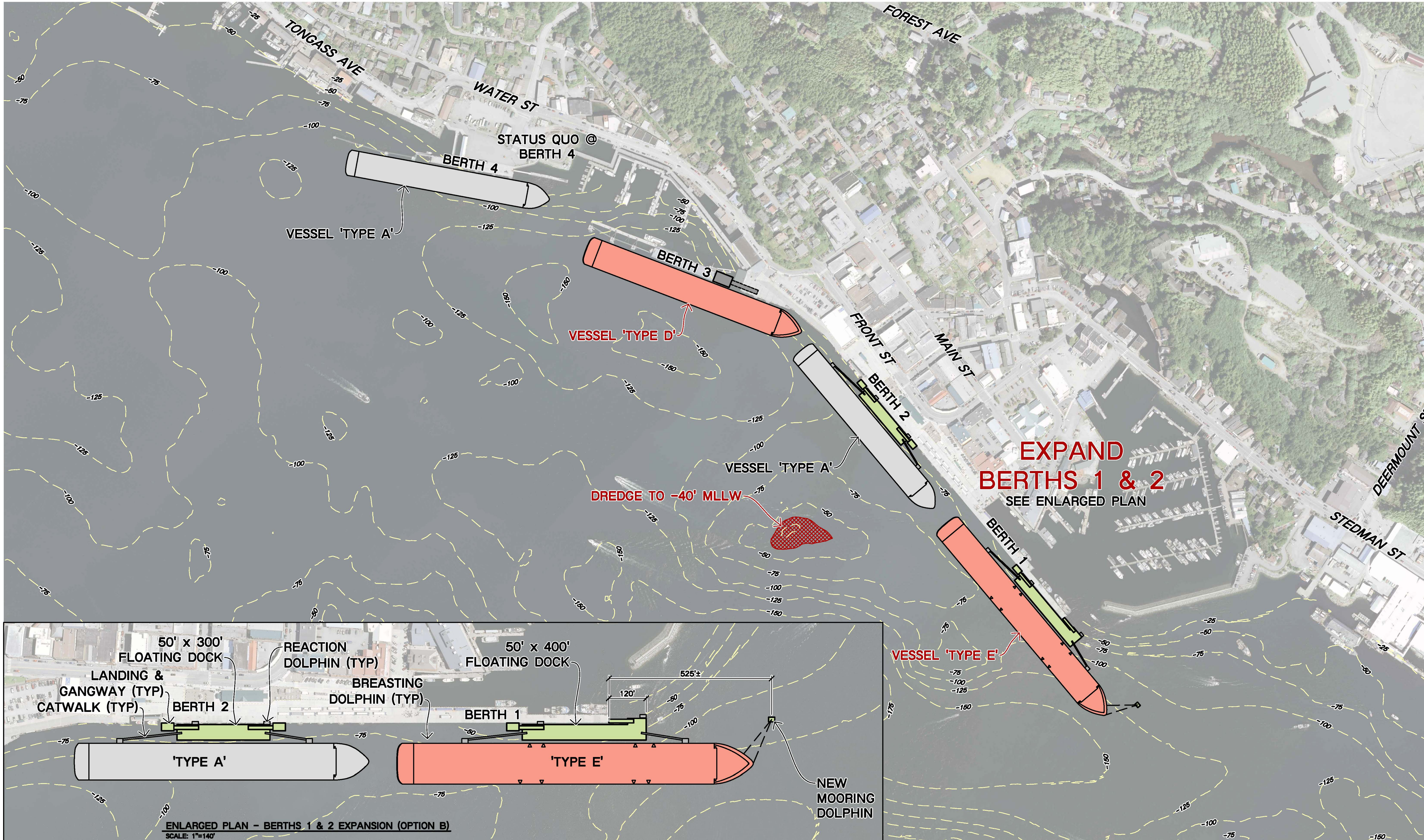
TYPE A	UP TO 950' LOA
TYPE B	950' TO 1000' LOA
TYPE C	1000' TO 1050' LOA
TYPE D	1050' TO 1100' LOA
TYPE E	1100' TO 1150' LOA

N

200' 0' 200' 400'

SCALE: 1"=200'

ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

FIGURE 5.2

moffatt & nichol | LandDesign | 12.09.2016 | BERTHS 1 & 2 EXPANSION - OPTION B

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

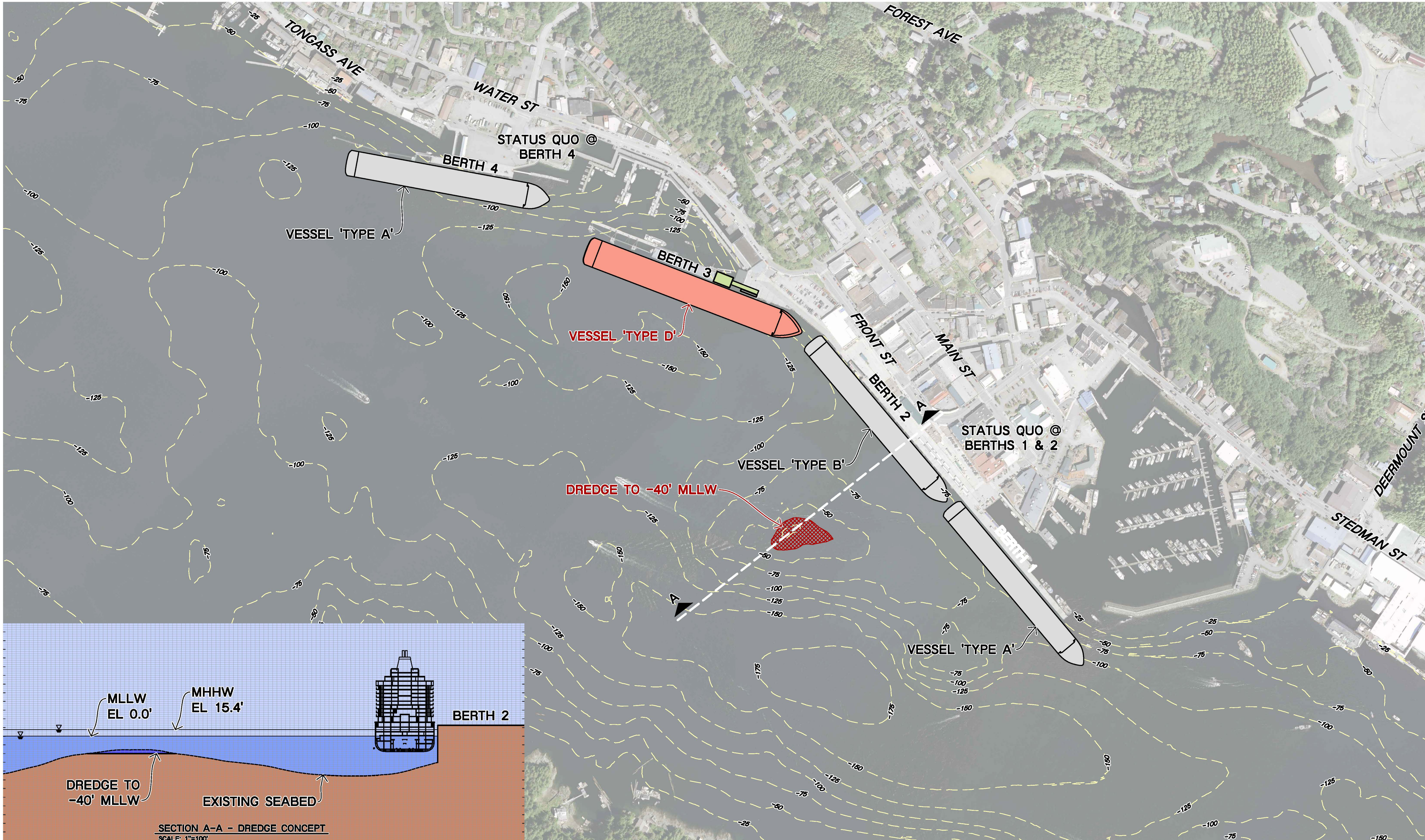
1. HYDROGRAPHIC SURVEY COURTESY OF NOAA, CIRCA 2000.
2. CONTOUR ELEVATIONS REFERENCED TO MLLW.

VESSEL LEGEND

TYPE A	UP TO 950' LOA
TYPE B	950' TO 1000' LOA
TYPE C	1000' TO 1050' LOA
TYPE D	1050' TO 1100' LOA
TYPE E	1100' TO 1150' LOA

200' 0' 200' 400'
SCALE: 1"=200'
N

ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

FIGURE 5.3

moffatt & nichol | LandDesign | 12.09.2016 | ROCK PINNACLE REMOVAL

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

1. HYDROGRAPHIC SURVEY COURTESY OF NOAA, CIRCA 2000.
2. CONTOUR ELEVATIONS REFERENCED TO MLLW.

VESSEL LEGEND

TYPE A	UP TO 950' LOA
TYPE B	950' TO 1000' LOA
TYPE C	1000' TO 1050' LOA
TYPE D	1050' TO 1100' LOA
TYPE E	1100' TO 1150' LOA

N

200' 0' 200' 400'

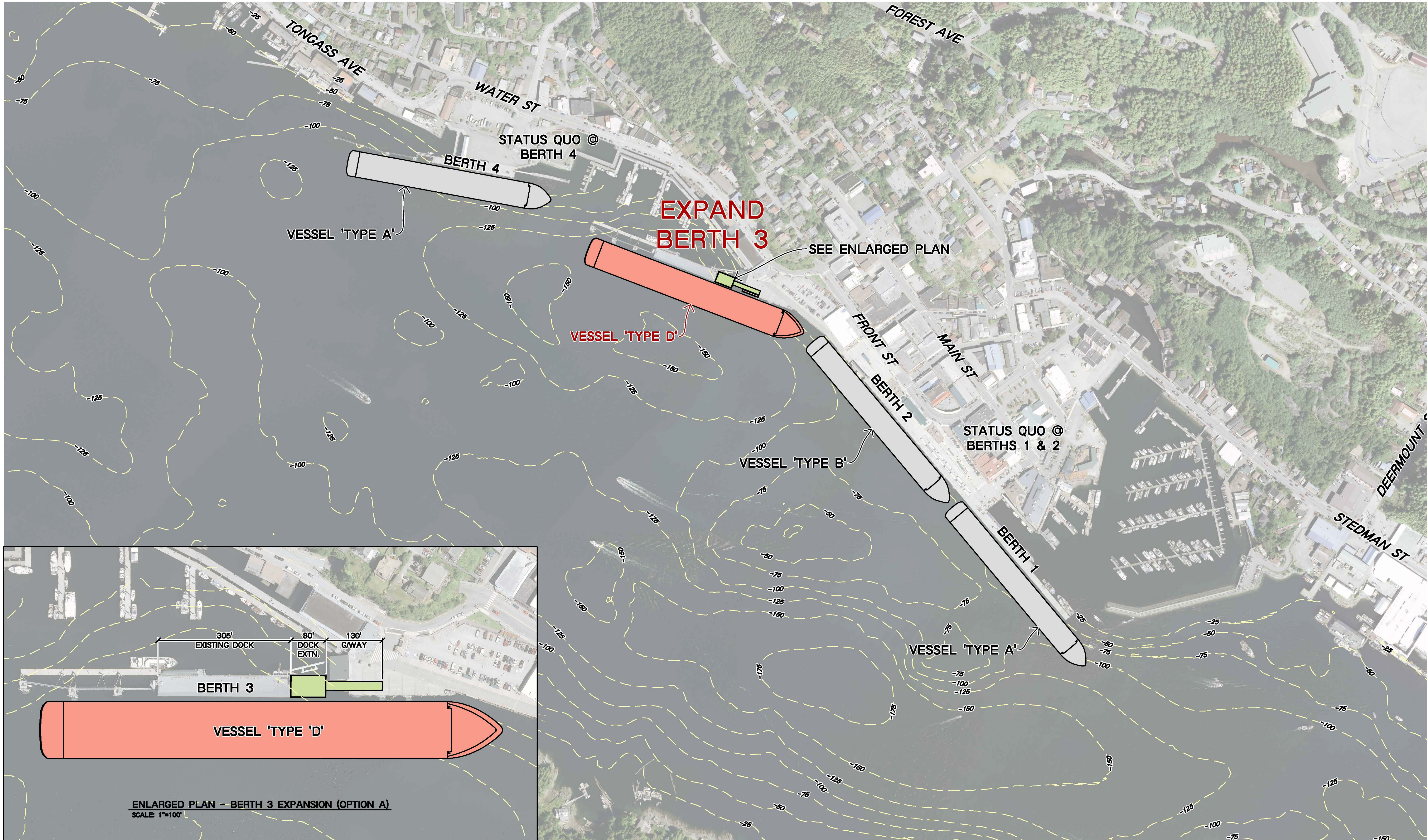
SCALE: 1"=200'

ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE

5.2.2 Berth 3

At Berth 3, two alternative expansion alternatives were considered. Concept A involves removing the existing floating dock to drydock at the Ketchikan Shipyard (KSY), and adding 80' of dock length to the float. The intent is to capture an additional vessel door with the longer floating dock, thereby facilitating and increasing the rate of passenger access during disembarkation and subsequent re-boarding. This alternative, proposed for execution during the scheduled winter 2016-17 maintenance of the Berth 3 boarding float, would also involve the selective demolition of the adjacent Berth 3 fixed dock.

As an alternative, Concept B would simply remove the existing floating dock to the KSY for scheduled maintenance and any necessary repair, and replace the float to its original position, unaltered in geometry (refer to Figures 5.4 and 5.5, respectively). Concept B will not result in expanded mooring capacity for larger vessels at Berth 3.



KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

FIGURE 5.4

moffatt & nichol | LandDesign | 12.09.2016 | BERTH 3 EXPANSION - OPTION A

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

1. HYDROGRAPHIC SURVEY COURTESY OF NOAA, CIRCA 2000.
2. CONTOUR ELEVATIONS REFERENCED TO MLLW.

VESSEL LEGEND

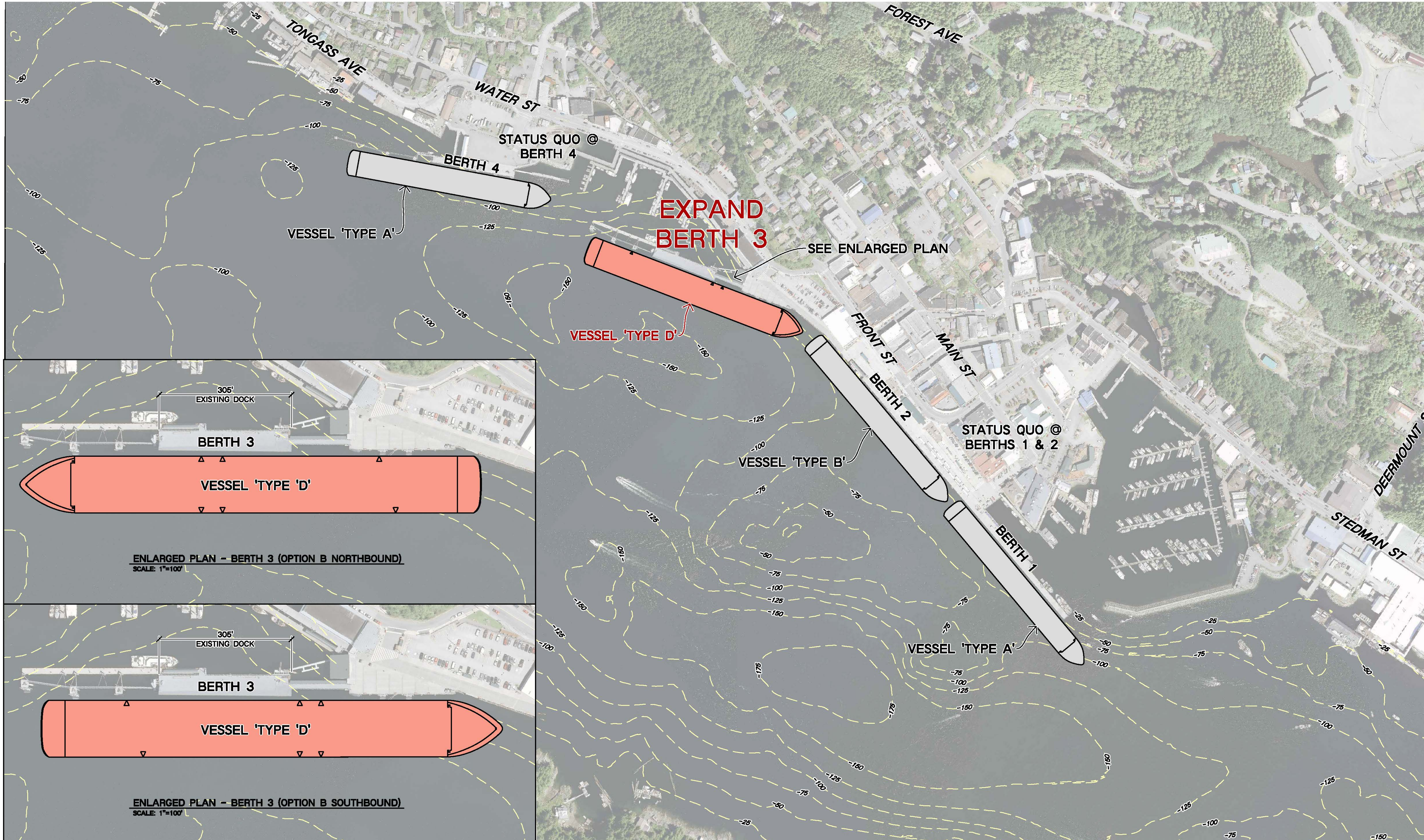
TYPE A	UP TO 950' LOA
TYPE B	950' TO 1000' LOA
TYPE C	1000' TO 1050' LOA
TYPE D	1050' TO 1100' LOA
TYPE E	1100' TO 1150' LOA

N

200' 0' 200' 400'

SCALE: 1"=200'

ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

FIGURE 5.5

moffatt & nichol LandDesign 12.09.2016 BERTH 3 EXPANSION - OPTION B

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

1. HYDROGRAPHIC SURVEY COURTESY OF NOAA, CIRCA 2000.
2. CONTOUR ELEVATIONS REFERENCED TO MLLW.

VESSEL LEGEND

TYPE A	UP TO 950' LOA
TYPE B	950' TO 1000' LOA
TYPE C	1000' TO 1050' LOA
TYPE D	1050' TO 1100' LOA
TYPE E	1100' TO 1150' LOA

200' 0' 200' 400'

SCALE: 1"=200'

ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE

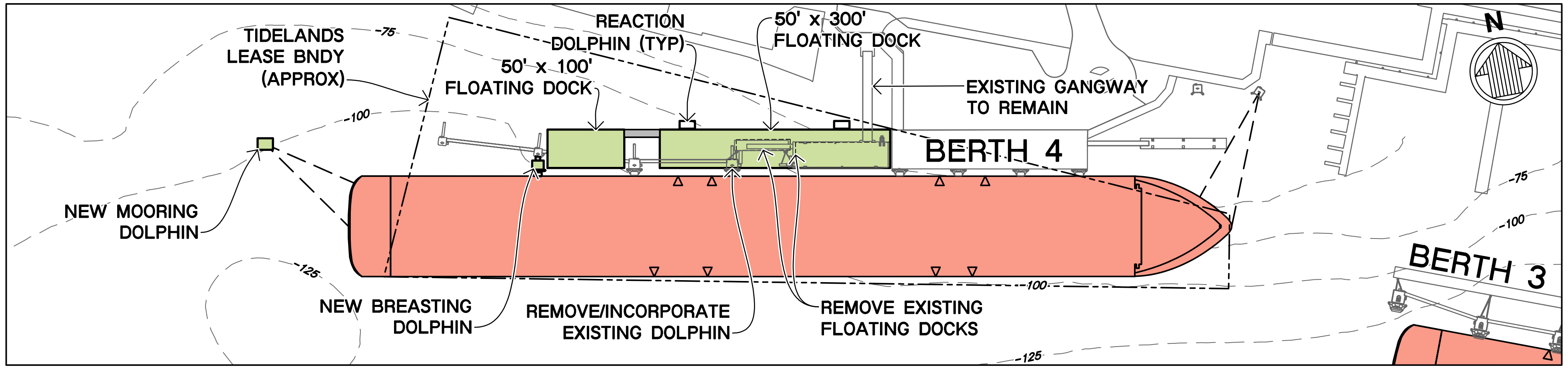
N

5.2.3 Berth 4 Expansion

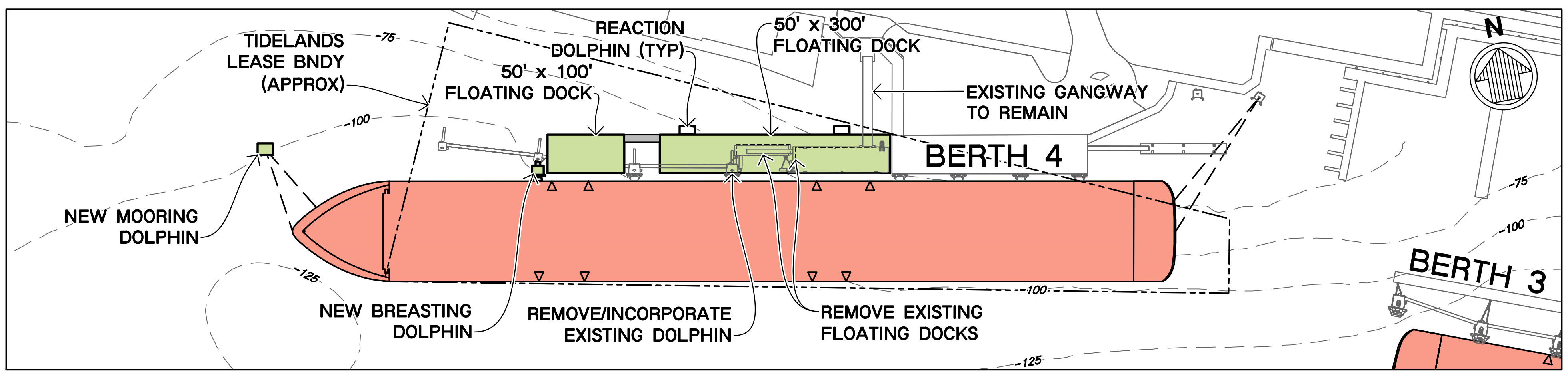
Three alternative expansion concepts were considered for Berth 4. The first, Concept A entails removal and replacement of the existing floating dock with a longer, broader float. Additionally, a smaller, supplemental floating dock would be installed between the northernmost breasting dolphin and the southernmost mooring dolphin. In the southbound direction of travel, this configuration would capture two PAX doors at the fixed dock, and two doors at the larger floating dock, for the Type E vessel; whereas in the northbound direction, this configuration would capture two PAX doors at the supplemental floating dock, and two doors at the larger floating dock. This alternative would require the demolition of three existing dolphins, and the subsequent replacement/relocation of two dolphins (refer to Figure 5.6).

Concept B for Berth 4 entails the addition of two supplemental floats: the existing floating dock would remain, unaltered. The southernmost float would be installed between the existing breasting dolphins and a second, northern float would be installed between the northernmost breasting dolphin and the southernmost mooring dolphin, as in Concept A. In the southbound direction of travel, this configuration would capture two PAX doors at the fixed dock and two doors at the southern supplemental floating dock for the Type E vessel, whereas in the northbound direction, this configuration would capture two PAX doors at the northern supplemental dock and two doors at the existing floating dock. This alternative would not require the demolition and/or replacement of any existing dolphins (refer to Figure 5.7).

Concept C for Berth 4 entails removing the existing floating dock to drydock at KSY, and subsequently adding extending the float by approximately 50' of berthing length. CLAA believes this will assist in capturing an additional PAX door at the floating dock for some vessels smaller than Type E, thereby increasing the capacity for passenger access during disembarkation and subsequent re-boarding for very large vessels. This alternative would involve the demolition and replacement of one existing dolphin (refer to Figure 5.8).



OPTION A – SOUTHBOUND



OPTION A – NORTHBOUND

ENLARGED PLANS – BERTH 4 EXPANSION
SCALE: 1"=100'

Berth IV Modification Conceptual Notes:

- *Option A demonstrates a complete replacement of existing float with 300 ft x 50 ft main float and addition of a supplemental 100' x 50' float.*
- *Option A demonstrates addition of two (2) discrete supplemental 100' x 50' floats, with existing main float to remain in place.*
- *Option A will require demolition and replacement/relocation of (at least) three (3) existing dolphins, and removal and disposal/storage of two (2) existing floats and associated gangway.*
- *As shown, vessel doors corresponding to Type "E" vessel are based on a Quantum Class vessel only. Door locations and spacing may vary significantly from those shown, with vessel type.*
- *New breasting dolphin shown at existing mooring dolphin location is an extension of existing dolphin seaward to provide additional breasting point for Type "E" vessel. It is not expected that such additional breasting would be necessary for vessels shorter than Type "E".*

KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

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FIGURE 5.6

BERTH 4 EXPANSION - OPTION A

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

1. CONTOUR ELEVATIONS REFERENCED TO MLLW.

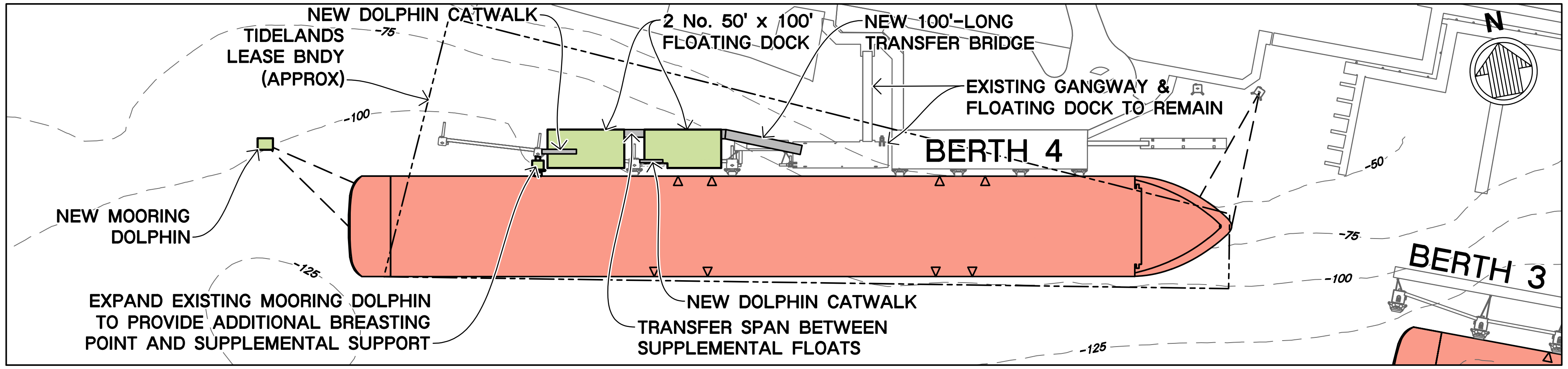
VESSEL LEGEND

TYPE A	UP TO 950' LOA
TYPE B	950' TO 1000' LOA
TYPE C	1000' TO 1050' LOA
TYPE D	1050' TO 1100' LOA
TYPE E	1100' TO 1150' LOA

100' 0' 100' 200'
SCALE: 1"=100'

N

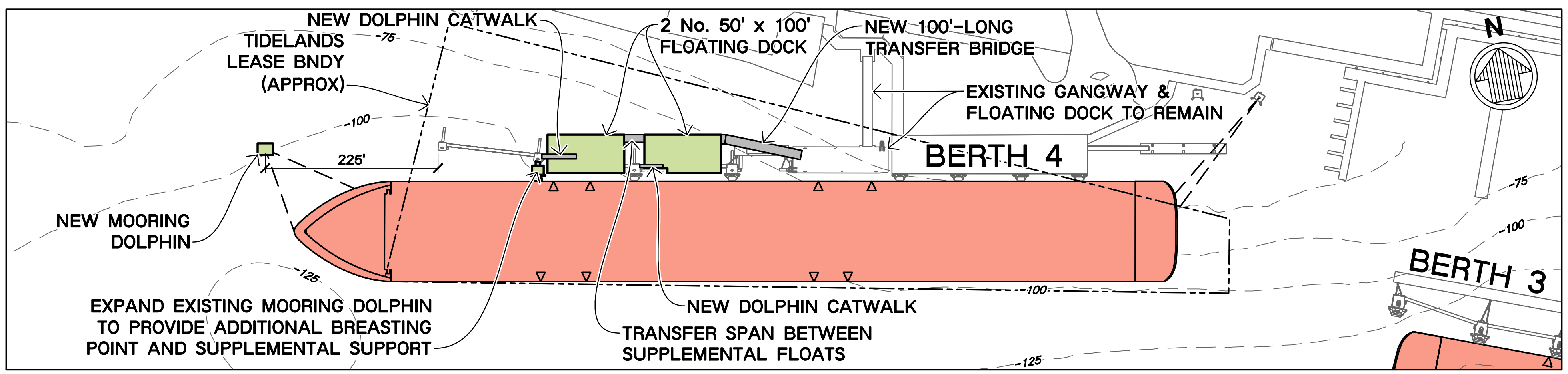
ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE



OPTION B – SOUTHBOUND

Berth IV Modification Conceptual Notes:

- *Option B will require demolition of existing dolphin-to-dolphin catwalk, and replacement with articulating catwalk from supplemental floats to dolphins, and additional small access float.*
- *As shown, vessel doors corresponding to Type "E" vessel are based on a Quantum Class vessel only. Door locations and spacing may vary significantly from those shown, with vessel type.*
- *New breasting dolphin shown at existing mooring dolphin location is an extension of existing dolphin seaward to provide additional breasting point for Type "E" vessel. It is not expected that such additional breasting would be necessary for vessels shorter than Type "E".*



OPTION B – NORTHBOUND

ENLARGED PLANS – BERTH 4 EXPANSION
SCALE: 1"=100'

KETCHIKAN PORT IMPROVEMENTS PLANNING AND DESIGN

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FIGURE 5.7

BERTH 4 EXPANSION – OPTION B

TIDAL INFORMATION

MEAN HIGHER HIGH WATER (MHHW)	15.4'
MEAN HIGH WATER (MHW)	14.5'
MEAN LOW WATER (MLW)	1.6'
MEAN LOWER LOW WATER (MLLW)	0.0'

NOTES

1. CONTOUR ELEVATIONS REFERENCED TO MLLW.

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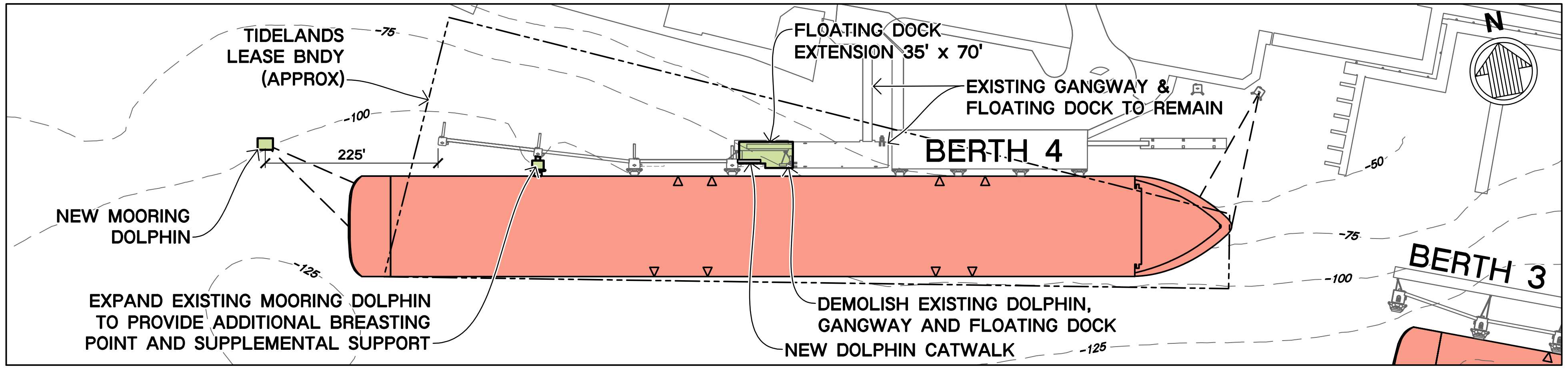
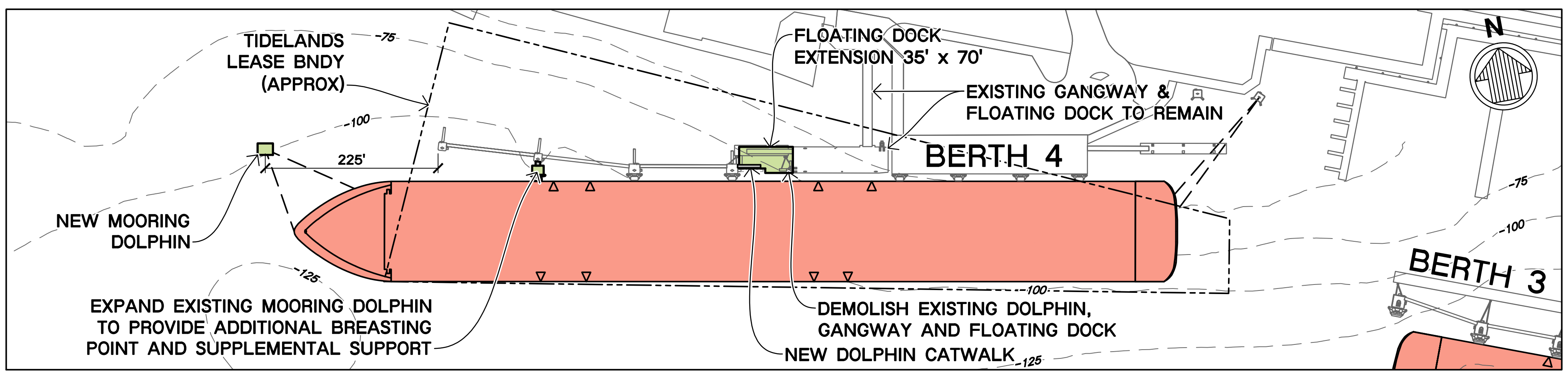


OPTION C – SOUTHBOUND



OPTION C – NORTHBOUND

ENLARGED PLANS – BERTH 4 EXPANSION
SCALE: 1"=100'

Berth IV Modification Conceptual Notes:

- *Option C demonstrates expansion of the existing barge-type floating dock by 75 ft in length.*
- *Option C will require demolition and replacement/relocation of at least one existing floating barge mooring dolphin, as well as removal of one span of breasting dolphin access catwalk. This option will require reconfiguration of the access point at the first breasting dolphin.*
- *As shown, vessel doors corresponding to Type "E" vessel are based on a Quantum Class vessel only. Door locations and spacing may vary significantly from those shown, with vessel type.*
- *New breasting dolphin shown at existing mooring dolphin location is an extension of existing dolphin seaward to provide additional breasting point for Type "E" vessel. It is not expected that such additional breasting would be necessary for vessels shorter than Type "E".*

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100' 0' 100' 200'
SCALE: 1"=100'

ORIGINAL SHEET SIZE 34" x 22" (ANSI D)
DRAWING SCALES ARE BASED ON THIS SHEET SIZE

N

5.3 Opinions of Probable Project Cost

Opinions of Probable Project Cost (OPPC) have been formulated for each of the above-referenced conceptual development alternatives, inclusive of: construction cost; survey; planning; permitting; design; procurement; and services during construction. The objective at this planning level of development is to provide the City with OPPCs conforming to a *Feasibility* or *Study* level of accuracy and contingency.

According to AACE International (formerly the Association for the Advancement of Cost Engineering), reasonable low and high boundary limits of variability at the conceptual level of project development, referred to as a *Class 4 Estimates*, are as follows:

- -15% to +30% for Berths 1, 2, 3 and 4 facility expansion alternatives.
- -15% to +300% for corrosion repair and cathodic protection at Berths 1, 2 and 3.
- -30% to +50% for removal of the rock pinnacle adjacent to Berths 1 and 2.

The higher level of uncertainty allowed for the rock pinnacle removal is associated with the need to obtain more accurate bathymetric and geotechnical information regarding this geological formation, in order to better understand and determine the level of effort of permitting, design and construction required for its removal. Costs associated with each of these project alternatives are summarized in Table 5.1.

TABLE 5.1: SUMMARY OF OPINIONS OF PROBABLE PROJECT COST (OPPC)

Potential Project	(Low Range)	Base OPPC	(High Range)
Berths 1, 2 and 3 Corrosion and Cathodic Protection	$ 2,661,000	**$ 3,131,000**	$ 4,070,000
Rock Pinnacle Removal	$ 3,308,000	**$ 4,725,000**	$ 7,088,000
Berths 1 and 2 (Option A)	$ 33,661,000	**$ 39,549,000**	$ 51,451,000
Berths 1 and 2 (Option B)	$ 31,453,000	**$ 36,984,000**	$ 48,116,000
Berth 3 (Option A)	$ 7,130,000	**$ 8,347,000**	$ 10,868,000
Berth 3 (Option B)	$ 1,185,000	**$ 1,380,000**	$ 1,794,000
Berth 4 (Option A)	$ 14,490,000	**$ 17,020,000**	$ 22,172,000
Berth 4 (Option B)	$ 8,464,000	**$ 9,879,000**	$ 12,869,000
Berth 4 (Option C)	$ 5,348,000	**$ 6,256,000**	$ 8,154,000

Note: Refer to Appendix C for detailed cost breakdowns, notes and limitations for each project.

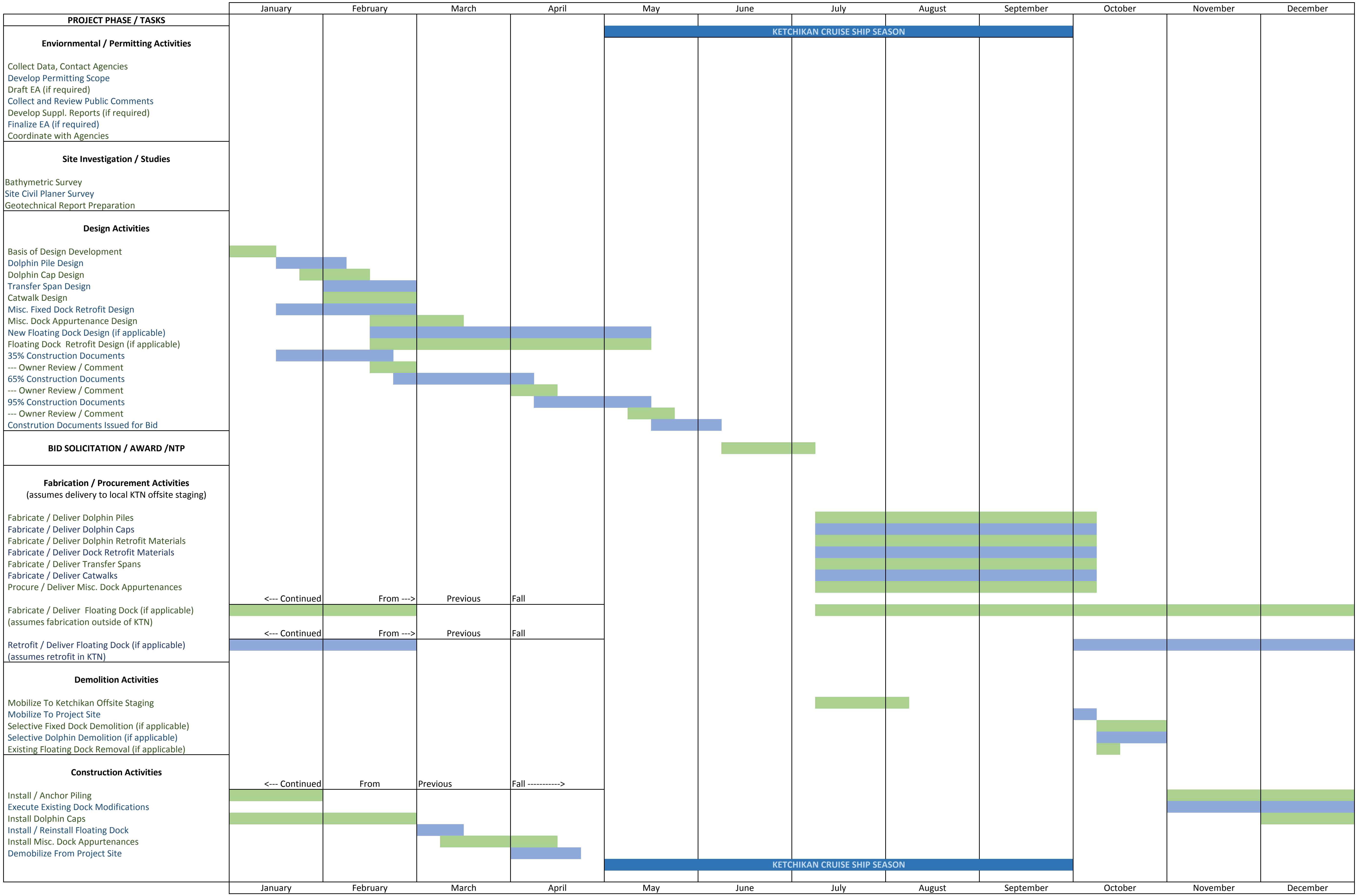
5.4 Sample Project Schedule

Table 5.2 illustrates a sample project schedule that accounts for the annual May-September cruise season in Ketchikan. This schedule is a generic approximation of the principal tasks for design and construction, based on a design-bid-build project delivery model, assuming construction is to be completed during winter months.

TABLE 5.2

SAMPLE PROJECT SCHEDULE, KETCHIKAN, ALASKA

(DESIGN, BID, BUILD DELIVERY MODEL)



5.5 Stakeholder and Community Input and Feedback

The planning process was intentionally iterative, drawing upon local knowledge, input and feedback from the Port & Harbors Department, key local industry stakeholders, and interested members of the Public-at-large. The M&N Team led three Community Meetings, each comprising two, two-hour sessions (from 3-5 and 6-8 PM), advertised locally with the latter two featured in the *Ketchikan Daily News:*

- Community Meeting #1 (June 15, 2016): The M&N Team presented the work approach and solicited local knowledge and input into the planning process. Five members of the Public attended.
- Community Meeting #2 (September 14, 2016): The M&N Team presented the regional cruise market forecast and vessel demand for Ketchikan as well as conceptual development alternatives for the expansion of Berths 1, 2 and 3 to accommodate larger cruise ships, soliciting feedback on all development alternatives. Findings of the Tier 1 topside, under-pier and underwater inspections of Berths 1 and 2 were also presented. Approximately forty-five members of the Public participated.
- Community Meeting #3 (November 16, 2016): The M&N Team reiterated the market research and presented: revised conceptual development alternatives for Berths 1 and 2; the previously developed Berth 3 alternative; and two new alternatives for potential Berth 4 expansion. Feedback was solicited on all conceptual development alternatives. Findings of the Tier 2 topside and under-pier inspections of Berths 1 and 2 were also discussed, as well as an update on the ongoing design of bollards, and modifications to bullrail, decking, lighting and appurtenances at Berths 1 and 2. Twenty members of the Public attended the meeting.

Port & Harbors Director Steve Corporon attended and assisted in the facilitation of these community meetings. The M&N Team made additional summary presentations to City Council as the work progressed at the scheduled evening meetings of June 16, July 21 and September 15, 2016. The preponderance of Public feedback was received during Community Meetings #2 in mid-September, in response to the development alternatives presented at that time. The following comments were recorded:

- The Berth 1 extension is problematic for vessels served by Trident and other processors to the south. Cruise ships will interfere with anchored floating tenderers waiting to be unloaded, and this area is already constricted during fishing season. Trident reported 6-7 vessels up to 140' (average 100') during peak days and emphasized the importance of the fishing community to Ketchikan's economy.
- This proposed Berth 1 extension is problematic to users of Thomas Basin due to currents from Ketchikan Creek, a back-eddy associated with cruise ships, trapped debris in the harbor, and lack of visibility over the breakwater when returning to the harbor at low tide. Harbor users reported it is already difficult to enter and exit and conditions will be exacerbated by the additional cruise ship overhang.
- A single passenger ramp at the end of Berth 1 (as shown in the fixed and floating dock extension concepts then presented) will not suffice and will create a bottleneck on the passenger landing float.
- Removal of the rock pinnacle offshore of Berths 1 and 2 is encouraged and will be good for small vessels as well as cruise ships. It is easy to lose sight of the navigation buoy in the city lights when returning to Ketchikan after dark.
- Consider expanding Berths 1 and 3 only, leaving Berth 2 for smaller cruise ships and thereby reducing the Berth 1 overhang. This could allow sufficient time for the rock pinnacle removal to be permitted and funded.

- Berth 3 expansion and additional passengers will create a significant bottleneck where passengers stage to access shore transportation.[18]
- Berth 4 should be included in the analysis, and needs to consider impacts on vessels and float planes to the north.[19]
- There was some interest in the consideration of a fifth berth, perhaps at the Safeway Mall, or at other location nearby downtown.
- The relatively short time in port (typically 6-7 hours) is concerning; thus the need to get passengers to/from ships and tours in an efficient manner. Ketchikan's visitors must continue to have a high quality experience. Concern was expressed that quality will be compromised by congestion resulting from a significant increase in the number of visitors on very large cruise ships.

During Community Meeting #3, it was acknowledged that the Berths 1 and 2 concepts were revised in response to concerns voiced at Community Meeting #2 by Trident, on behalf of tenders mooring in front of their facility, and by users of Thomas Basin. Nancy McNulty (owner of Talbots, Inc., adjacent to Berth 4) voiced her opposition to any Berth 4 expansion, noting that any shoreward incursion and/or new dolphin construction would impede their permitted plans for a float plane facility. The City noted that any such expansion would need to go through a formal permitting process including USCG review and comment as to navigation. Ms. McNulty subsequently issued a letter to City Manager Karl Amylon dated November 17, reiterating her expressed concerns regarding any plans to expand of Berth 4.

The M&N Team scheduled meetings with Cruise Line Agencies of Alaska (CLAA) on June 15, September 2 (via teleconference) and September 14, 2016; and with Survey Point Holdings, LLC on October 18 (via teleconference). Port & Harbors Director Steve Corporon participated on-site in all meetings and a visiting Captain from Princess Cruises participated in the September 14 meeting. The June 15 meeting solicited input into the planning process and the October 18 meeting involved focused discussion on the potential for expansion to Berth 4, which is privately-owned and under long-term lease to the City. The purpose of these discussions was to solicit input and feedback on behalf of the cruise lines and pilots on the various conceptual development alternatives. The September 14 meeting, evaluating conceptual development alternatives for Berths 1, 2 and 3, generated the following feedback:

- The findings of the market research were confirmed; specifically, the demand for as many as three Type E vessels (up to 1,150' LOA). Princess indicated that vessels in this range may be arriving in as little three years, and that the City should shorten their planning horizon and accelerate projects to accommodate these larger vessels. Princess agreed that it is critical to provide expedient passenger access to and from large cruise vessels; otherwise the shore experience will be too short. They added that if facilities are not constructed timely, they would consider bypassing Ketchikan in favor of another day at sea.
- CLAA endorsed the floating dock option for Berths 1 and 2 expansion, rejecting the fixed dock alternative initially developed. Floats provide all-tide access for passengers on three PAX ramps simultaneously, which results in efficient passenger access and egress.

[18] Uplands planning, specifically the passenger/shore tour interface, falls outside of this scope of work, but is recommended as a future planning stage.

[19] Consideration of Berth 4 was subsequently added to the scope of work, following Community Meeting #2.

- CLAA endorsed the eventual expansion of Berth 3 to accommodate future larger vessels up to Type E and the loading/unloading by three PAX ramps simultaneously. It is believed that vessels up to 1,100' LOA (i.e., Type D) can be accommodated in its current configuration.
- CLAA strongly endorsed the removal of the rock pinnacle offshore of Berths 1 and 2, as an important improvement to navigation and berthing. Princess confirmed that current maneuvering into berth is difficult and that will be made more difficult, if not impossible, with the proposed movement of the pier head line approximately 60' further seaward (i.e., due to the construction of boarding floats for expanded Berths 1 and 2).

VIEWPOINT: MULTIPLE SCENARIOS EXIST TO EXPAND TO THREE LARGER BERTHS

The City must consider not only the relative cost of each individual berth expansion concept but also how each project will contribute towards the progressive, phased expansion of its cruise facilities, over time, to accommodate up to three Type E cruise vessels. Berth 3 appears to be an obvious starting point based on the scheduled winter 2016-17 float retrofit.

The rock pinnacle removal is a necessary inclusion to the development of either of the Berths 1 and 2 expansion alternatives, and should begin at once, given the anticipated lengthy USACE planning, permitting and funding/procurement process for navigation improvements of this scope and nature.

6.0 PORT FACILITY EXPANSION ALTERNATIVES

6.1 Near-term (2017-2019) Improvements

The follow near-term improvements have been authorized and funded through the existing grants for improvements to Berths 1 and 2. The improvements are currently being designed with the expectations that construction will occur in 2017. The proposed improvements will improve the capability and efficiency for existing vessels at these berths up to 1,000' LOA (i.e., Type B).

- The addition of four new bollards: two at the west end of Berth 2; one between Berths 1 and 2; and one at the mooring dolphin at the east end of Berth 1.
- Repairs and upgrades to safety ladders.
- Repair and/or replacement of fender transition plates and timber planks.
- Repair and/or replacement of light poles.
- Bullrail replacement.
- Water line replacement.

In addition to these improvements, it is recommended that 80' of dock length be added to the Berth 3 float while it is in drydock at KSY for its next scheduled maintenance and refitting, following the 2017 cruise season (Option A). This will also require selective demolition and modification of the adjacent Berth 3 fixed dock. The proposed improvements will allow for berthing of vessels up to 1,100' long (i.e., Type D) and will accommodate an additional PAX door. Alternatively, Option B (i.e., simple maintenance and retrofit with no change in geometry) may be selected with no net increase in berthing capacity.

Concurrent with these near-term improvements to Berths 1, 2 and 3, it is recommended that the maintenance items and repairs identified by the Tier 1 and 2 inspections be undertaken.

It is recommended that the subsurface investigation, bathymetric survey, and permitting process associated with removing the rock pinnacle begin at once. It is expected that the regulatory process to obtain a permit for removal and disposal of the material will take at least 12 to 18 months.

6.2 Mid-term (2020-2023) Improvements

Recommended mid-term improvements consist of expanding Berth 4 to accommodate cruise ships up to 1,150' long (i.e., Type E). This will require a longer floating dock and depending on the selected alternative, adding new and/or relocating existing mooring structures. Similar to Berth 3, the longer dock at Berth 4 will allow the use of an additional PAX door which is necessary to efficiently move passengers to and from the larger capacity ships. Concepts A, B or C may be selected, with various costs and associated facility improvements and benefits for each. While Concept C, consisting of a 50 to 80' floating extension to the existing floating dock and the demolition and replacement and/or relocation of one existing dolphin is indeed the least expensive alternative, it is recommended that careful consideration of all three concepts be conducted during the project programming phase.

The physical removal of the pinnacle is included as a mid-term recommendation due to the need to an anticipated lengthy USACE project planning process, and its execution will be dependent upon regulatory agency requirements, their responsiveness throughout the permitting process, and funding availability.

6.3 Long Term (2024+) Improvements

Incorporating floating docks and expanding Berths 1 and 2 are the recommended long-term improvements. This will require extending Berth 1 to the south and will include relocation and/or addition of a new mooring dolphin. Assuming Berth 4 is expanded in the mid-term, the less obtrusive (i.e., to Thomas Basin and adjacent fisheries to the south) Option B can be exercised. These improvements will allow Berth 1 to accommodate cruise ships up to 1,150’ LOA (i.e., Type E) and Berth 2 up to 1,000’ LOA (i.e., Type B). More importantly, the floating component will allow for multiple passenger door access and provide great flexibility in accommodating vessels with overhanging elements. The potential and perceived impacts to Thomas Basin entrance access as well as operations at the adjacent fish processing facilities should be addressed, notwithstanding the selection of Options A or B. The expansion of Berths 1 and 2 is dependent upon the prior removal of the rock pinnacle since it will not allow the larger cruise ships to safely maneuver to the expanded berths with their extended pier head line.

6.4 Summary of Recommendations

Table 6.1 summarizes the alternatives and Ketchikan’s recommended approach to accommodate larger vessels expected to enter the Alaskan cruise market over the next 10 to 15 years. Section 5 details and describes numerous options for Berths 1, 2, 3 and 4 expansion, and the costs presented therein represent the range of base OPPCs[20] of the alternative concepts for each item. Complete build-out of these improvements will allow Ketchikan to continue to operate four berths accommodating four large cruise ships. At least two of the berths will accommodate Type E vessels, and a third Type E vessel may also be accommodated depending on the total combined extension of Berths 1 and 2 that is implemented in the long term.

Phasing, and particularly the selection of preferred expansion options within each of these programmatic scenarios will need to consider available funding and the timely meeting of projected cruise market demand. Each development scenario will result in unique challenges to upland facilities in addition to collateral impacts, both real and perceived, to adjacent waterfront uses. Upland facility and passenger access/egress planning will be needed once an expansion development plan and associated project timelines are determined.

Once a long-range development plan is determined and its timeline projected, additional upland facility and cruise passenger access/egress/flow planning should be undertaken to highlight and address potential upland bottlenecks to the Ketchikan shore excursion experience, from the perspective of cruise passengers, tour providers, and local businesses and residents. By effectively balancing the waterfront and upland improvements, the City will be able to accommodate a significant increase in annual cruise visitors while providing a high quality experience to cruise passengers during their 6-7 hour visit to Ketchikan: Alaska’s gateway port-of-call.

[20] Base OPPCs do not include project contingency. Refer to Table 5.1 and Appendix C for additional detail including estimated ranges of contingency for individual projects.

TABLE 6.1: SUMMARY OF RANGE OF BASE OPPC FOR RECOMMENDED FACILITY EXPANSION BY IMPLEMENTATION TIMELINE

	Near-term (2017-2019)	Mid-term (2020-2023)	Long-term (2024+)
Projects	• Berths 1 and 2 authorized and funded improvements[21] • Berth 3 Expansion while in drydock following 2017 cruise season (Options A or B) • Berths 1, 2 and 3 Corrosion Maintenance and Cathodic Protection • Subsurface investigations, bathymetric survey, and begin permitting process for Rock Pinnacle Removal	• Berth 4 Expansion (Options A, B or C) • Rock Pinnacle Removal	• Berths 1 and 2 Expansion (Options A or B)
OPPC	$5.5 to $12.5 Million	$10.0 to $20.7 Million	$37.0 to $39.5 Million

VIEWPOINT: A LONG-RANGE FACILITY EXPANSION PLAN AND ADDITIONAL UPLANDS PLANNING ARE NEEDED

Possible scenarios to accommodate up to three Type E cruise ships in Ketchikan include: Berths 1, 2 and 3 expansion with no modification to Berth 4; and Berths 1, 3 and 4 expansion with reduced extension towards Thomas Basin Harbor and fisheries to the south. Phasing within each of these programmatic scenarios will need to consider available funding and the timely meeting of projected cruise market demand. Each development scenario will result in unique challenges to upland facilities in addition to collateral impacts, both real and perceived, to adjacent waterfront uses.

Once a long-range development plan is determined and its timeline projected, additional upland facility and cruise passenger access/egress/flow planning should be undertaken to highlight and address potential upland bottlenecks to the Ketchikan shore experience, from the perspective of cruise passengers, local businesses and tour providers alike. This upland planning will effectively balance the planned waterfront improvements and associated upland access and support needs, in order that a significantly higher number of annual visitors can move efficiently and comfortably between their cruise ships and Ketchikan's destination activities.

[21] Near-term costs do not include previously authorized and funded improvements to Berths 1 and 2.

PORT OF KETCHIKAN

BERTHS 1,2, AND 3

KETCHIKAN, AK

CONDITION ASSESSMENT REPORT

Prepared by:

moffatt & nichol

880 H Street, Suite 208

Anchorage, AK 99501

Presented to:

CITY OF KETCHIKAN ALASKA

Port & Harbors

8/8/2016

PORT OF KETCHIKAN

BERTHS 1,2, AND 3

KETCHIKAN, AK

CONDITION ASSESSMENT REPORT

Rev No	1	2	–	–	–
Issue Purpose	Draft Report	Final Report			
Date	7/25/16	8/8/16			
By	PW	CB			
Checked	CB	CB			
Approved	SM	SM			

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Appendices

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1 INTRODUCTION

The Port of Ketchikan, Berths 1, 2, and 3 serve the community of Ketchikan, which is located within the Ketchikan Gateway Borough on Revillagigedo Island. The Berths are adjacent to downtown Ketchikan on the shore of the Tongass Narrows. The berths' infrastructure is primarily intended to receive cruise ships and passengers. The City of Ketchikan receives as many as six ships a day from May to September each year, with as many as 950,000 passengers visiting downtown Ketchikan annually.

In May 2016, The City of Ketchikan retained Moffatt and Nichol to undertake a condition assessment of Berths I, 2, and 3. Berth IV, which is leased by the city, was not inspected under this contract. This report summarizes the findings of the field investigation performed by Moffatt and Nichol. It includes a condition assessment of the structures, recommendations regarding immediate repair or replacement items, an order-of-magnitude cost estimate for repair or replacement items, and recommendations for addition inspection as well as testing, as deemed appropriate.

As directed by the city, the features of the existing components observed included, but were not limited to:

- Global vertical and lateral structural load-resisting pathways
- Secondary structural framing
- Dock fender system
- Mooring cleats, bollards and bullrail;
- Berth 3 barge float
- Breasting and Mooring Dolphins
- Appurtenances
- Tendering Float

2 EXECUTIVE SUMMARY

Classifications of the condition of existing systems and individual elements of construction, as tabulated below, generally conform to descriptions provided in the American Society of Civil Engineers (ASCE) No. 130, *Waterfront Facilities Inspection Manual* (WFIM), Table 2-14 (included in Appendix D of this report) where applicable.

The dock is in overall fair to poor condition with areas that require immediate attention. With some repairs and general maintenance the dock appears to have years of useful life remaining.

A. GENERAL CONDITION ASSESSMENTS:

Classifications of the condition of existing systems and individual elements of construction, as tabulated below, generally conform to descriptions provided in the ASCE's WFIM, Table 2-14 (included in this memorandum) where applicable.

I. Facilities - Overall

Facility Under Consideration	Condition	Recommendation
Berth 1 and 2	Fair	Special purpose inspection. Structural repair of localized minor to moderately damaged structural elements.
Berth 3	Fair	Structural repair or upgrade of localized minor to moderately damaged structural elements.

As expected, the docks at Berths 1, 2 and 3 are in generally fair condition. The WFIM defines the condition of fair as encompassing:

> 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 loadbearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low. (Table 2-14, p. 64)

The present rating of fair is based on the information and data the condition assessment team was able to collect during their inspection. This rating is based on (a) the presence of identifiable damage and potentially advanced deterioration in discrete locations throughout the structures and (b) the need for additional testing and inspection, possibly including limited material sampling, to better ascertain actual material condition.

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II. Individual Systems

Facility Under Consideration	Condition	Recommendation
Berth 1 and 2		
a) Dock – Surface	Satisfactory	Monitor potential voids in ground areas. Regularly inspect expansion joint.
b) Dock – Substructure	Fair	Limited testing on select box beams. Eventual re-coat of substructure.
c) Dock – Support Piles	Fair	Limited weld testing. Periodic re-inspection.
d) Cathodic Protection (CP)	Fair	Eventual replacement of CP system.
e) Fender Systems	Fair	Repair damage, replace missing components. Consider upgrades to reduce “stuck” fenders.
f) Mooring Dolphin	Fair	None
Berth 3		
a) Floating Dock	Good	Repair minor coating damage. Eventual cathodic protection.
b) Transfer Span	Good	Repair minor damage. Modify ramp surface for improved traction.
c) Tendering Float	Fair to Poor	Repair spalled concrete and damaged connections. Mitigate prop wash from cruise ships.
d) Fender Systems	Good	Consider upgrade of dolphin fendering system to reduce “stuck” fenders.
e) Breasting Dolphins	Satisfactory	Install cathodic protection on piling. Eventual re-coating of steel in the intertidal zone.
f) Mooring Dolphins	Satisfactory	Install cathodic protection piling. Eventual re-coating of steel in the intertidal zone.
g) Reaction Dolphins	Satisfactory	Install cathodic protection piling. Eventual re-coating of steel in the intertidal zone.
h) Reaction Pile Hoops	Fair	Replace worn fender units. Consider upgrading pile hoops.
i) Catwalks	Good	None.

B. SUMMARY

Of greatest structural concern at this time are the substructure and support piles at Berth 1 and 2, and the reaction dolphin pile rings and the tendering float at Berth 3.

Berth 1 and 2

The piles and several box beams at Berth 1 and 2 appear to have moderate corrosion damage over discrete portions of their length and circumference/perimeter, as well as at key weld locations. Many of the pile sections are lined with a post-installed sleeve system; the locations and extent of which appears to vary widely from pile to pile. Sealed design drawings (c.2005) detail the installation of the pile wrap, metalized coating, and cathodic protection, though the actual installed location of the pile wrap appears to vary from the plans. No other documentation was available at the time of the inspection which could provide information on exactly when it was installed or what rationale was used in selecting those areas which were sleeved.

With closed sections such as pipe and fabricated box beams, it is necessary to ascertain whether or not this corrosion is limited to the outside surface, rather than originating from within.

In the latter instance, the resulting visible corrosion at the outer surface could be a sign of significant wall loss; which could result in reduction of load-carrying capacity. Additionally, the presence of moderate to major corrosion at the pile/beam interface welds could also present capacity issues, as these welds are a critical step in the principal path for laterally applied loading; such as the dock experiences from side-berthing vessels.

Berth 3

The damage to the pile rings at Berth 3 appears to be associated with an operational constraint; specifically the manner which vessel crews handle – or, mishandle – the mooring lines of ships at berth throughout a portion of the tide cycle. Some of the pile ring internal fender units have been badly damaged by the action of rising and lowering tides while under sustained compression. Some of the units have been removed, reducing the overall dock restraint system effectiveness in resisting seaward drag loads.

The damage to the tendering float appears to be related to its exposure to the wake created by approaching cruise vessels, as well as the directional thrusts applied during their departure. The dock shows significant wear at the joints, and on at least one occasion there was complete failure of some of the mooring hardware, resulting in a moored vessel drifting away, uncontrolled.

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III. Appurtenances

Facility Under Consideration	Condition	Recommendation
Berth 1 and 2		
a) Bullrail	Satisfactory	Repair/minor damage. Possible replacement of some bullrail.
b) Safety Ladders	Satisfactory	Repair minor damage.
c) Bollards	Satisfactory	Repair minor coating damage.
d) Lighting	Fair	Repair/replace moderately damaged light pole.
e) Dock Crane	Satisfactory	Eventual re-certification by 3rd party.
f) Potable Water Systems	Satisfactory	Repair minor damage.
g) Miscellaneous		
- Life Rings	Fair	Repair/replace critically damaged life ring cabinet.
- Fire Extinguishers	Fair	Repair/replace critically damaged life ring cabinet.
Berth 3		
a) Guard Rail	Good	Repair minor coating damage
b) Safety Ladders	Good	None.
c) Capstans	Good	Repair minor coating damage
d) Bollards	Good	Repair minor coating damage
e) Lighting	Good	None.
g) Miscellaneous		
- Life Rings	Good	None.
- Fire Extinguishers	Good	None.

3 PROJECT BACKGOUND

In 2016, Moffatt & Nichol (M&N) was engaged by the City of Ketchikan to execute a port planning and design effort, to support the city in preparation for the expected future growth in the cruise industry. In order to properly support this effort, a comprehensive site inspection was conducted by M&N engineers from the Anchorage, Alaska office.

A. BRIEF FACILITIES HISTORY

The development of the Port of Ketchikan extends back many, many decades. However, a survey of only the most recent efforts to modernize the Port facilities to support large cruise operations proved to be sufficient to support the inspection effort. A brief summary of the principal developments considered follows.

In 1993, Ketchikan undertook a major improvement of what was then known as Berth 1. Based on the new design, the breadth of the existing dock was deepened by adding new dock space in the seaward direction. The expansion resulted in the realignment of nearly four hundred feet of the berth face. Included was an extension of nearly six hundred feet of dock length along that new alignment. While the existing dock was constructed of timber, the dock expansion portion was constructed of structural steel pile and substructure, with precast concrete deck panels. This extended dock face would now facilitate the berthing of two (2) cruise vessels of modest size, end-to-end.

While the project was originally referred to as Berth 1 South, this area is now commonly known as Berth's 1 and 2.

The Spruce Mill Dock replacement was designed in 2005 and the interstitial open spaces between the 1993 addition and the existing dock face was filled in. Construction was structural steel pile and substructure, with precast concrete panels, and reinforced cast-in-place concrete doweled to existing construction as necessary.

Also in 2005, rehabilitation and upgrade of the 1993 Berth 1 South construction was undertaken. This project involved thermal-spray-coating of portions of the structural steel substructure with a zinc product, as well as installation of an aftermarket protective pile wrap system. Also, passive cathodic protection was introduced in the form of anodes welded to piles.

In 2006, design was undertaken of an entirely new cruise ship dock space, which would come to be known as Berth 3. The project transformed the original Berth 2 area into an uplands staging area for the new floating dock facility. A nearby existing small boat harbor facility was replaced with the new Casey Moran floats. Other additions included a tendering float alongside the floating dock, a new portion of dock at Dock Street, the new Ryus float, and a new restroom and covered shelter facility.

The new dock facility included a steel-barge-type float, anchored on station by two (2) multi-steel-pile barge mooring dolphins. A series of steel catwalks extended from the north end of the float to a series of two (2) steel pile and steel cap breasting dolphins, and to a mooring dolphin at the extreme north end of the facility.

In 2008, a series of modifications were made to the new Berth 3 facility. The available drawings indicate bollard replacements and railing modifications, as well as the addition of two (2) bracing struts between the barge float and the southernmost portion of the tendering float. The strut additions were accompanied by the removal of two (2) existing pile hoops from the tendering float, which had been attached to guide pipes mounted to the rear face of the barge float.

Also indicated in this drawing set are the presence of two (2) tendering float guide piles in addition to those indicated in the original Berth 3 construction drawings. Included is bracing extending from the tops of these additional piles to the adjacent catwalk sections. These additional piles are indicated on the Berth 3 modification drawings as though already existing; but there is no available documentation (i.e. drawings, sketches, notes, etc.) which indicates when these pile and bracing were added, or identifies their construction in detail.

Also in 2008, a series of timber dock repairs were undertaken at Berths 1 and 2; which would foreshadow a much more comprehensive renovation of those berths in the coming years.

From 2011 through 2013, design for the first three of four phases of a Berth 1 and 2 rehabilitation effort were undertaken. These initial three phases provided for the replacement of the remaining timber dock with structural steel pile and substructure, and cast-in-place and precast concrete construction.

These improvements were followed in 2013 by the design of a new Port Security building at Berth 2 and a number of site enhancements, including a pair of pedestrian benches and canopies, and bollards.

In 2015, the fourth of the four-phase Berth 1 and 2 rehabilitation was undertaken. In addition to a new bus canopy, log benches, and expansion joint replacement, a new grey water system and new equipment screening was constructed. Additionally, the Ryus float was replaced under this scope of work.

In 2016, Berth 3 experienced an allision event when a large cruise vessel severely impacted several elements of the facility, causing a significant amount of structural damage. Following the incident, several weeks and nearly one million dollars were required to bring the facility back into working order.

B. INSPECTION AND ASSESSMENT PRACTICES AND PROCEDURES

M&N was engaged by the City of Ketchikan (Ketchikan) to execute a routine inspection of the city's Berth 1, 2 and 3 facilities. Ketchikan's desire is to ascertain the general condition of the facility, develop a sense of the future actions necessary to (a) maintain the safety and serviceability of the facility, and (b) plan future expansion to address expected growth in the local cruise industry.

This effort is intended to conform generally to American Society of Civil Engineers (ASCE) document No. 130, *Waterfront Facilities Inspection Manual* (WFIM). In order to most efficiently manage the city's resources, this inspection effort will necessarily involve a two-tiered inspection approach, as described in the WFIM.

Tier 1: Site Condition Assessment.

The first tier is a routine inspection, which is ***included in the present scope of services***, involves conducting a site condition assessment to ascertain the general situation and state of repair of the existing facilities. The assessment is intended to gather limited data to (a) determine whether or not the existing construction generally conforms to existing construction documentation, and (b) broadly identify defects, damage or other deficiencies which may compromise the continuing present and distant future safe operational life of the facility.

As the WFIM suggests, *"Documentation of inspection results should be limited to the collection of data necessary to support these objectives to minimize the expenditure of maintenance resources."* (p. 10) As detailed in the contracted scope of services, this inspection effort was limited to that defined by WFIM as Level I, which involves only visual and tactile inspection (pp. 12, 14), as well as limited ultrasonic thickness testing of a discrete number of structural steel elements.

The goal of the site condition assessment tier of the routine inspection is to assign priority of needed attention (testing, repairs, etc.) to defects, damage and other deficiencies identified during the site condition assessment.

The follow-on activities resulting from a Tier 1 inspection may include a limited analytical effort, used to broadly ascertain structural capacities, by comparing existing conditions to those shown in the construction documentation. Also, broad recommendations regarding repair types or methodologies of repair may be appropriate at the conclusion of some Tier 1 inspections. At such point any resulting analysis or repair recommendations would be considered preliminary, only, and not intended to support a construction effort.

Additionally, any recommendations for repair or upgrade would ordinarily be accompanied by a high-level (i.e. low-granularity) opinion of probable repair costs associated with these recommendations.

Also, the result of a Tier 1 inspection might include a recommendation for additional inspection or testing activities; a Tier 2 effort.

Tier 2: Structural Repair and Upgrade Inspection

The Tier 2 inspection, which is presently ***beyond the current scope of services***, involves a separate repair inspection effort. The purpose of this effort is to obtain detailed documentation of defects, damage or other deficiencies identified during the site condition assessment tier of the inspection effort. As the WFIM suggests, this inspection may take more time and resources to execute than is often afforded in the site condition assessment tier of the inspection.

The level of inspection detail required will depend on the type and severity of the defects, damage or other deficiencies broadly identified during the site condition assessment tier of the routine inspection. The repair inspection effort may include both destructive and non-destructive testing, detailed physical measurement collection, and collection of in situ soils information, as well as additional underwater dive inspection. Special access and instrumentation may be required to properly execute each discrete structural repair inspection activity.

The higher level of detail associated with the Tier 2 inspection is required to support final (i.e. for-construction) design and detailing of any necessary repairs to be implemented, at the city's discretion. For instance, any analytical modeling or opinions of probable repair costs formulated during the site condition assessment (Tier 1) of the routine inspection effort would be updated and/or augmented as necessary by use of the findings of the structural repair inspection (Tier 2).

Brief Overview of Tier 1 Inspection.

Berths 1, 2 and 3, and the Berth 3 tendering float and gangway were each inspected by top-side walk-down. The underside of the Berth 1 and 2 dock structure was inspected by use of a small skiff, provided for use by the Ketchikan port and harbor department.

The inspection was generally limited to visual and tactile assessments, although a limited amount of ultrasonic testing was performed at discrete pile locations; by both M&N personnel from the skiff, and during ACD's dive inspections. Various hand tools were used to ascertain gross dimensional characteristics of the framing; both for the purposes of confirming general conformance to existing design drawings, and to record location and general severity of damage. Comprehensive and detailed as-building was not included in the scoped work for this project.

The condition of the coating system at most field welds precluded the accurate collection of manual weld size measurements. The water level varied from very low to very high during the skiff-mounted underside inspection. Additionally cruise ships were actively arriving and departing during the overall inspection effort. Both of these circumstances necessarily limited available underside inspection time and tactile access to structure. Sufficient time was not available between outgoing and incoming tides to facilitate collection of soundings around the dock footprint, due to the velocity of the current in both directions; although the dive inspection accomplished soundings at those locations inspected along the dock face. Photo-documentation was made of all observed dock surface and underside features of construction, including topside appurtenances, where appropriate.

C. INSPECTION PERFORMANCE

Personnel from M&N's Anchorage, Alaska office traveled to Ketchikan to execute the inspection phase of the project. Paul Wallis, PE, SE and Charles Balzarini, PE executed the inspection during a four-day visit to the site from May 23-27, 2016.

Topside inspection was executed by walk-down of the accessible areas of the facilities. Measurements, probing and other manual inspection activities were conducted with hand tools. Concrete delamination inspection was conducted by drag of a simple length of heavy chain.

Underside inspection was facilitated by provision of a small skiff by the Port and Harbors division. Mr. Balzarini was the principal operator of the skiff during the underside inspection portion. Inspection was visual and tactile, with some limited use of small-scale ultrasonic investigation of pile wall thickness.

Also during that time, a periodic underwater inspection was conducted by Alaska Commercial Divers (ACD) with support and direction from Moffatt Nichol Engineers. Mr. Balzarini remained onsite until May 28 to support the latter effort to conclusion.

ACD proceeded to execute dive inspection on sixty (60) steel vertical piles along Berths 1, 2 and 3, compiling a video record of condition and discrete thickness measurements.

4 FEATURES OF DESIGN AND CONSTRUCTION

Berth 1 and 2.

Berths 1 and 2 are pile supported dock structures arranged as shown in the 1993 design drawings titled ”Ketchikan Berth 1 South“. The dock extends roughly northwest/southeast. While much of the dock is marginal to the shoreline, the south 600 ft (+/-) of the dock features mooring space on the both the seaward face and the shoreward face of the dock, with a timber fender pile system on the latter side. The dock is of conventional construction with a concrete deck on a steel substructure, supported by steel pipe piling. Steel fender panels with floating fenders and arch fenders serve to absorb and transmit pseudo-static mooring loads and dynamic berthing energy. Additionally, the dock is outfitted with mooring bollards, bullrails, and safety appurtenances, as well as a pedestal crane. A single mooring dolphin resides to the south of Berth 1 and 2.

Berth 3.

Berth 3 features a floating barge-style dock of steel construction, restrained by steel guide piles incorporated into barge float mooring dolphins. A transfer span provides pedestrian and vehicular access from the barge float to a pile supported platform. There are two breasting dolphins and a mooring dolphin which are accessible by a series of catwalks between the float and dolphins. The berthing line is generally east-west in orientation, at an oblique from the shore and from the berthing line of Berth 1 and 2. A concrete tendering float parallels the berthing line on the north side of the barge float. The barge float and breasting and mooring dolphins feature various appurtenances including safety equipment, bollards and capstans, as well as safety railing.

A. GENERAL DOCK ARRANGEMENT AND FEATURES

Berth 1 and 2.

The Berth 1 and 2 dock is approximately 1450 feet long. The northern 375’ (nominal) length of dock (referred to in the original construction documents as the “Berth 1 Addition”) is nominally 26’ in width as originally constructed. A series of recent rehabilitation projects (circa 2012) expanded the usable concrete deck area to a nominal width of approximately 66’.

The center 806’ (nominal) length of dock (referred to in the original construction documents as “Berth 1 South”) is nominally 50’ in width.

The southern 271’ (nominal) length of dock (referred to in the original construction documents as the “Berth 1 South Extension”) is nominally 26’ in width.

The facility is constructed of large diameter steel pipe piles, supporting fabricated box beam type steel framing, surfaced with a precast/prestressed concrete plank panel deck. (See Fig. 1)

The dock support piling include 24” nominal diameter pipe (NDP) vertical (plumb) and 2:1 battered sections with 1/2”nominal wall thicknesses. Depending on soil conditions and design loading, some of the piling are equipped with a proprietary flight-plate-type system on the embedded end of the pipe, while others are anchored into the bedrock. Aluminum anodes are installed on the piling, as is a pile wrap system consisting of primer, marine tape, and a bolt-on plastic outer cover

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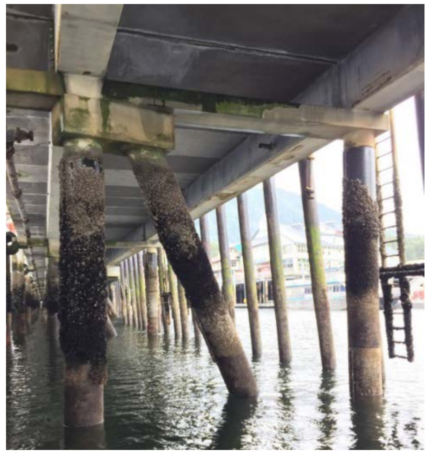

Figure 1: Vertical and Battered Steel Pipe Piles

The substructure framing is comprised of heavy steel fabricated sections. The pile caps are constructed of (2) HP 14x73 sections welded together longitudinally, with full length cover plates (see Fig. 2). At locations with battered piles, box shaped sub-caps fabricated from 1" thick steel plate, are installed below the pile caps (see Fig. 3). The pile caps support steel box girders with 1-1/2" thick bottom plates, ¾" thick top plates, and 7/16" side plates. The box girders range from 40-42" tall and 28 to 30" wide. The box girders run longitudinal along the dock (see Fig. 4).

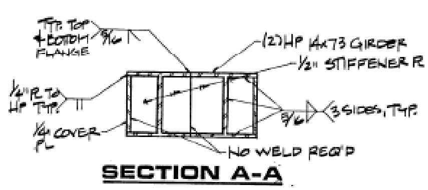

Figure 2: Pile Cap

(NOTE: All Drawing Excerpts Courtesy City of Ketchikan, Typ. UNO)

Figure 3: Batter Pile Sub Cap

Figure 4: Box Girder

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Precast concrete deck panels span between the box girders. The panels are 12-1/2" thick with a combination of pre-tensioned 0.5" strands and mild reinforcing bars. Where the panels extend across the box girders, near each longitudinal edge of the dock, the panels are grouted from above through pre-formed slots through the panel cross section (see Figs. 5 and 5a). Panel ends are grouted together across a field of headed shear studs, which are welded to the top plate of the box girders. Mild reinforcing extensions cast into the panels are lapped at the end joint (see Figs. 6 and 6a).

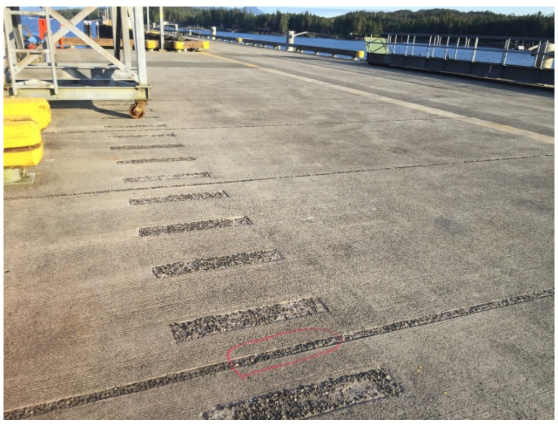

Figure 5: Grout Slots Over Box Girder

Figure 6. Panel End Joints at Box Girder

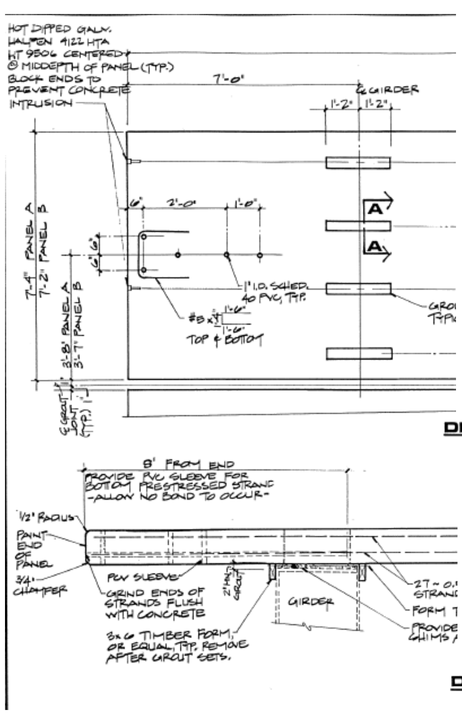

Figure 5a: Grout Slots Over Box Girder

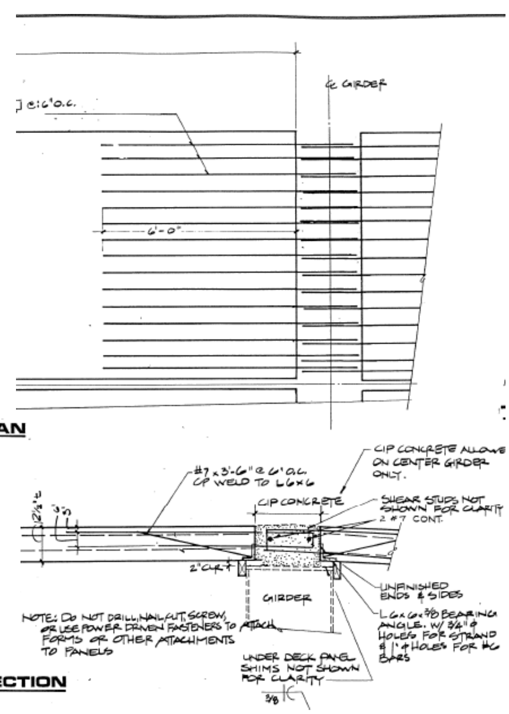

Figure 6a: Panel End Joints at Box Girder

The faces of the dock are lined with 12x12 timber bullrail, supported by 8" diameter pipe assemblies with steel base plates. Some sections of bullrail have been made removable to accommodate cruise ship ramp access. For much of this dock, the bullrail serves as more of a guardrail to keep vehicles and passengers from approaching the very edge of the deck. The bullrail does not appear to be meant to serve as a mooring point for vessels.

Figure 7: Bullrail and Support

Figure 8: Removable Bullrail

The seaward face of the dock is protected by a fender system. The fender system consists of foam-filled floating fenders backed by a timber and steel fender panel assembly (see Fig. 9a). Sixteen inch (16") Fender piling, driven into the sea floor, support the fender panel. Pairs of energy-absorbing circular fender units are provided between each fender panel and the dock face (see Fig. 9b). These units accommodate some relative movement of the fender panels at the dock face, and provide additional energy absorption during vessel berthing. Fender panels are typically located at each pile bent. Each panel features a safety ladder which is located coincident to the vertical centerline of the panel. A steel transition plate extends between the fender panel and dock.

Figure 9a: Typical Fender Panel

Figure 9b: Typical Fender Panel

Mooring bollards are installed at regular intervals between each fender panel. The bollards are constructed of 20” diameter steel pipe piling, with 8” diameter standard pipe cross bar (see Fig. 10a). Twenty inch (20”) piling are driven into the sea floor and fastened to the concrete deck of the dock (see Fig. 10b). A 12X12 timber is attached to the face of the pile, acting as a rub strip.

Figure 10: Typical Mooring Bollard

Figure 10: Typical Mooring Bollard

On the landward side of the southern end of the dock, round timber fender piles comprise the fender system. Fender piles are spaced at approximately 6.5 ft o.c. and are attached to the concrete deck by means of a steel support sleeve, which is attached at the bullrail bolts. Safety ladders are typically located on the centerline of the transverse dock bents. The landward side of the dock is reportedly lightly used by commercial fishing vessels and other smaller craft. Cruise ships of any significant size are not known to make berth on this dock face.

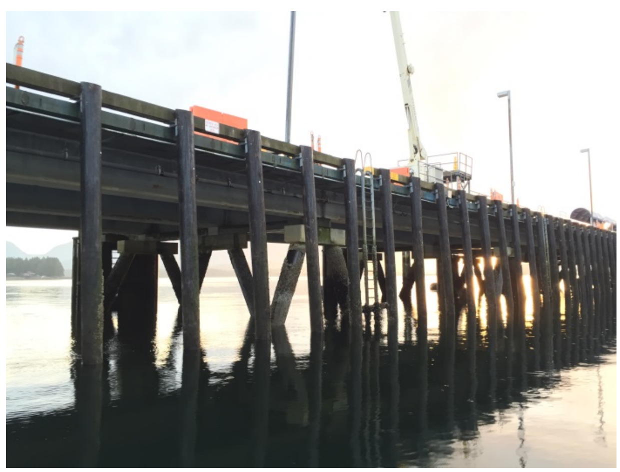

Figure 11: Timber Fender Piling

Berth 1 and 2 are fitted with a range of appurtenances, including potable water hydrants, overhead lighting, navigation lights, life ring cabinets, safety ladders, and a pedestal type deck crane (see figs. 12-17).

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Figure 12: Water Hydrant

Figure 13: Lighting

Figure 14: Navigation Light

Figure 15: Life Ring Cabinet

Figure 16: Safety Ladder

Figure 17: Crane

Berth 3.

Berth 3 primarily consists of a barge type float of steel construction, laterally restrained by two reaction dolphins; referred to the by construction drawings as “barge float mooring dolphins”. Berth 3, which was constructed in 2007, is detailed in a design drawing set (c.2006) titled “Port Berth Reconfiguration”. The barge measures 300 feet long and 50 feet wide, and has a freeboard of approximately 10 feet.

The barge itself is constructed of a steel plate shell, with internal framing primarily constructed of steel angle trusses (see Figs. 18 and 18a). Two outboard pile hoops constructed of 16x16 square tube frame assemblies are welded to the float. Each hoop assembly is compartmentalized to accommodate three (3) 48” diameter guide piles. The inner surface of the guide pile compartments is lined on all four sides by energy-absorbing arch fender units. Each arch fenders has a UHMW-PE outer low-friction shield at the pile contact face (see Figs. 19 and 19a).

Figure 18: Barge

Figure 19: Guide Piling

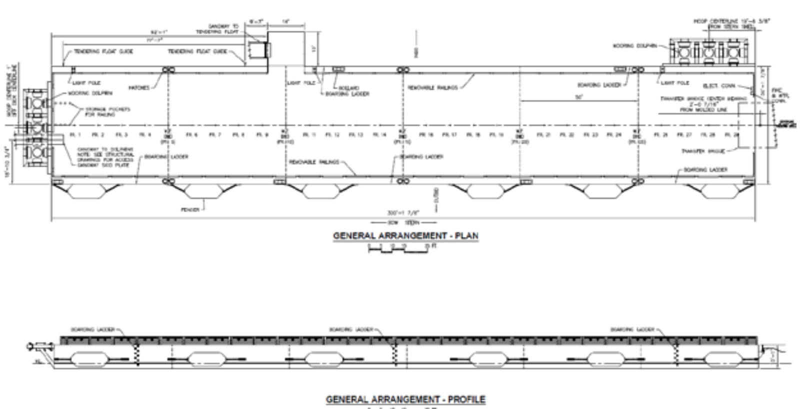

Figure 18a: Barge

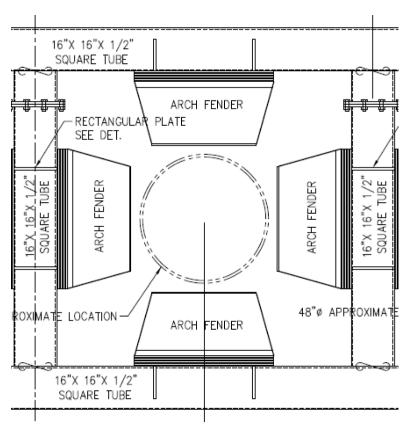

Figure 19b: Guide Piling

The barge float mooring dolphins are comprised of the three (3) vertical guide piles, as well as batter pile(s). The guide piles are anchored into the bedrock and extend up to box type dolphin cap constructed of 1" continuously welded steel plate. The northern barge float mooring dolphin is laterally supported by a single 48" diameter batter pile, which is oriented at an oblique horizontal angle from the line of guide piles. The southern dolphin features two 48" diameter batter piles (see Fig. 20). One of these is horizontally oriented parallel to the line of guide piles, while the other is oriented transverse (see fig. 21).

Figure 20: North BFMD

Figure 21: South BFMD

Shore access to the barge float is provided by a 130 foot long transfer bridge. The transfer bridge features a 6 foot wide covered pedestrian route, and an 11 foot wide vehicle ramp. The 9/16" thick steel deck is coated with a non-slip surface on the walkway and a non-skid surface on the driving lane. The sub-framing is constructed of built up sections of steel plate. The deck serves as a top flange with ½" plate and 1-1/4" plate sections serving as the web and bottom flanges. Bent plate longitudinal stringers run between the built up sections (see Fig. 22a).

The transfer bridge features a sliding rocker assembly at the shore side connection, while the barge float end features a rocker that is detailed to restrain that end from transverse and longitudinal translation. A submerged supplementary float section provides reserve buoyancy, reducing the effective weight of the transfer bridge on the barge float (see Fig. 22b).

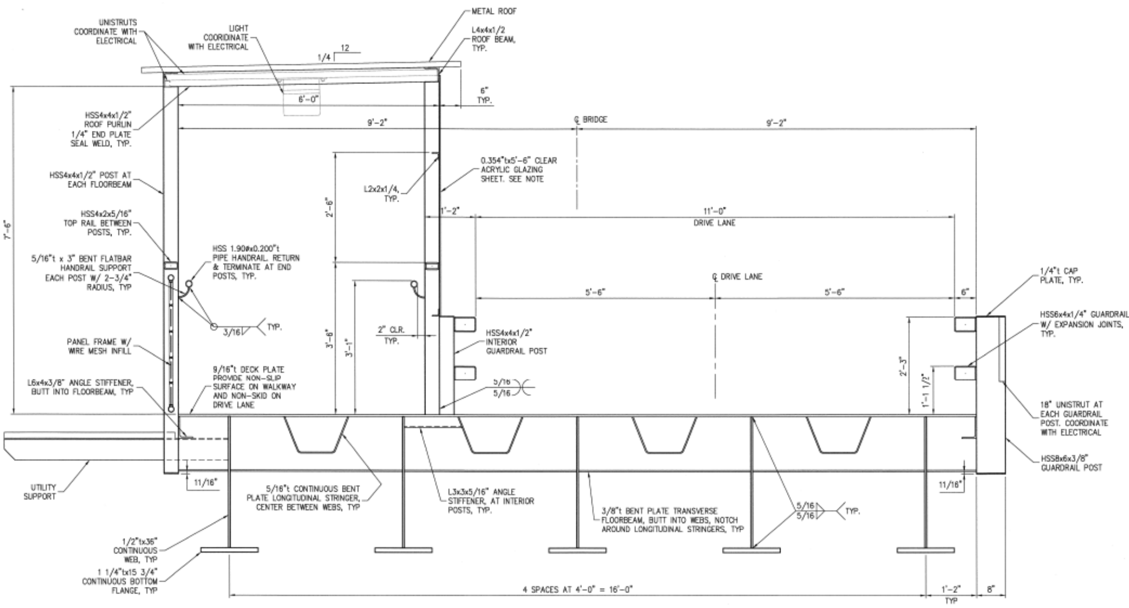

Figure 22a: Transfer Bridge

Figure 22b: Transfer Bridge

The transfer bridge connects the float to the Berth 3 platform; a triangular shaped platform with the seaward face measuring 244 feet long and the perpendicular face measureing approximately 93 feet. Similar to Berth 1 and 2, the structure is constructed on a foundation of steel pipe piling with steel framing and a precast panel concrete deck. The platform was provided with steel fender panel assemblies and mooring bollards at discrete locations along its face.

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The Berth 3 Platform is supported by 36” diameter plumb piling with 24” battered piling providing lateral stability. The piling are either pinned or rock anchored to the bedrock. Each vertical pile is welded to a steel pile cap which is a built up section using (3) W 30x191 wide flange sections (see Figs. 24a and 24b). Shear studs on top of the pile caps are used to connect the precast panels to the pile cap. The panels consist of 16” thick x 4’-10” wide x 27’-4” long precast/prestressed concrete planks (see Figs. 23a and 23b). The panel reinforcing consists of numerous 7–wire pre-stressing strands and mild steel reinforcement.

The Berth 3 Platform fender panels consist of a fabricated steel assembly composed of two 4’-3” outside diameter sleeve pipes that slide over the 48” diameter fender piles. A pair of 16” square HSS vertical infill tubes are positioned between the pipes to provide additional lateral support to the floating foam filled floating fenders. The floating fenders are secured to a 16” diameter x 1/2" wall thickness guide pipes with chained chafing rings at each end of each float. This is meant to hold the fenders on station while allowing them to accommodate the changes in tide (see Fig. 27).

The seaward edges of the platform are lined with a steel pipe bullrail which acts as a guardrail for vehicles and pedestrians. Mooring bollards are constructed similar to those on Berth 1 and 2, using a 24” diameter pipe pile rock anchored into the bedrock. The bollard cross bar is a nominal 8” diameter pipe section. The pile is bolted to the concrete deck with an attachment plate weldment.

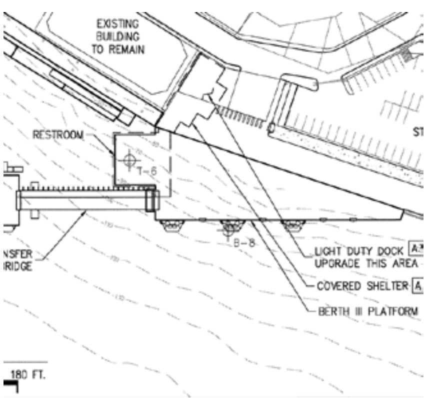

Figure 23a: Berth 3 Platform

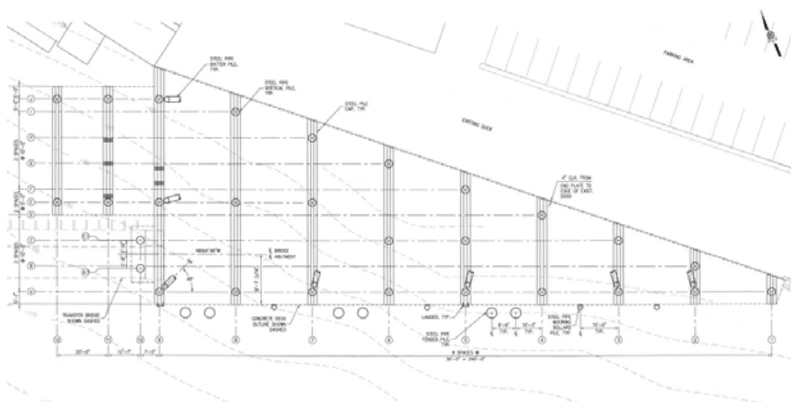

Figure 24a: Piling and Cap

Figure 23b: Berth 3 Platform

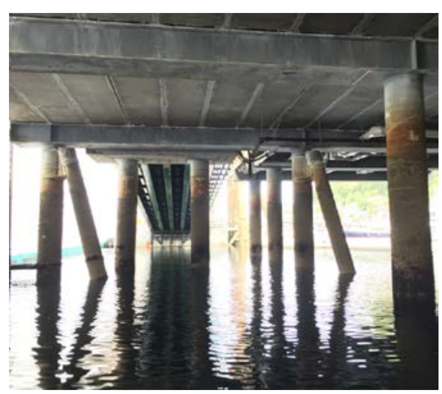

Figure 24b: Piling and Cap

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Berth 3 features three (3) dolphin structures used for cruise ship mooring and berthing activities. A single mooring dolphin is positioned at the far north end of the facility. Located behind the breasting line, this dolphin is intended for mooring only (see Fig. 25). Two breasting dolphins are positioned on the mooring line, in succession just north of barge float (see Fig. 26). The mooring and breasting dolphins all have bollards and capstans to aid in line handling. All of these dolphins have catwalk access from the barge float, as well as safety ladders and other appurtenances.

Figure 25: Mooring Dolphin

Figure 26 Breasting Dolphin

The mooring and breasting dolphins are nearly identical to one another in construction. The dolphins consist of 3 pipe piles; a plumb king pile, and two batter piles. The king piles are 48” diameter steel pipe piling with 1” thick walls. The battered piles have 7/8” thick walls. The pipes are welded to heavy plate steel caps which are fabricated from 1” thick plate sections. The caps are approximately 4 feet tall with a 16 foot square foot print. Each of the dolphins have a fender panel attached to their outboard edge. The fender panels at the mooring and breasting dolphins are nearly identical to the fender panels at the Berth 3 Platform.

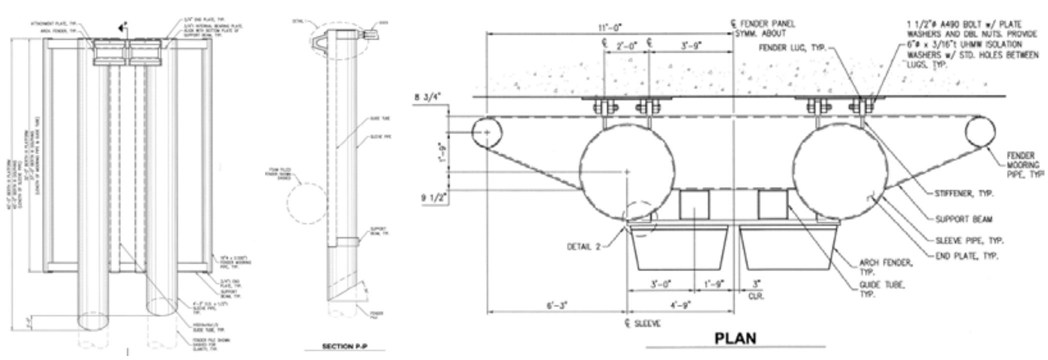

Figure 27: Typical Fender Panel

The breasting and mooring dolphin caps, and catwalks feature appurtenances including capstans with quick disconnect bollards, safety ladders, overhead lighting, and life ring and fire extinguisher cabinets.

Figure 28a: Capstan / Appurtenances

The mooring and breasting dolphin caps are accessible by means of a series of steel catwalks, spanning from the barge float to the first breasting dolphin, then between each dolphin. The catwalks connecting the barge float to the first breasting dolphin (catwalk 1) and the catwalk connecting the first breasting dolphin to the second breasting dolphin (catwalk 2) are both 90’ long single span pony trusses, with 4” square HSS chords and 3” square HSS webs. The catwalk between the second breasting dolphin and the mooring dolphin is a 100’ long single span pony truss with 5” HSS chords and 4” square HSS webs. All catwalks are proportioned approximately 3’-11” out-to-out, both vertically and horizontally. All catwalks are decked with 1-1/4” steel bar grating, with bearing bars oriented parallel to the path of travel.

Figure 28b: Catwalks

A tendering float is provided on the shoreward side of the barge float. The tendering float is oriented parallel to the longitudinal axis of the barge float. The tendering float is a small vessel berthing facility constructed using precast monolithic concrete float modules (see Fig. 29a). The tendering float is approximately 406’ long and 12’-10” wide and is comprised of 45 foot long precast concrete modules. The precast concrete shell has a 5” thick deck and is filled with a solid polystyrene flotation core. Concrete modules butt together end-to-end and are joined with 1-1/4” diameter through rods. The rods are recessed into pockets on the side of the float module with one pocket elongated to facilitate rod removal. The rods are encased in a rubber connection block with 2” thick rubber washers behind the nuts to allow differential movement between float modules. A neoprene bearing pad is also inserted at each concrete section joint to mitigate dynamic impact between the concrete edges of adjacent float sections (see Fig. 29a).

Figure 29a: Concrete Modules

The tendering float is held on station by five (5) - 24” diameter guide piles, two (2) of which were added after the initial construction. The tendering float is also secured to the barge float near the southern and northern ends of the latter by means of hinged pipe struts. These were also added after the initial construction (see Fig. 29b).

Figure 29b: Guide Piles, Pipe Struts

There are a number of appurtenances located on the tendering float, including mooring cleats, vessel power pedestals, overhead lighting, and life ring and fire extinguisher cabinets (see Fig. 29c).

Figure 29c: Appurtenances

Access to the tendering float is provided by a 6 foot wide by 80 foot long aluminum covered gangway (see Fig. 29d).

Figure 29d: Aluminum Gangway

B. GENERAL DESIGN CRITERIA

Occurring over a period of decades, the design requirements for each phase of the improvements of the Ketchikan cruise ship facilities have necessarily varied. This section provides a general overview of those requirements for the principal improvement projects under consideration. Those are: Berth 1 South (design c.1993), Berth 3 (design c.2006), Berth 1, 2 Phase 1 (design c.2012), Berth 1, 2 Phase 2 (design c.2012), Berth 1, 2 Phase 3 (design c.2013), and Berth 1, 2 Phase 4 (design c.2015).

I. Loading Considerations

According to the available project documentation, design loads utilized on the various port projects (i.e. Berth 1 South, and Berth 1, 2 Phases 1, 2, 3 and 4) conformed to the following:

Ground Snow: 55 psf Uniform (Berth 3, Berth 1, 2 Phase 1, 2, 3); not stated (Berth 1 South)

Roof Snow: 40 psf Uniform (Berth 1, 2 Phase 4)

Live Load:

Main Dock, AASHTO HS-20, 50-ton Forklift Axle, 400 psf Uniform (overload), 80-ton Mobile Crane (with mats, by diagram) (Berth 1 South);

250 psf Uniform, AASHTO H-20, 100 psf Uniform (gangways), 85 psf Uniform (transfer bridge), AASHTO H-15 (transfer bridge), 100 psf (promenade), 20 psf Uniform (floats), 60 psf (catwalk/dolphins) (Berth 3);

250 psf Uniform (combined future dead, live and snow load), AASHTO HS-25 (by diagram), Large Bus Axle (by diagram), Small Bus Axle (by diagram) (Berth 1, 2 Phase 1, 2, 3);

not stated (Berth 1, 2 Phase 4)

Wind Design Parameters: IBC 120 mph 3-sec gust, Exposure D (Berth 3); 100 mph Base Wind Speed per AASHTO (Berth 1, 2 Phase 1, 2, 3); 150 mph 3-second gust (Berth 1, 2 Phase 4); not stated (Berth 1 South)

Seismic Design Parameters: Equiv. Static Load = 0.2 W (any direction) (Berth 1 South); AASHTO Acceleration Coefficients, A = 0.07, Importance Classification, IC = II, Seismic Performance Category, SPC = A, Site Coefficient, S = 1, Response Modification Factor, R = 1 (connections), Analysis Procedure = 1 (Berth 4); Site Class B, PGA = 0.085, S_S = 0.185, S_1 = 0.141 (Berth 1, 2 Phase 1); Site Class C, PGA = 0.085, S_S = 0.185, S_1 = 0.142 (Berth 1, 2 Phase 2, 3); Site Class C, SDC B, S_S = 0.302, S_1 = 0.247 (Berth 1, 2 Phase 4)

Tidal Range: EHW = +20.8’ (estimated), MHW = +14.4’, MLW = 0’, ELW = -5’ (estimated) (Berth 1 South)

Berthing Energy: 135 ft-kips, due to 800 ft long x 125’ beam x 70,000 ton displacement design vessel (Berth 1 South); 260 ft-kips shoreward (1/4 point berthing at any one dolphin), due to 1,000 ft long x 135’ beam x 65,000 tonnes displacement design vessel (Berth 3).

Mooring Loads: 200 kips (any direction) (Berth 1 South); 350 kips (net line pull) at H = +/-90 deg and V = +/-30 deg. (Berth 3)

II. Structural Wood Components

According to the available project documentation, structural wood components utilized on the various port projects (i.e. Berth 1 South, and Berth 1, 2 Phases 1, 2, 3 and 4) conformed to the following:

Sawn Timber, Dimensioned Lumber: Coast Region Douglas Fir No. 1 or Better (Berth 1 South; Berth 1, 2 Phase 1, 2, 3); Coast Region Douglas Fir Select Structural (Berth 3); Alaskan Yellow Cedar No. 1 or Better, Douglas Fir-Larch North No. 2 and Better (Berth 1, 2 Phase 4)

Glued-Laminated Timber: Coast Region Douglas Fir 24F-V4 (Berth 1 South); Coast Region Douglas Fir, F_b = 2,4000 psi, F_v = 165 psi, E = 1.8e6 psi

Wood Treatment, Sawn Timber, Dimensioned Lumber: ACZA 0.60 pcf (typical), 2.5 pcf (fenders) (Berth 1 South); ACZA 0.60 pcf (Berth 3, Berth 1, 2 Phase 1, 2, 3); Pressure Treated (Berth 1, 2 Phase 4)

Wood Treatment, Glued-Laminated Timber: Creosote 12 pcf (Berth 1 South, Berth 3)

III. Structural Steel Components

According to the available project documentation, steel utilized on the various port projects (i.e. Berth 1 South, and Berth 1, 2 Phases 1, 2, 3 and 4) projects conformed to the following:

Piling Pipe: ASTM A252, Grade 3 (all berths)

Misc. Pipe and Sleeves: ASTM A53, Grade B (all berths)

Square and Rectangular Structural Tube, HSS: ASTM A500, Grade B (all berths)

Round HSS: ASTM A500, Grade B or C (Berth 3)

Wide-Flange Sections: ASTM A572, Grade 50 (Berth 1 South); ASTM A36 (Spruce Mill Dock replacement); ASTM A992 (all other berth work)

HP Shapes: ASTM A572, Gr. 50 (all berths)

Steel Sheet Pile: API 5Lx 60 (Spruce Mill Dock replacement)

Misc. Rolled Shapes: ASTM A36 (all berths)

Misc. Plate: ASTM A36 (Berth 1 South, Spruce Mill Dock replacement); ASTM A572, Gr. 50

(all other berth work)

Misc. Flat Bar: ASTM A36 (Berth 1 South, Berth 1 and 2 Phases 1, 2 and 3); ASTM A572, Gr. 50 (Berth 3)

High-Strength Fasteners, Threaded Anchors: ASTM A325 (all berths); ASTM F1554 Grade 55 (all berths)

All Other Threaded Structural Steel Fasteners: ASTM A307 (all berths)

Welding was executed according provisions of American Welding Society (AWS) standard D1.1, "Structural Welding Code – Steel"; with a weld material of not less than 70 ksi ultimate strength.

All steel shapes and fasteners appear to have been galvanized, per the project technical specifications, by a hot-dipped process according to ASTM A123 and/or A153.

Berth 1, 2 Phases 1, 2 and 3 indicate that, "Cathodic protection is provided by galvanization. After 10 years, Owner shall inspect and provide anodes if necessary."

According to record documents for the project Phase 1 Port Improvements (City Contract 05-27, c.2005), 90 lb aluminum anodes were added to the vertical and batter piles at the original Berth 1 South construction, and each pile was outfitted with a SeaShield pile wrap system, to some extent.

IV. Structural Concrete Components

According to the available project documentation, concrete utilized on the various port projects (i.e. Berth 1 South, and Berth 1, 2 Phases 1, 2, 3 and 4) conformed to the following:

Minimum (28-day) compressive strength, f'c, Cast-in-place (CIP) Concrete: 6,000 psi (Berth 1 South; Berth 1, 2 Phase 1, 2, 3); 4,000 psi (Berth 1, 2 Phase 4)

Minimum (28-day) compressive strength, f'c, Precast Concrete (PC): 8,000 psi (Berth 1 South; Berth 1,2, Phase 1, 2, 3)

Minimum Concrete Content, CIP: 6 sacks/CY (Berth 1, 2 all phases); not stated (Berth 1 South); not stated (Berth 1 South)

Minimum Concrete Content, PC: 7 sacks/CY (Berth 1, 2 all phases); not stated (Berth 1 South)

Maximum Water/Cement, CIP: 0.40 (Berth 1, 2 Phase 1, 2, 3); 0.45 (Berth 1, 2 Phase 4); not stated (Berth 1 South)

Maximum Water/Cement, PC: 0.40 (Berth 1, 2 all phases); not stated (Berth 1 South)

Tri-Calcium Aluminate Content, CIP, PC: < 8% (Berth 1 South; Berth 1, 2 all phases)

Air Entrainement, CIP, PC: 4-7% (Berth 1 South); 5-8% (all remaining berths)

Maximum Aggregate, CIP, PC: ASTM C33 3/4" (all berths)

Mild Reinforcing, CIP, PC: ASTM A615, Gr. 60 (Berth 1, 2 Phase 4); ASTM A615, Gr. 60 galvanized (Berth 1 South); ASTM A615, Gr. 60, galvanized to ASTM A767 (Berth 1, 2 Phase 1, 2, 3)

Prestressting Tendons, PC: ASTM A416, 7-wire strand, Gr. 270 (Berth 1 South); ASTM A416, 7-wire low-relaxation strand, Gr. 270 (Berth 1, 2 all phases)

Shear Studs: ASTM A108, Gr. 1015, Field-Welded Per AWS (Berth 1 South); ASTM A108, Gr. 1015, Welded Full-Strength (Berth 1, 2 Phases 1, 2, and 3)

5 INSPECTION FINDINGS AND RECOMMENDATIONS BERTH 1 AND 2

Berth 1 and 2

The dock is in overall fair condition with a few areas that require attention. With some repairs and general maintenance, the dock appears to have years of useful life remaining. The repair recommendations identified in this report do not generally pose immediate concern for the structure.

A. GENERAL FIELD OBSERVATIONS

This section provides general discussion of the assessed condition of each significant element of construction as described in section 2.A above.

I. Dock – Surface- Precast Panels

Exposure to the elements and ordinary service occupancy has caused normal wear and tear to the surface of the precast pre-stressed concrete panels, though no significant defects were observed. Regular cleaning and maintenance likely contribute to the overall satisfactory condition of the deck. A chain drag inspection identified several locations at grouted joints between panels with apparent voids in the grout. These areas have been identified on a plan drawing included in Appendix B

Figure 30: Typical Deck Surface

Figure 31: Apparent Grout Voids

The south east corner of the dock shows signs of impact damage. The damaged concrete is behind a steel fender pile, apparently installed to protect the corner of the dock. The design drawings show 3 timber fenders piling as corner protection at this location. It's possible that the timber fender piling were damaged in the same event that damaged the dock corner, and that the steel fender piling was installed as a replacement. The damaged concrete should be patched to prevent corrosion of the reinforcing steel.

Figure 32: Damaged Corner

II. Expansion Joint

The entire length of the Berth 1 and 2 expansion joint was inspected. No significant defects or damage was noted, beyond normal debris accumulation.

Figure 33: Expansion Joint

III. Dock – Substructure

The dock's box girder substructure framing appears on the whole to be in generally serviceable repair. Corrosion appears to be the only significant impact to the remaining life of the substructure. The box girders were originally spray metalized prior to their installation in 1994. It is believed that the box girders were blasted and re-metalized circa 2005 as part of a corrosion mitigation project. The box girders are again showing signs of corrosion. The corrosion is primarily located on the bottom face of the beams and more prominent on the seaward girders. It is not apparent whether the corrosion has occurred as a direct result of coating failure or if the material is corroding beneath the coating, causing the coating to fail. It is also possible that the water-tightness of the box has been compromised at locations which have allowed rainwater to infiltrate; causing the corrosion to initiate from within the section.

Additionally, it was noted during a rain event; which occurred during the underside inspection, that runoff at the seaward edge of the dock tends to travel back along the top flange of the double-H pile cap. Corrosion also appears to occur more frequently at locations where the box girder welds to the pile caps. It is possible that water tends to pond at these locations, causing more corrosion on the girders themselves and at the welded connection.

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Figure 34: Box Girder Corrosion

The pile caps generally show no signs of damage beyond localized, moderate coating failure and corrosion. The locations of coating damage are infrequent but tend to occur where the box girders weld to the caps.

The batter pile sub caps show no signs of damage beyond localized minor coating failure and corrosion. The minor coating failure occurs most commonly at corners or where the sub cap welds to the pile cap.

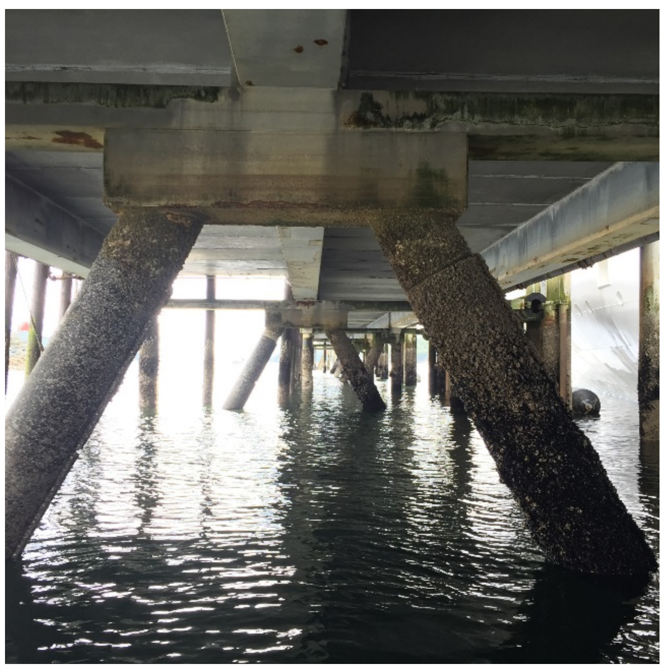

Figure 35: Pile Cap and Sub Cap Corrosion

IV. Dock – Support piles

The support piling are generally undamaged, other than the expected galvanized coating loss. Many of the piling were wrapped c.2005, presumably in areas that were experiencing corrosion and/or coating failure. It appears that these areas are primarily located in the tidal zone where the pile is subject to wetting and drying during the tide cycle. On many structures, this region often experiences increased corrosion over the rest of the structure, due to increased oxygenation and water velocity by wave action, as well as the ineffectiveness of the anodes protecting the portion of the structure that is not submerged. Corrosion tends to peak around the high tide and low tide lines. Figure 35a shows the typical relative magnitude of corrosion for different regions of submerged steel piling.

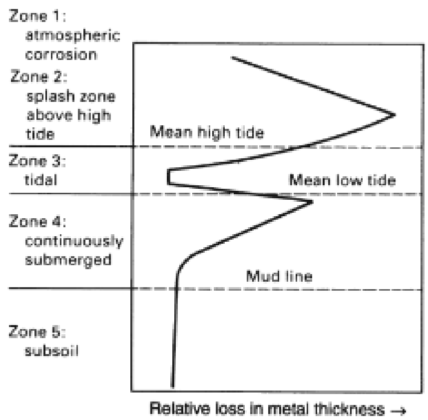

Figure 35a: Relative Pile Corrosion

Besides visual observations, ultrasonic thickness readings were attempted on a sampling of the piling. The ultrasonic thickness readings indicated minimal section loss of the piling likely due to the effectiveness of the cathodic protection system.

During inspection of the piling the galvanized coating was observed to be mostly intact with localized areas of coating failure, as should be expected for a facility of this age. No structural damage was observed on any of the piling inspected. Typical levels of marine growth were observed on the piling.

A summary of the pile underwater visual and UT inspection is included in Appendix C of this report.

V. Dock – Support Piles Cathodic Protection

The cathodic protection system is believed to have been installed around 2005. The system consists of sacrificial aluminum anodes welded directly to the steel pipe piling. During the underwater inspection, anodes were visually and tactilely inspected when encountered. Of the anodes inspected, most were observed to have between 25% and 50% of their sections remaining. The anodes will continue to be consumed as they protect the structure. It is estimated that the anodes inspected have between 5 and 10 years of useful life remaining, assuming they are consumed at a similar rate. After the anodes are consumed, the galvanized coating will be consumed at a more advanced rate and eventually the piling will begin to experience section loss and reduced structural capacity due to corrosion. The condition of encountered and inspected anodes during the underwater inspection is included in Appendix C.

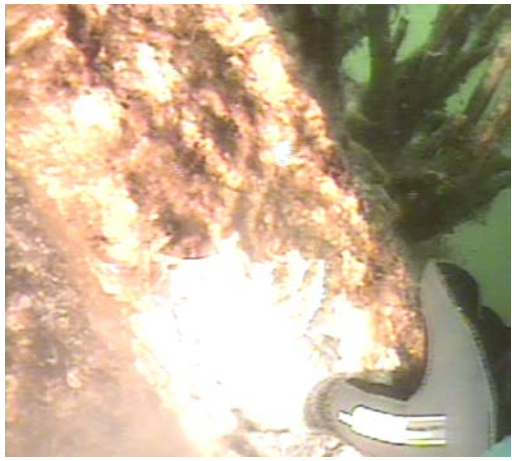

Figure 36: Typical Anode

VI. Dock – Fender Panels

The fender panels are of critical importance for protecting the dock structure, the berthing or moored vessel, and its passengers. The fender panels are generally in fair condition. The foam filled floating fenders on the face of each fender panel serve to provide the bulk of the dynamic energy absorption, particularly during normal and abnormal berthing events.

During the inspection, it was noted that at several of the floating fenders the restraint chain became bound upon their guide pipes on one or both ends, causing them to become fully or partially submerged or suspended based on the elevation of the tide. Fenders inadvertently bound up in such position could cause or worsen damage to the structure during a hard or abnormal berthing event. If a vessel hull were to fail to make contact with the fender, it might impact the fender panel structure beyond, resulting in dangerously high levels of energy transfer.

Figure 37: Fender Panel with Bound Fender (submerged)

The arch fenders at the top of the fender panel serve to absorb small amounts of berthing energy and accommodate small movements of moored vessels. The circular fender units between the fender panel and the dock serve to absorb additional energy and provide a flexible connection between the dock and the fender panel. Obvious defects were not observed on the arch and circular fender units. But as these units continue to age resist cyclic loading, they will likely develop cracks and checks, which will be an indicator of reduced performance.

Damage was observed on the timber fender panel planks. Damage was more prevalent where the planks cantilever past the steel wale that connects the panel to the circular fender units. The damage generally consists of moderate cracks, splits, and abrasions in the planks. One Plank on the southern-most dolphin was found to be fractured where it bolts to the wale.

Figure 38: damaged Fender Planks

Corrosion was noted on the fasteners that tie the timber planks to the steel wale many fasteners are showing complete coating loss and moderate corrosion, where visible. It is possible that the length of fastener passing through the planks themselves are severely corroded to the tendency of the wood to trap moisture and the potential for reaction between the treated wood and the steel bolts. Wood treatments containing copper are known to corrode steel and galvanized steel fasteners in marine environments.

The fender panel assemblies feature transition plates which provide access from the ladders in the middle of the panel, to the deck of the dock. These transition plates reportedly have a history of becoming dislodged and many have missing or loose fasteners. Several transition plates are missing completely. The plates are bolted to a steel shelf angle which is then lag screwed into the fender panel timbers. Many of the lag screws show signs of advanced corrosion and there is evidence that some of the plates and angles have been re-attached multiple times. For instance, some of the shelf angles are oriented with the vertical toe down while others are installed with the vertical toe oriented up.

The fender panels and fender piling were not inspected below the waterline except when encountered incidentally. The steel portions of these structures are likely protected with sacrificial anodes which may be expected to have similar life remaining to the anodes on the support piling.

VII. Dock – Mooring Bollards

The mooring bollards are generally in good condition. They are showing moderate coating loss due to abrasion from line handling and minor to moderate corrosion is visible at those locations. On several bollards, on the northern end of the dock, the outside face of the bollard at the cap plate are deformed from an apparent impact.

Figure 39: Damaged Bollard Cap

The mooring bollards were not inspected below the waterline, except when encountered incidentally; no damage was noted below the water line. These galvanized piling do not appear to be protected by sacrificial anodes. Anticipating their remining service life is difficult in the absence of additional data; but the addition of passive cathodic protection is recommended.

VIII. Dock – Mooring Dolphin

The mooring dolphin is in fair condition. It does not appear to see the same level of use or maintenance as the rest of the facility. The deck of the bollard and the top of the fender panel show accumulation of debris and plant growth.

The underside of the dolphin cap and the piling show signs of coating loss and corrosion. Moderate corrosion was noted, particularly at the pile to cap welds. There appears to be at least minor section loss due to corrosion at the weld locations.

A Come-Along style cable-tensioning device has been installed to tie the fender panel to the dolphin piling. It appears the intent of the device is to hold one of the fender panel planks in position; though there is no apparent damage to the plank. The circular rubber fenders that tie the fender panel to the deck are showing signs of aging and are showing minor weather checking on their exterior. The checking does not warrant immediate replacement, but the fenders should be inspected periodically for cracks if the dolphin is to be used for berthing. The fasteners that hold the circular fender are showing complete coating failure and moderate to severe corrosion, indicating they should be replaced.

The capstan mounted on the mooring dolphin was not operated during the inspection. Its surface shows approximately 90% coating loss and signs of moderate corrosion. The mooring bollard is in good condition but the cross bar appears to have sustained damaged and may have been replaced at some point. The replacement section appears to have suffered a complete coating failure and shows signs of moderate corrosion. A galvanized light pole on the mooring dolphin is showing approximately 50% coating loss and signs of minor to moderate corrosion of the steel. The fixture appears to have moisture inside the lens which may reduce the life of the fixture.

The underwater portion of the dolphin was not inspected. It is unknown if the dolphin has any cathodic protection installed, but it is assumed to be un-protected as the 2005 Berth 1 Rehabilitation and Upgrade drawings make no mention of this dolphin. As the dolphin ages, the galvanized coating will continue to be consumed until it is no longer sufficient to protect the steel piling, at which point, section loss and reduced structural capacity of the steel piling will occur.

Figure 40: Damaged Bullrail Sections

IX. Bullrail

The timber bullrail on Berth 1 and 2 is in overall satisfactory condition with areas of localized damage. The bullrail damage consists of splits, checks, and abrasion. Damage is most common at the ends of bullrail members, particularly at the openings for the fender transition plates. The damage typically appears to effect less than 10% of the cross section of the bullrail at most locations. As the bullrail is not used for line handling operations, the damage does not appear to significantly impact its functionality and is mostly detrimental in terms of appearance. There are however, several sections that are severely damaged and should be replaced. On the south end of the dock, a section of bullrail is severely cracked through its entire section at the gap in the bullrail for the safety ladder. At pile cap grid 19, the bullrail section that protects the light pole is severely damaged from an apparent impact. During the inspection, it was noted that many of the bullrail mounting assemblies appeared to have been re-drilled, presumably during construction to accommodate fastener placement.

Figure 41: Damaged Bullrail Sections

X. Timber Fender Piling

The original fender piling on the shoreside of the dock were recently replaced with new timber piling. The timber fender piling are generally in good condition with few signs of deterioration or decay. Only minor damage was noted on top of the piling. The damage is mostly superficial and does not warrant repair or replacement of the timber piling. The top of the fender piling is un-treated and may accomodate decay, desipite the copper nails intended to prevent rot and decay.

Figure 42: Fender Pile Top With Minor Damage

At the extreme south end of Berth 1 and 2, there are missing bolts at the bullrail base plate at some of the timber fender piles. As the fender guides share these bolts with the bullrail, their absence results in the top of the fender pile being laterally unsupported.

Figure 43: Missing Fender Pile Bolts

XI. Safety Ladders

The safety ladders are in satisfactory condition with only minor damage to the tops of the ladders, likely from line handling operations. During the inspection, it was noted that the ladders on the south end and shoreward face of the dock are not of sufficient length to be usable at lowest tides.

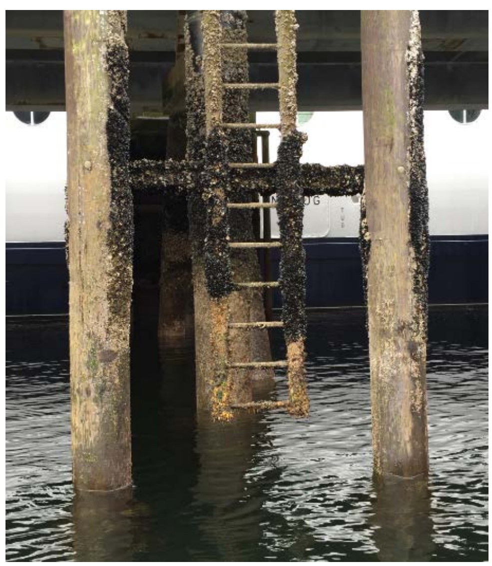

Figure 44: Safety Ladder at Low Tide

Ladders on the seaward face of the dock are also inaccessible from the water, due to the location of the floating fenders. The absence of fully usable ladders and the potential for relatively high currents, particularly at the south end of the dock, should be considered a major safety concern.

Figure 45: Safety Ladder Blocked by Fender

Most physical damage to the ladders was noted primarily where the handrail meets the deck. At the south end of the dock, the rail on the safety ladder is bent over and would be difficult to use. The ladders typically show signs of light marine growth and minor corrosion.

Figure 46: Bent Ladder Rail

XII. Lighting

The inspection included the structural elements of the lighting system. The light poles are generally showing signs of minor coating loss and minor corrosion. The light pole at pile bent 19 was observed to lean moderately, apparently from an impact. Upon closer inspection, it was noted that the welds at the base of the light pole were cracked. It is possible that under a high wind event or in the case of even a modest impact, the light pole could become unstable and collapse.

Figure 47: Damaged Light Pole Bases

XIII. Dock Crane

The dock crane was visually inspected for signs of obvious damage or damage to the surrounding structure. No damage was noted beyond minor to moderate coating failure and minor corrosion. The crane has a tag indicating it was inspected by structural diagnostic testing per OSHA 190.179 in March of 2016. Prior to the 2016 inspection, it had been inspected in 2012 by National Crane. The crane was not operated or tested as a part of this inspection.

XIV. Potable water system.

The potable water system was visually inspected but was not operated or tested. The steel waterline piping was observed during the inspection to show signs of moderate coating loss and moderate corrosion. The mechanical joints at the pipe connections show moderate to severe corrosion. The hydrant assemblies on the deck of the dock appeared to be in good condition with minor coating failure and minor corrosion on many of the components. The fasteners on the backflow prevention devices show signs of moderate corrosion, and replacement should be considered. A leaky valve was noted during the inspection, but was subsequently repaired by maintenance staff.

B. RECOMMENDATIONS

This section provides general discussion of the conceptual repair recommendations provided for each of the significant elements of construction described in section 5.B above. None of these recommendations is complete enough in engineering or construction detail to be implemented without further investigation and analysis.

It is strongly recommended that a repair and upgrade inspection, commensurate with the general effort outlined under the description, “Tier 2: Structural Repair and Upgrade Inspection” found in section 3.B of this report be undertaken prior to pursuing any recommended repairs. Additionally, detailed information is required to properly and effectively remedy the existing damage and general wear to the dock facility.

Based on the information available at the time of the inspection, the structural and non-structural repair recommendations identified in this report should not be a cause for immediate concern, such as emergency action; with the exception of the damaged light pole. All of these items should, however, be given due consideration and remedial action taken within a reasonable period of time to mitigate exacerbation of any existing damage.

It should be noted that the recommendations contained in this section do not contemplate specific improvements or upgrades which might be undertaken to increase the structural capacity or otherwise alter the present operational conditions of the existing facility.

I. Dock – Surface- Precast Panels

The precast panel at the southeast corner of the dock should be repaired. The damaged corner does not have a significant impact to the structure. The larger concern is that without the normal concrete cover, corrosion will advance at a faster rate, possibly causing a loss of capacity in the panel. It is recommended that the concrete be patched or sealed to slow corrosion.

II. Dock – Substructure

It is recommended that the dock substructure be inspected further to determine the probable source and extent of corrosion of the box girders, welds, and other components. It is recommended that a tier 2 inspection, including non-destructive and, if necessary, destructive (i.e. coupons, etc.) testing be completed on the substructure. The eventual repair will likely include coating repair, and may include structural upgrades if the capacity of the members has been reduced by corrosion.

III. Dock – Support piles

It is likely that the cathodic protection system at the support piles will require replacement within the next 5 to 10 years. It may be desirable to include a corrosion protection survey in the tier 2 inspection scope. It should be noted that simply assessing the remaining physical quantity of an anode may not provide an accurate estimation of its effectiveness or remaining life. This survey would include galvanic potential readings for the piling to better determine the adequacy of the corrosion protection system and to assist in more accurately estimating the remaining effective service life of the existing anodes.

The tier 2 inspection would also include removal of a small sampling of pile wraps to assess their present effectiveness at mitigating corrosion.

IV. Dock – Mooring Bollards

A sampling of the mooring bollards should be included in the tier 2 inspection mentioned in sections II and III, above. A pile wrap or other forms or rehabilitation may be considered for any areas where section loss has compromised the structural capacity of the pile. Additionally, since the bollard piles are isolated from the rest of the steel, they should have cathodic protection installed, which may not already be present.

V. Dock – Fender Systems

Modifications to the fender system should be considered to reduce the frequency with which the floating fender restraint chains bind upon the guide pipes. A UHMW-PE or HDPE sleeve can be retrofitted to the guide pipes to reduce friction, thereby reducing the risk of the fender chain binding. This may also require modifications to the connection between the fender chains and the guide.

The wholesale replacement of the timber planks on the fender panels does not appear to be necessary. However, replacement of damaged planks should be considered. Although this is a low priority item, as most of the damage noted appears superficial; one plank in the southernmost panel is broken off near the waterline and should be replaced by maintenance staff as a moderate priority item. Also, badly corroded fastening hardware (i.e. bolts, washers, nuts, etc.) should be replaced with new galvanized components as time and resources permit.

Repair of transition plates from the fender panels to the deck should be considered a moderate priority. The lag screws securing each transition plate should be replaced with new larger lag screws or thru-bolted. The missing transition plates should be replaced in kind with new units. Also, the shelf angles should be reoriented such that the vertical toe is positioned upward, typically.

Inclusion of a sample of fender panel components in the tier 2 inspection scope mentioned above is at the discretion of the owner. At this time, it is uncertain whether or not such effort is warranted. However, in the apparent absence of any cathodic protection, submerged elements may be experiencing corrosion at a higher rate than observed in the tidal zone. Besides additional investigation, installation of passive cathodic protection should be considered for these assemblies, generally.

VI. Dock – Mooring Dolphin

The mooring dolphin should receive regular maintenance including sweeping and removal for debris from the deck and fender panel structure. The fasteners holding the circular fender units to the dolphin cap and fender panel should be replaced with new galvanized steel hardware. The pile-to-cap connections should be inspected as part of the tier 2 inspection scope, to ensure that there has not been significant section loss of the welds or the base metal. It is not known that dolphin has any cathodic protection below the waterline. The tier 2 inspection should include galvanic potential measurements for the dolphin. If not already present, sacrificial anodes should be installed on the dolphin piling to mitigate further corrosion. A pile wrap or other forms or rehabilitation may be considered for any areas where section loss has compromised the structural capacity of the pile. The capstan should be coated with a marine epoxy coating and maintenance should be performed regularly in accordance with the manufacturer's recommendations. If it is determined after additional inspection that the existing cable-tensioning device is a temporary measure to secure a fender component, then, another more permanent solution should be devised.

VII. Bullrail

Sections of bull rail identified above should be replaced with new timbers. The remaining bullrail sections appear to be serviceable. Timber bullrail life may be prolonged with occasional cleaning, and removal of any vegetation that begins to grow in the cracks.

VIII. Timber Fender Piling

The minor damage to the fender piling does not necessitate repair. The pile tops do not appear to be treated. Copper nails were installed in the pile tops to prevent rot and decay, however, with their effectiveness is very likely limited to the top few inches of the pile. It is recommended that the pile tops be capped with a bituminous roofing tar or a coal tar epoxy to prevent rot of the pile tops. Also, all missing connection hardware should be replaced, to ensure that pile tops are laterally supported, according to their original design.

IX. Safety Ladders

The Tongass Narrows are known to be experience moderate currents during tide changes, which would challenge even a strong swimmer. The safety ladders should be extended to a depth below the lowest occurring extreme tide or replaced with longer ladder assemblies. It is also recommended that additional safety ladders be installed on the face of the dock away from the fender panels, as the ladders at those locations are inaccessible due to the presence of the foam-filled floating fender.

Any hand rails at the tops of ladders that are bent out-of-plumb should be straightened or replaced. Ladders should be re-coated with a marine coating or spray metalized to mitigate corrosion. Ladders should be kept clean of marine growth.

X. Lighting

The bent light pole should be replaced or repaired. It may be possible to remove the light pole from its base, square up the bottom, and re-weld to the base plate. This repair is of immediate concern, as even a modest vehicle or other impact could cause a failure of the remaining weld, and collapse of the light pole.

XI. Dock Crane

It is recommended that the dock crane continue to be maintained in accordance with the manufacturer's recommendations and that it be inspected by qualified crane inspector on a regular basis.

XII. Potable water system.

Corroded fasteners and mechanical joint restraints should be replaced on the potable water line. The replacement components should be galvanized or stainless steel. The exterior surfaces of the exposed pipe should be painted with a marine epoxy coating.

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6 INSPECTION FINDINGS AND RECOMMENDATIONS BERTH 3

A. GENERAL FIELD OBSERVATIONS

This section provides a general discussion of the assessed condition of each significant element of the Berth 3 construction.

Note that the inspection described below concluded only days before an event that caused significant structural damage to Berth 3. On June 3, 2016 the vessel Celebrity Infinity allided with elements of the facility, causing localized failures in both of the breasting dolphin structures, as well as the barge float mooring dolphins, the catwalks, and the tendering float. This damage has since been repaired.

The structure was approximately 10 years old at the time of inspection and the damage and wear prior to the allision tended to be of a relatively minor nature.

I. Barge Float

The floating barge was observed to be in overall good condition. The internal chambers and the underside of the barge were not inspected, though it was noted the barge would be removed for routine inspection and maintenance during the winter of 2017/2018. The deck of the barge shows signs of multiple instances of coating repair. It is presumed that these repairs have been made on a fairly routine basis since the barge float's installation. The hull of the barge shows minor coating damage over about 10% of its surface and minor to moderate corrosion.

The northwest corner of the dock was crushed during the above-referenced allision. While the material was clearly overstressed, no breach of the barge float's hull integrity was noted, and no water was noted upon removal of a nearby hatch cover. While this damage was not structurally repaired, it was sufficiently recoated to protect it from the elements until the float's scheduled removal for maintenance.

The removable guardrail sections were found to be in good condition with only minor coating damage and minor localized corrosion. It was noted that some sections of guardrail are stockpiled on the float and appeared undamaged. The empty guardrail pockets were found to have coating damage and light corrosion. Some light marine debris was found in the pockets.

Figure 48: Guard Rail Pockets

II. Transfer Bridge

The transfer bridge was found to be in good condition. Locations of minor coating damage and minor corrosion were noted over approximately 10% of the coated surfaces. The covered pedestrian walkway portion of the structure was in good condition. No significant trip hazards or defects were noted. The vehicular access side of the transfer span appeared to be in good condition, however the driving surface is reportedly slippery when wet. This could be dangerous, particularly if a motorized vehicle were to utilize the ramp during wet conditions at a time when the berth was occupied by passengers. The transition plates at each end of the transfer bridge were inspected and no defects were noted.

The sliding bridge bearing surfaces were inspected at the shoreward abutment. The sliding surface showed only normal wear with no indications of the need for immediate replacement. Some debris was located in the bearing area, which should be removed. Damage was noted to the grout pad at the shore side abutment. The corners of the pad appear to have spalled away from the underlying concrete. The damage appears to be superficial and there are indications that the grout pad may have been extended beyond the limits required by functionality in order to improve its aesthetic. If the grout continues to crack and spall further, it will eventually impact the bridge bearing plates.

The rocker connections at the seaward bridge bearing were inspected and showed only signs of normal wear and minor corrosion.

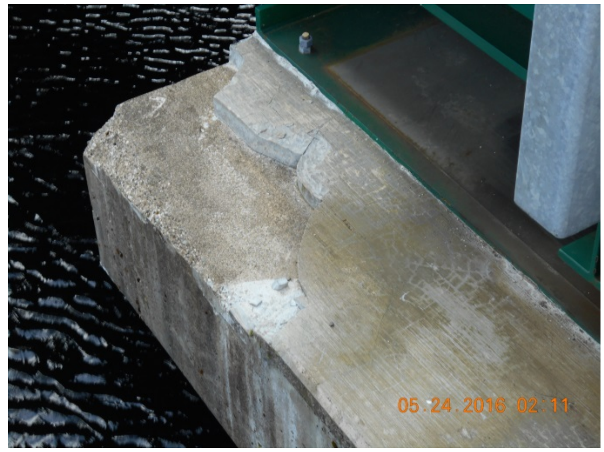

Figure 49: Transfer Bridge Abutment

III. Barge Float Mooring Dolphins (BFMD, AKA: Reaction Dolphins)

The barge float mooring dolphins are in satisfactory condition. Without the presence of cathodic protection, the piling is experiencing moderate coating failure and showing signs of minor corrosion. In excess of 50% of the coating area appears to have failed completely. Galvanized coating may be expected to have a design life of 10-15 years in saltwater, depending on a number of factors, and so the coating condition seems reasonable given the facility's age. Ultrasonic thickness readings (see Appendix C) show little to no section loss of pipe wall thickness.

Without the installation of a cathodic protection system, the piling will soon experience moderate corrosion and eventually significant section loss, leading to a reduced structural capacity. The pile caps were noted to be in good condition with no evidence of damage and the coating appeared to be over 90% intact. While moderately damaged during the above-referenced allision, the caps have since been repaired.

IV. Berth 3 Platform, Dock Street Addition

The Berth 3 Platform and the Dock Street addition were inspected from the topside and by skiff. As these are of relatively new structure, these structures are in relatively good condition. The support piling has experienced minor coating loss and corrosion in the tidal zone. Approximately 40-50% of the galvanized coating appears to have failed in this area. Eventual remediation will be required, but by and large, the piling are not in immediate danger of significant section loss. The piling were not inspected below the waterline, however, they are not presumed to be protected by a cathodic protection system. The below waterline condition could be expected to be similar to the condition of the Berth 3 dolphin piling.

The welds at the connection between the batter piles and plumb piles are showing signs of moderate corrosion and there is some scaling near the weld. This area should receive relatively prompt attention. The steel substructure was found to be in good condition, with no structural defects noted, and the coating was found to be over 90% intact with only minor localized corrosion.

Figure 50: Pile and substructure corrosion

Figure 51: Corrosion at Connection

The decks at the Berth 3 platform and the Dock Street addition were found to be in good condition. The deck shows signs of normal wear and tear, but there was no evidence of damage beyond very minor spalling and cracking. A chain drag inspection of the decks did not identify any signs of significant voids or potential delamination.

The steel pipe bullrail, which is functionally more of a pedestrian and vehicle guardrail, was found to be in good condition. The bullrail showed no signs of structural defects and the coating appeared to be at least 80% complete with localized minor corrosion.

The bollards were found to be in good condition with only minor coating damage and light corrosion from lines rubbing on the bollard and deterioration of the galvanized coating in the tidal zone. As with the support piling, the mooring bollard piling are reportedly not protected by a cathodic protection system and will eventually be subject to the effects of corrosion if not adequately protection is not provided.

Figure 52: Bollard Abrasion and Corrosion

Figure 53: Bullrail Corrosion

The fender panels at the Berth 3 platform and the Dock Street addition appear to see only very occasional use. As such, they appear to be in good condition with only minor damage. One of the arch fenders on the middle panel at the Berth 3 platform is missing its UHMW-PE face. Otherwise, defects on the fender panels appear to be limited to moderate coating loss and corrosion on the steel fender panel components and fender piling.

Note that the fenders and piling were not inspected as part of the underwater inspection. They are not thought to have any form of cathodic protection, and as such, it may be expected that coating loss and corrosion will continue below the water line; eventually leading to section loss and reduced structural capacity.

Figure 54: Fender Missing UHMW-PE

The safety ladders appear to be in good condition with no damage noted other than minor to moderate coating loss and corrosion, more prevalent below the high tide line. The life ring and fire extinguisher and cabinets appeared to be in good condition.

V. Breasting and Mooring Dolphins

The dolphins were inspected from the top side by skiff and underwater by diver. At the time of inspection, all three of the dolphins were found to be in satisfactory condition. The dolphin caps showed no signs of damage beyond normal wear. The coating condition on each structure exceeds 90% and there are signs of only minor corrosion. The pile caps on the two breasting dolphins were damaged in the above-referenced allision but have since been were repaired. The dolphin piling are considered to be in fair condition due to coating loss and corrosion. Visible coating loss exceeds 50% of the piling surface area. Areas of exposed steel are experiencing minor corrosion. Ultrasonic thickness readings (see Appendix C) show little to no section loss of the pilings base metal. However, without the installation of a cathodic protection system, the piling will soon experience moderate corrosion and eventually section loss, reducing structural capacity.

VI. Fender Systems

The dolphin fender systems are in satisfactory condition. The steel framing shows signs of moderate coating loss and corrosion, but are otherwise in very serviceable condition. The fasteners that connect the fender panels to the dolphins have very little to no remaining coating and are showing signs of moderate corrosion. Fender panels and fender piling were not inspected below the water line. The panel and piling do not have a corrosion protection system. As such, it is reasonable to expect that the galvanized coating is in similar condition to that of the dolphin piling. Additional coating failure, corrosion, and section loss may be expected to occur on the submerged steel fender panel components without the installation of a cathodic protection system.

The floating fender units on the dolphins were observed to be in good condition, showing signs of regular use, except for the fender at the mooring dolphin, which is seldom used. The floating fenders occasionally bind on the guides and become stuck either above the water line or submerged. The fenders are of large diameter, so in most cases they may still be effective. If a fender were to be located well below the waterline, it’s possible that a ship could contact the dolphin directly, causing damage to the ship and or dolphin. The Arch fenders located on the fender panels appeared to be in good condition with no signs of damage. Vessel contact with the arch fenders is not common due to hull geometry and the geometry of the berth.

The floating fender units on the floating barge were found to be in satisfactory condition with no signs of damage beyond normal wear and tear. The fenders on the floating barge do not ride on guides and are not subject to the same potential for binding issues as those on the fixed dock and dolphins.

Note that the arch fenders and the floating fenders at the breasting dolphins and the barge float were subjected to significant loading due to the above-references allision. Some obvious damage to the arch fenders was noted and these have largely been replaced. Some apparent compression setting of a few of the floating fenders was noted and the city intends to replace these, as well.

VII. Catwalks

The catwalks were visually inspected from the topside. Each catwalk structure was found to be in good condition with minor coating failure and minor corrosion over approximately 25% of the catwalk surface area. No structural defects were observed on the catwalk framing or grating members. The hinge points on the articulating catwalk were inspected and no excessive wear or damage was noted.

Note that the catwalks were subjected to significant loading due to the above-references allision. One section of catwalk was dislodged entirely from the dolphin cap at one end and fell partially; being restrained only by the lateral bracing attaching it to the tendering float guide pile. At other sections, the restraining bolts were sheared off and the walking surface was damaged. This damage has all since been repaired.

Figure 55: Catwalk Corrosion

VIII. Tendering Float

The tendering float is in fair to poor condition. The float is regularly exposed to wake and wave action and thrust from cruise ships. Only minimal use of the tendering float was observed during the inspection. Anecdotally, the float is occasionally over-topped by cruise ship thrust.

The performance of the tendering float was observed during the departure of a cruise vessel from Berth 3 during the inspection. During this event, the tendering float was subjected to a heavy flow of seawater by the ship's directional thrusters. The float was not overtopped, but it was evident that it was under tremendous stress and that the freeboard was greatly reduced during the event. Similarly, an access float at nearby Berth 4 was observed to partially wash under due to the thrust of a departing cruise from that berth.

Anecdotally, vessels moored to the tendering float have even been said to have been dislodged by cruise ship thrust in the past. Some small vessels in the nearby small boat harbor were even thought to have been swamped by the movements of the cruise vessels. Although no written reports or other tangible detailed accounts of such events were immediately available during the inspection, the tendering float seems to show visible signs of distress; most probably from multiple past events.

The concrete surfaces of the floats show signs of damage at the module-to-module interface. The joint corners are typically spalled, badly delaminated, or both. At many joints, the neoprene bearing pad has been displaced, allowing the concrete modules to make direct contact when experiencing a transverse loading event. Over time the spalling will become more widespread. This will create significant trip hazards at each joint and reduce the cover thickness over panel reinforcing steel, leading to premature corrosion. This corrosion will in turn cause expansion of the reinforcing steel which will further spall the concrete creating a cycle of corrosion-related failure as the floats continue to degrade.

The float module connection rods were observed to show signs of minor to moderate corrosion in some locations. Most of the rubber washers show signs of stress and weathering. Worn or crushed rubber washers will be unable to inhibit large-scale movement between the float modules. This will contribute to further displacement of the neoprene joint filler pads. This will in turn lead to damage to the concrete due to uninhibited impact between float sections. The potential for tripping hazards, delamination, and spalling will increase. Note that several of the rubber washers were damaged during the above-referenced allision and have since been replaced.

The pile hoops that secure the tendering float to the guide piles are in fair condition. The pile hoop at the extreme northern end of the float pulled free from its mounting bolts at some point and was welded to the existing steel embed plates due to damage and corrosion of the original fasteners. Another two (2) pile hoops failed during the above-referenced allision and were welded to the existing embed plates in like fashion. The two pile hoops which were retrofitted to the float after the initial installation appear to be in good condition with only minor coating failure and corrosion visible.

The tendering float aluminum access gangway was found to be in good condition with no observed damage.

IX. Safety ladders

Each of the dolphin safety ladders were inspected from above and from the waterline. Like much of the steel fabrication on the dolphins, they show signs of moderate corrosion and coating damage. The ladders are covered in light marine growth below the high tide elevation but were still accessible.

X. Capstans and quick release bollards

The capstans found on each of the dolphins were found to be in satisfactory condition. Each capstan was operated briefly but the quick release bollards were not operated. City staff indicated the capstans/bollards are regularly maintained, helping to extend their useful life. The capstans/bollards were found to show signs of minor to moderate coating failure and corrosion. Stainless steel hardware appears to be made from a low grade stainless, which is showing moderate surface corrosion. Left un-checked, corrosion will eventually result in section loss which may affect the capacity of the capstan/bollard units.

XI. Bollards

The bollards on the berth 3 barge float were found to be in good condition with minor coating damage from normal use, and signs of minor corrosion.

XII. Pile Hoops

The pile hoops which connect the barge float to the barge float mooring dolphins were inspected. The fenders used to absorb berthing energy and dampen the movement of the float were observed to have moderate deformation and cracking. Damage was prevalent in six of the fenders which are frequently cyclically loaded during both berthing and mooring operations. It is our understanding that these fenders are replaced by the city when they appear to be too damaged for normal use. Six of these fenders were damaged in the above-referenced allision and were replaced. Continual maintenance and replacement efforts should be expected with the current pile hoop fender design.

The steel framing for each pile hoop was found to be in satisfactory condition. Moderate coating failure and corrosion was noted where the pile hoops and braces weld to the barge float. If the corrosion continues unchecked, eventually section loss and reduced structural capacity will occur.

XIII. Lighting

The light poles were inspected for structural defects but were not inspected for operation. The light poles on the dolphins and catwalks were found to be in satisfactory condition with approximately 50%

of the galvanized coating missing and minor corrosion of the steel where the coating was damaged. No structural damage was noted.

XIV. Miscellaneous

The struts that connect the barge float to the tendering float were inspected. The struts and connections were found to be in satisfactory condition, only showing signs of moderate coating failure and corrosion. The northern of the two pipe struts was pulled from the tendering float during the above-referenced allision and subsequently repaired.

Life ring and fire extinguisher cabinets were found to be in good condition on the barge float, tendering float, and dolphins. Cabinets on the dolphins which were damaged during the above-referenced allision were replaced in kind.

B. RECOMMENDATIONS

At the time of inspection, the Berth 3 facility showed few signs of structural defects beyond maintenance issues and corrosion. Recommendations focus on mitigating the long term effects of corrosion, as if left un-checked, the useful life of the structure will be reduced. Due to the depth of water, bedrock conditions, and rock socketing/anchoring requirements, the piling installed at Berth 3 would be some of the most expensive piling of its type in the state. As mentioned elsewhere in the report, the facility was struck by the Celebrity Infinity on June 3, 2016 shortly after the conclusion of this inspection. Repairs were made with the intent of bringing the structure back to the pre-incident structural and operational capacity.

I. Floating Barge

It is recommended that the barge float be removed from service for maintenance as planned during the 2017/2018 off season. Maintenance should include, at a minimum, coating repair, an inspection of the inner chambers, inspection of the hull, and replacement of sacrificial anodes.

II. Transfer Bridge

The transfer bridge requires little in the way of repairs. Areas with failed coating should be ground clean and re-painted with a marine epoxy coating. The vehicle ramp should be coated with a non-skid coating, and/or steel cleats or traction bars. The area behind the sliding bridge bearings should be regularly cleaned, and all debris and trash removed. It was noted during operations that a rope and cones are placed at the top of the ramp to discourage pedestrian traffic. It may be advisable to install a gate or more robust removable barrier.

III. Berth 3 Platform and Dock Street Addition

The Berth 3 platform and Dock Street Addition do not require structural repairs. Provision of additional corrosion protection, such as welded anodes, should be considered. The batter-pile-to-plumb-pile connections should be blasted and recoated with a high performance marine coating or spray metalizing. A pile wrap, similar to that used on Berth 1 and 2, should be considered for long term protection of the support piling in areas susceptible to accelerated corrosion. The coating loss and light corrosion on the bullrail, mooring dolphins, etc. may be repaired by spray metalizing or by coating with a

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zinc rich paint. The deck of the dock requires no repairs, however it should be regularly swept and kept clean.

IV. Breasting and Mooring Dolphins

The breasting and mooring dolphins require little in the way of repairs. The coating damage and corrosion on the dolphin caps and handrails could be repaired by spray metalizing or simply coating with a zinc rich paint. The piling should have a cathodic protection system such as sacrificial anodes installed to slow corrosion and to extend the useful life of the system. A pile wrap or high performance coating should be installed to protect the piling in the tidal zone where cathodic protection is less effective.

V. Fender Systems

The above water portion of the fender panel assemblies should be coated with a high performance coating or spray metalized. The fender piling should have anodes or other means of cathodic protection installed. Severely corroded fasteners should be replaced as they are discovered as part of the regular maintenance program.

Modification should be considered to reduce the frequency of the floating fender restraint chains from becoming bound upon their guide pipes. A low friction HDPE or UHMW-PE sleeve could be retrofitted to the chain guide and would reduce wear on the steel surface as well. The sleeve would be slightly larger than the guide, possibly requiring modification to the chain assembly.

VI. Catwalks

Structural repairs or modifications to the catwalks are not necessary, but coating repair should be considered. It is recommended that areas of the catwalks showing coating failure should be coated with a high performance marine coating or spray metalized to slow corrosion.

VII. Tendering Float

The tendering float is in need of maintenance and repairs. It is recommended that all of the rubber washers showing cracking or signs of stress be replaced. Connection rods and hardware that are moderately corroded should also be replaced.

The damaged concrete at the module-to-module interface requires repair. The continual relative movement of the float makes concrete patching difficult. It is recommended that the damaged concrete be sealed to keep seawater from prematurely corroding the reinforcing steel. The bearing pad between modules should be replaced and a transition plate be installed to avoid the tripping hazard created by the damaged concrete. A transition plate with a plastic or rubber pad that extends from the middle of the plate into the module gap is recommended. To allow for differential movement, the plate would be securely fastened to one module and allowed to slide on the other.

New pile hoops should be retrofit to replace the original hoops which have been welded in place. Replacement pile hoops would likely be of similar design to the two retrofit hoops that were installed after the original construction.

To protect the float from the continued adverse effects of arriving ship wakes and departing ship thrusters, a floating breakwater or wave attenuation structure of some sort is recommended. This will undoubtedly extend the service life of the tendering float over taking no action in this regard.

VIII. Guardrail

The removable guardrail sections should be coated with a marine epoxy coating in locations where the coating has failed. The guardrail pockets should be cleaned at least annually to ensure the drain holes are not plugged.

IX. Safety ladders

Safety ladders should be re-coated with a high performance marine coating or spray metalized. Marine growth should be cleaned off of the ladders to keep them easily accessible.

X. Capstans and quick release bollards

The capstans and bollards should be painted according to the manufacturer's recommendations. Corroded fasteners should be replaced with 316 stainless or galvanized bolts. The capstans and quick release bollards should see continued maintenance including grease and oil changes, as recommended by the manufacturer.

XI. Bollards

The minor coating damage on the bollards should be repaired when the float is removed for maintenance.

XII. Pile Hoops

Coating damage on the pile hoops should be repaired when the barge float is removed for maintenance. The city should consider retrofitting the pile hoops with an alternative guide system to reduce the frequency of required maintenance. A revised pile hoop design would likely still require the use of fenders, however, these could be installed so as to mitigate the existing berthing and mooring issues.

XIII. Lighting

Eventual coating repair is recommended for the light poles. The light poles could be spray metalized or painted with a marine coating.

7 TIER 2 INSPECTION RECOMMENDATIONS

Attached is an estimated level of effort and associated costs for the execution of the recommended Tier 2 inspection and testing program, which should be considered accurate to within an order of magnitude for the inspection and testing program outlined therein. M&N will recommend suitably qualified testing agents, who may be retained at the discretion of the city.

Should the city move forward with the recommended Tier 2 inspection and testing efforts, those efforts may impact the scope of repairs indicated in section 8, *Opinion of Probable Construction Costs (OPCC)*. In particular, any damage found to have compromised the structural capacity of any tested member(s) may in turn necessitate additional structural repairs.

The probable cost of the Tier 2 inspection effort is *not* included in the OPCC.

The probable costs presented here are estimated for a single inspection effort, by a single inspection specialist, encompassing all recommended investigation.

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Ketchikan Berths 1, 2 and 3 - Tier 2 Inspection and Testing Estimate [1,2]

Project: 9333 By: PBW Date: 072516

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ORDER OF MAGNITUDE ESTIMATED COST: CORROSION CONTROL INSPECTION AND TESTING

Senior Corrosion Control Specialist (2 days travel, mob/demob)	16 hours	165 $/hr	$2,640
Staff Corrosion Control Specialist (2 days travel, mob/demob)	16 hours	145 $/hr	$2,320
Pile / Cap Testing - 16 piles over 2-days; 2-tides / day; 4-hrs / tide; 1-hr / pile [3,4]			
Senior Corrosion Control Specialist	16 hours	165 $/hr	$2,640
Staff Corrosion Control Specialist	16 hours	145 $/hr	$2,320
Box Girder Testing - 16 locations over 2-days; 2-tides / day; 4-hrs / tide; 1-hr / location [3,4]			
Senior Corrosion Control Specialist	16 hours	165 $/hr	$2,640
Staff Corrosion Control Specialist	16 hours	145 $/hr	$2,320
Airfare, 2 Seats, Roundtrip[5]	2 ea.	850 $/ticket	$1,700
Lodging, 5 nights, 2 beds	10 days	150 $/day	$1,500
Meals, 6 days, 2 worker	12 days	65 $/day	$780
Rental Car, 5 days	5 days	150 $/Taxi	$750
Senior Corrosion Control Specialist, Report prep (incl. drafting, figures, etc.)	16 hours	165 $/hr	$2,640
Staff Corrosion Control Specialist, Report prep (incl. drafting, figures, etc.)	8 hours	145 $/hr	$1,160
Clerical/Admin	4 hours	165 $/hr	$660
Project management, etc.	4 hours	215 $/hr	$860
Subtotal			$24,930
M&N Subconsultant Premium	1 ea.	10 %	$2,493
M&N Project Management[6]	16 hours	215 $/hr	$3,440
Total Tier 2 Inspection and Testing Cost			**$30,863**

NOTES:

1. All estimates are in 2016 USD, and rounded to the nearest one-dollar.
2. Non-destructive testing (NDT), only; coupons not anticipated for initial Tier 2 effort.
3. Presumes use of City-provided skiff.
4. Time on station includes cleaning/prep and testing time; no coating/surface repair included.
5. Presumes coach travel.
6. Includes management of, coordination with sub consultant; reporting results to City, etc.

8 OPINION OF PROBABLE CONSTRUCTION COST (OPCC)

Attached is an Opinion of Probable Construction Cost (OPCC), which should be considered accurate to an order of magnitude for the repairs outlined therein. The costs presented in the OPCC are estimated for a single project encompassing all recommended repairs.

This estimate includes costs for design-related and construction-related activities as outlined in the recommendations of this report and is limited to the specified tasks. Additional scope items in both design and construction would necessarily increase the cost of the final project.

The items on the OPCC include repairs and upgrades important for the mid- to long-term service life of the structure, as well as the repair and/or replacement of safety equipment which should be carefully considered.

Also, should the city move forward with the recommended Tier 2 inspection efforts, as outlined in section 7 above, the findings of that effort could affect the OPCC.

The OPCC does not include costs associated with repairs that are already scheduled or those which are expected to be completed by city maintenance staff. Such repairs include those which will occur on the berth 3 barge when it is removed from the water, replacement of corroded fasteners, minor coating repair, and general maintenance items.

Certain items which are mentioned in the body of this report as requiring attention are deemed to be maintenance-level items; which we might expect the city to either self-perform, or approach on a discrete basis project with a local contractor using discretionary funds. These include, but are not limited to, repair of the damaged light pole, replacement of bolts and washers at the tendering float, recovery and replacement of the transition plates from dock to fender panels, and modification of the foam-filled floating fender anchor chains.

Ketchikan Berths 1, 2 and 3 - Recommended Repairs [1]

Project: 9333 By: PBW Date: 072516

Order of Magnitude Opinion of Probable Construction Cost (OPCC)

moffatt & nichol
880 H Street, Suite 208
Anchorage, AK 99501
(907) 677-7500 Fax (907) 677-7577
www.moffattnichol.com

Item No.	Description	Approx. Quantity	Unit	Unit Cost ($) [1]	Extended Cost (Rounded)
1	**Repair Dock Corner Impact Damage** [2]	1	LS	$ 5,000	$ 5,000
2	**Furnish, Install Safety Ladders** [3]	22	EA	$ 2,680	$ 59,000
3	**Replace 5% of Bullrail** [4]	150	LF	$ 50	$ 8,000
4	**Furnish, Install Cover Plates at Tender Float Joints** [5]	104	LF	$ 304	$ 32,000
5	**Furnish, Install Pile Anodes** [6]	101	EA	$ 2,000	$ 202,000
	Estimated Bid Price				**$ 306,000**
	Contingency			(25%)	$ 77,000
	Opinion of Probable Construction Cost				**$ 383,000**
	Planning, Permitting, Design and Bid Documents			(10%)	$ 38,000
	Contract Administration, Construction Inspection & Other Indirect Costs [7]			(5%)	$ 19,000
	Direct Reimbursable Costs [7,8]			(3%)	$ 10,000
	Estimated Project Cost				**$ 440,000**

NOTES:

1. All estimates are in 2016 USD and rounded up to the nearest thousand dollars.
2. Includes removal and replacement of all ancillary structure and appurtenances, and all temporary support framing.
3. Seaward side of Berths 1, 2, only.
4. Berth 1, 2, only.
5. Includes all concrete coating necessary to prevent corrosion of reinforcement
6. Includes all Berth 3 dolphins, Berth 3 platform, tendering float guide piles, and Dock Street addition, only.
7. Includes only periodic site inspection during construction.
8. Includes travel costs (but not time) associated with (3) site inspection visits (airfare, lodging, meals, rental car, etc.).

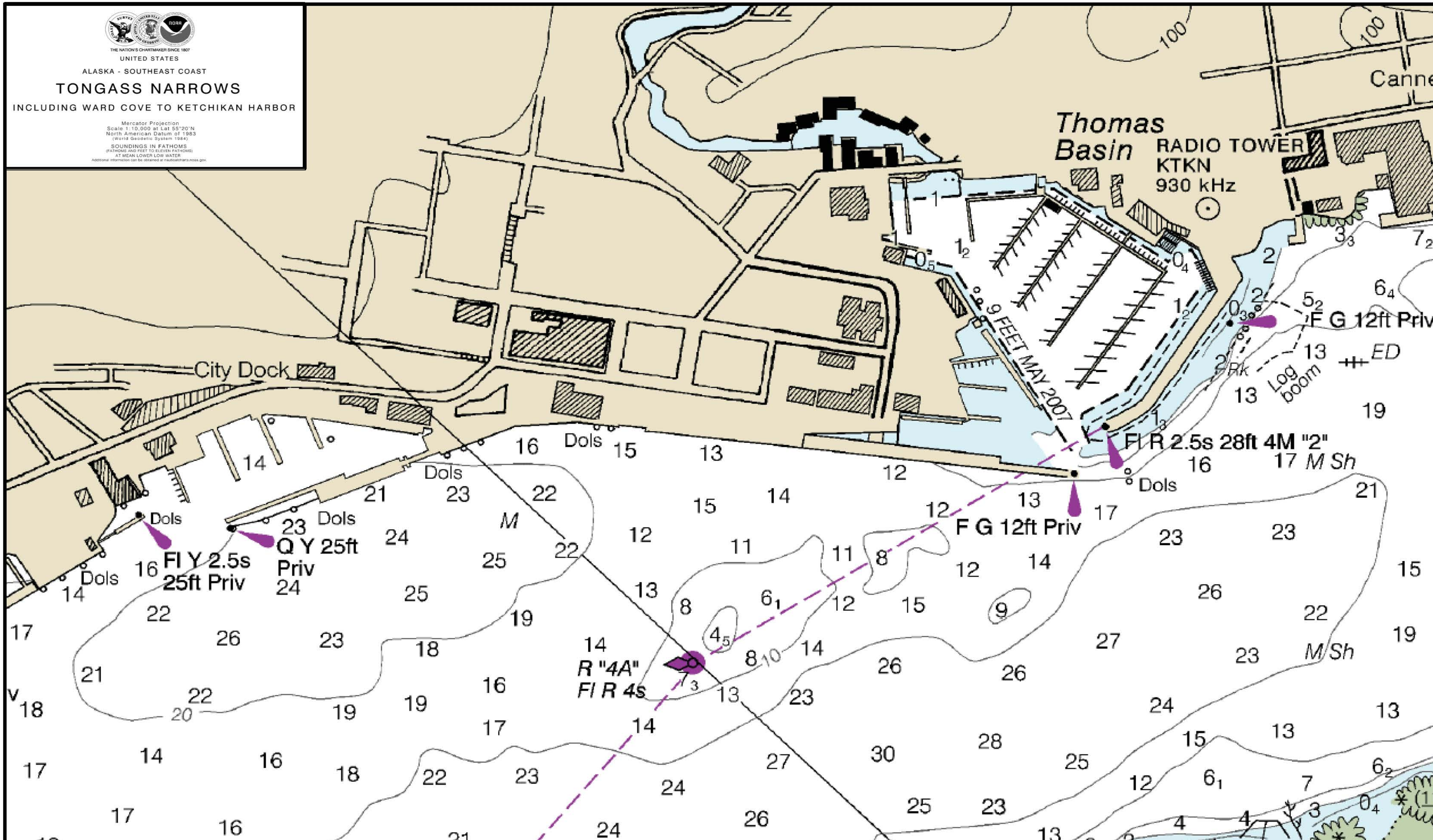
Appendix A

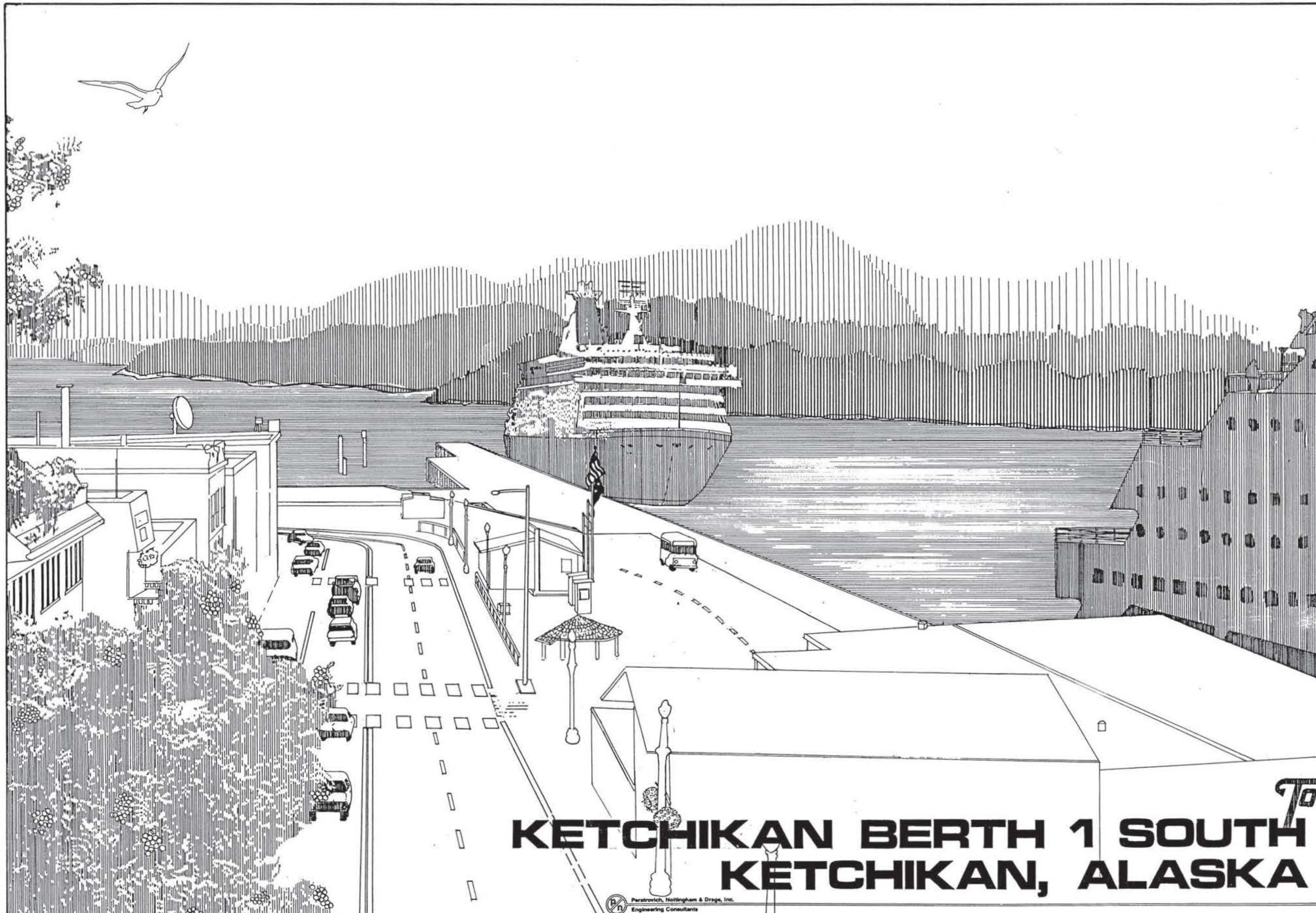
Original Design Drawing Excerpts:

9333 - Ketchikan Port Improvements
General Site Arrangment: Berths 1, 2, 3 and 4

moffatt & nichol

9333 - Ketchikan Port Improvements
Navigational Chart No.17430 (Excerpt)



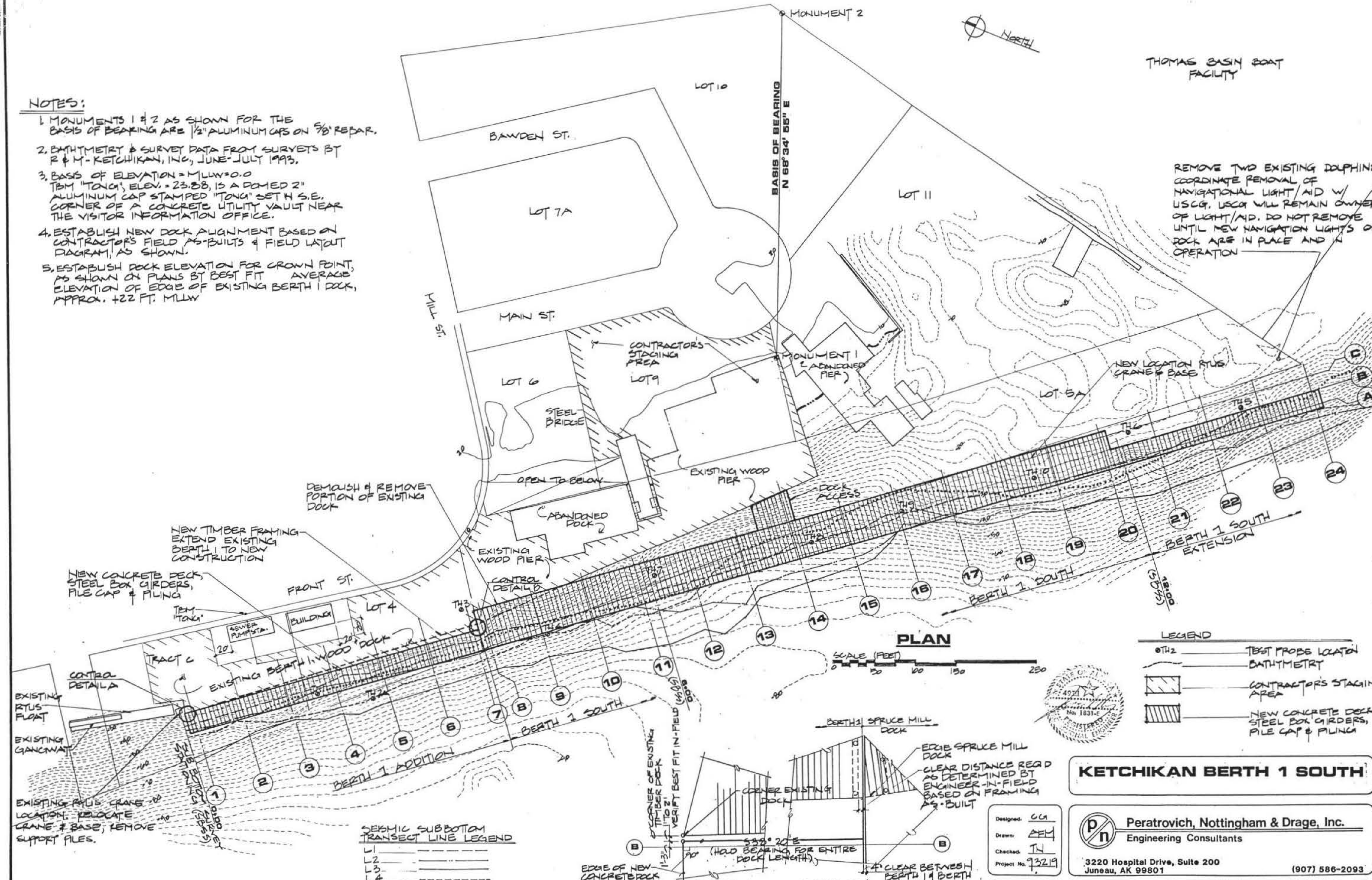


KETCHIKAN BERTH 1 SOUTH
KETCHIKAN, ALASKA
Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants

10/15/93

NOTES:

1. MONUMENTS 1 & 2 AS SHOWN FOR THE BASIS OF BEARING ARE 1½" ALUMINUM CAPS ON 5/8" REBAR.
2. BATHYMETRY & SURVEY DATA FROM SURVEYS BY R & M-KETCHIKAN, INC, JUNE-JULY 1993.
3. BASIS OF ELEVATION = MLLW = 0.0 TBM "TONG", ELEV. = 23.88, IS A DOMED 2" ALUMINUM CAP STAMPED "TONG" SET IN S.E. CORNER OF A CONCRETE UTILITY VAULT NEAR THE VISITOR INFORMATION OFFICE.
4. ESTABLISH NEW DOCK ALIGNMENT BASED ON CONTRACTOR'S FIELD AS-BUILTS & FIELD LAYOUT DIAGRAM, AS SHOWN.
5. ESTABLISH DOCK ELEVATION FOR CROWN POINT, AS SHOWN ON PLANS BY BEST FIT AVERAGE ELEVATION OF EDGE OF EXISTING BERTH 1 DOCK, APPROX. +22 FT. MLLW



FIELD LAYOUT DIAGRAM

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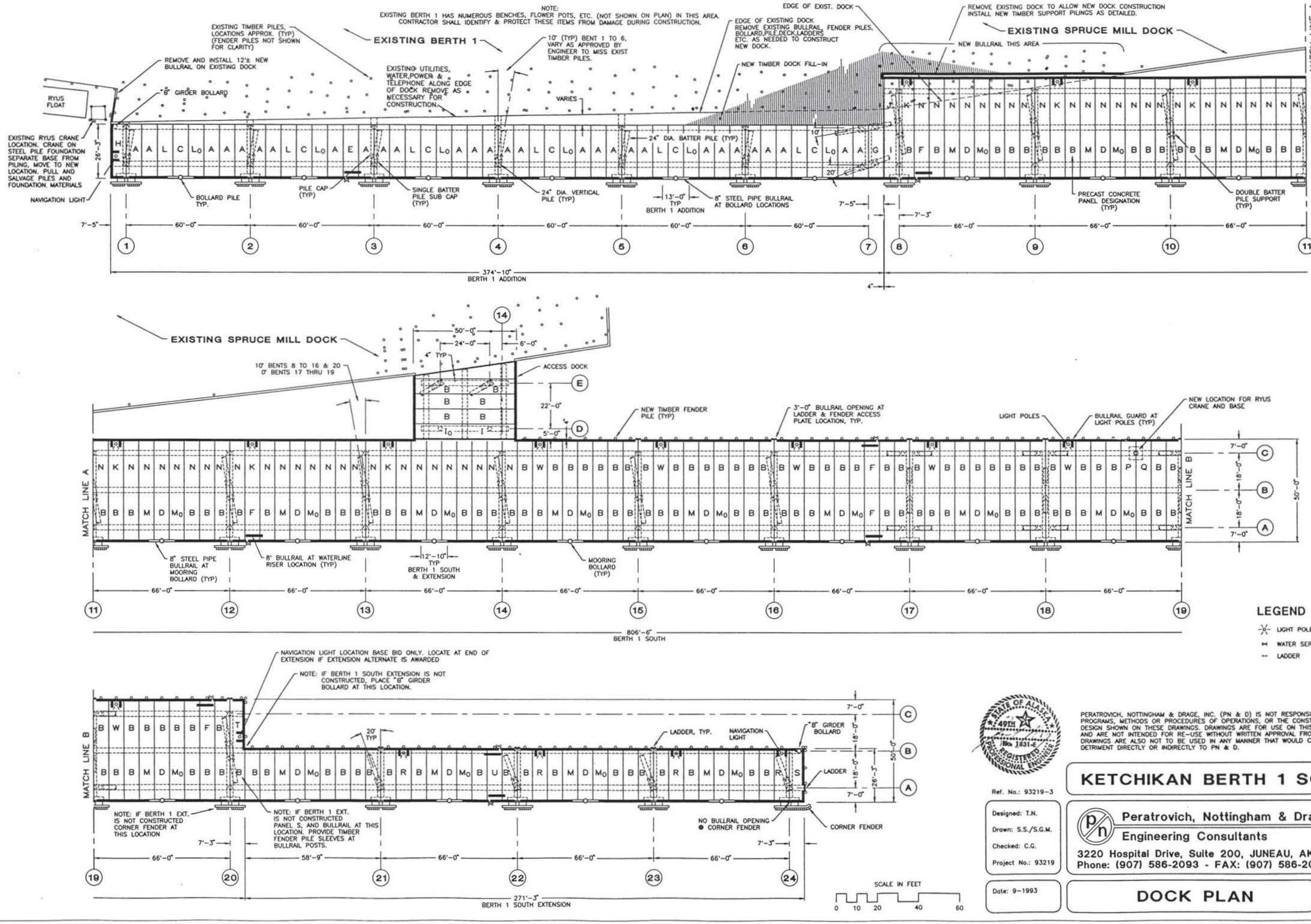
KETCHIKAN BERTH 1 SOUTH

Designed:	CG
Drawn:	AEM
Checked:	TN
Project No.	93219
Date:	AUG 93
Scale:	—

Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
3220 Hospital Drive, Suite 200
Juneau, AK 99801
(907) 586-2093

SITE PLAN

sheet 3 of 21



STATE OF ALASKA 49TH REGISTERED PROFESSIONAL ENGINEER No. 1831-E

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KETCHIKAN BERTH 1 SOUTH

Ref. No.: 93219-3

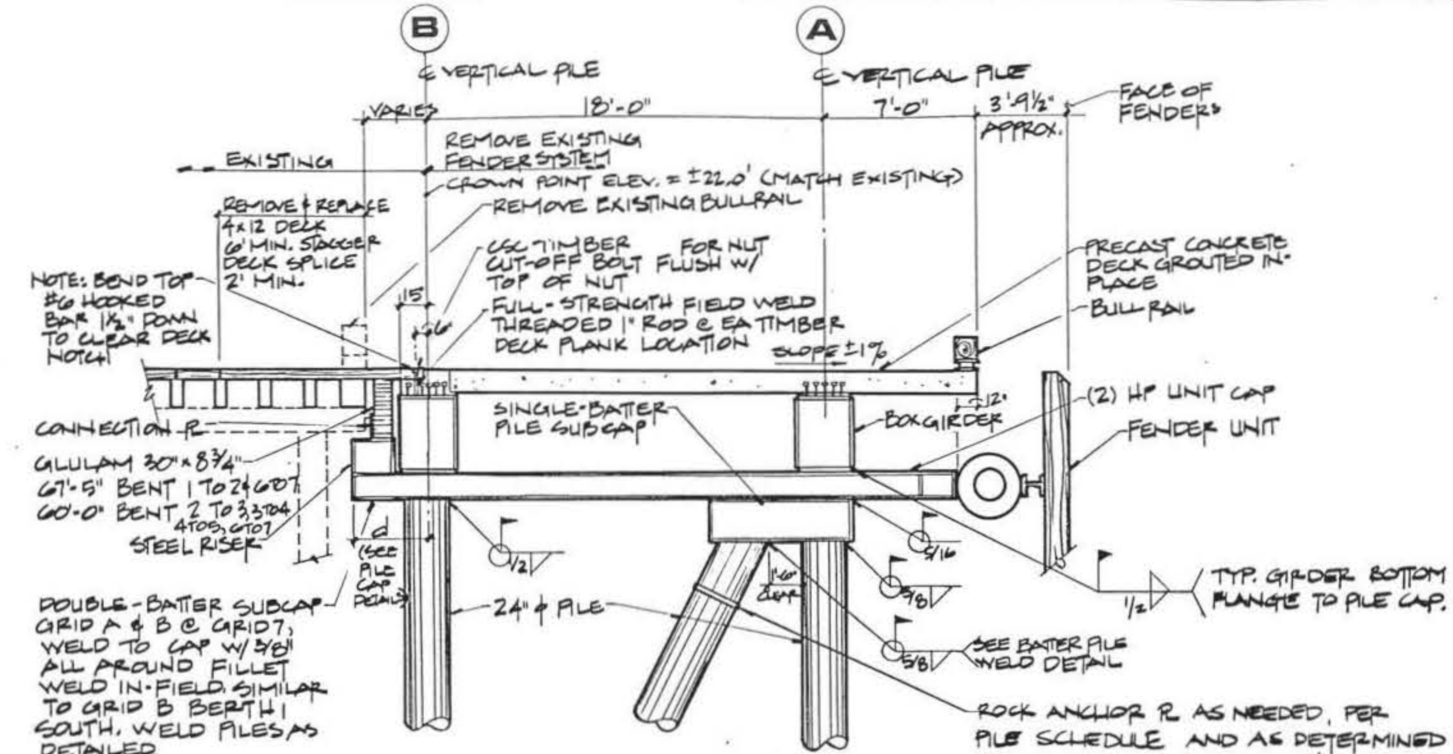
Designed: T.N.
Drawn: S.S./S.G.M.
Checked: C.G.
Project No.: 93219

Peratrovich, Nottingham & Drage, Inc.
Engineering Consultants
3220 Hospital Drive, Suite 200, JUNEAU, AK 99801
Phone: (907) 586-2093 - FAX: (907) 586-2099

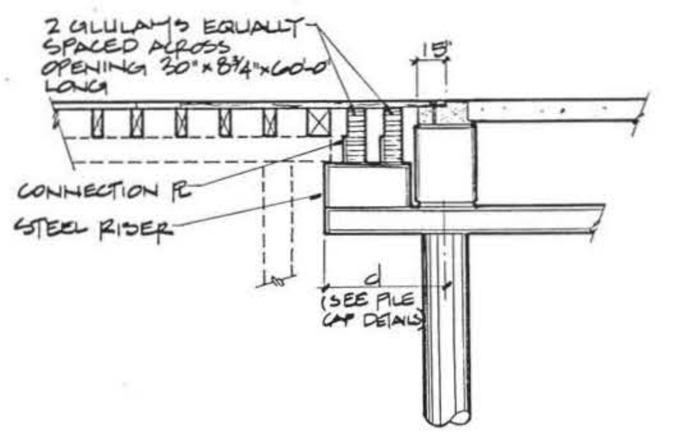
Date: 9-1993

DOCK PLAN

SHEET 6 of 21

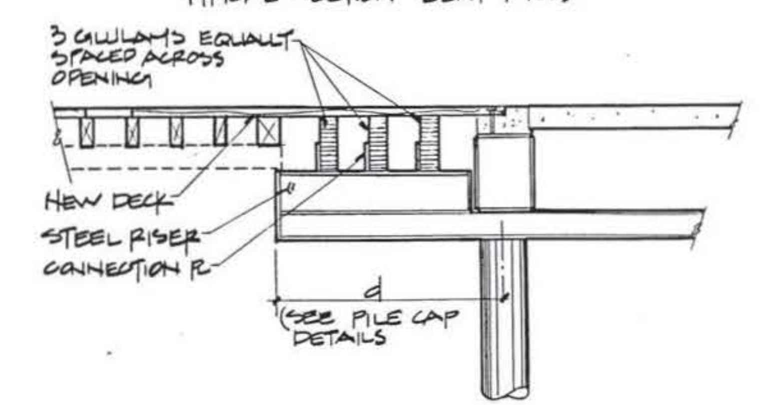


TYPICAL SECTION BENTS 1 TO 3



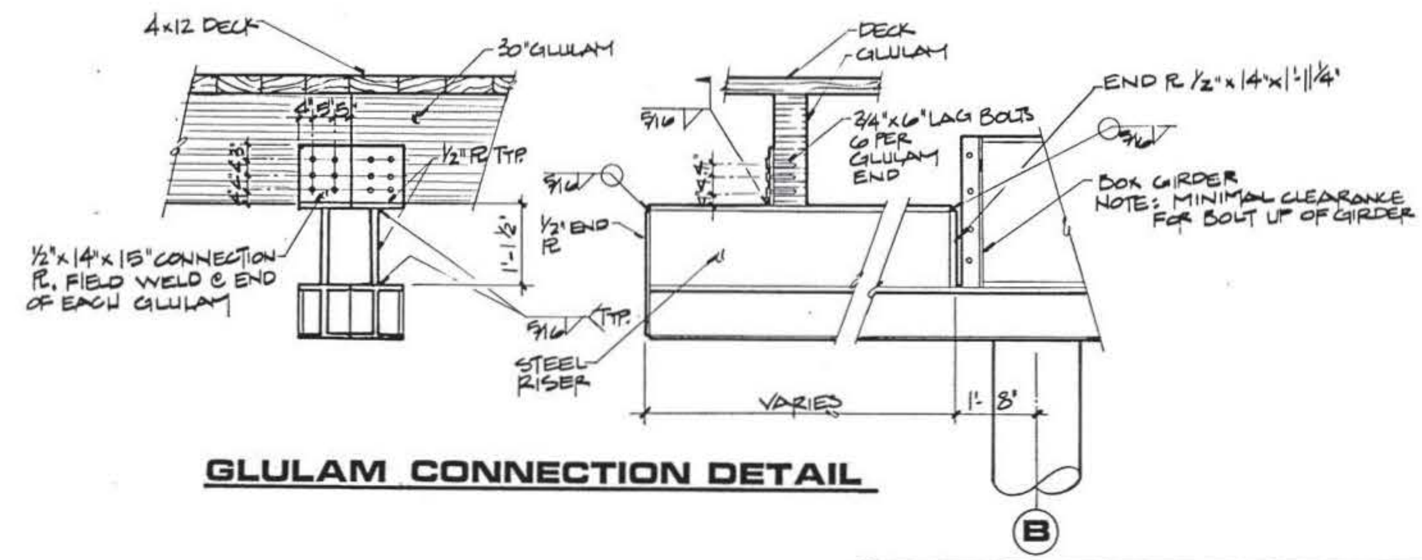
TYPICAL SECTION BENTS 3 TO 5

DETAILS NOT SHOWN SIMILAR TO TYPICAL SECTION BENT 1 TO 3



TYPICAL SECTION BENTS 5 TO 7

DETAILS NOT SHOWN SIMILAR TO TYPICAL SECTION BENT 1 TO 3



GLULAM CONNECTION DETAIL

KETCHIKAN BERTH I SOUTH

STATE OF ALASKA 49TH REGISTERED PROFESSIONAL ENGINEER No. 1831-E

Designed	CG
Drawn	AFM
Checked	TN
Project No.	93219.0
Date	SEPT 93
Scale	—

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Engineering Consultants
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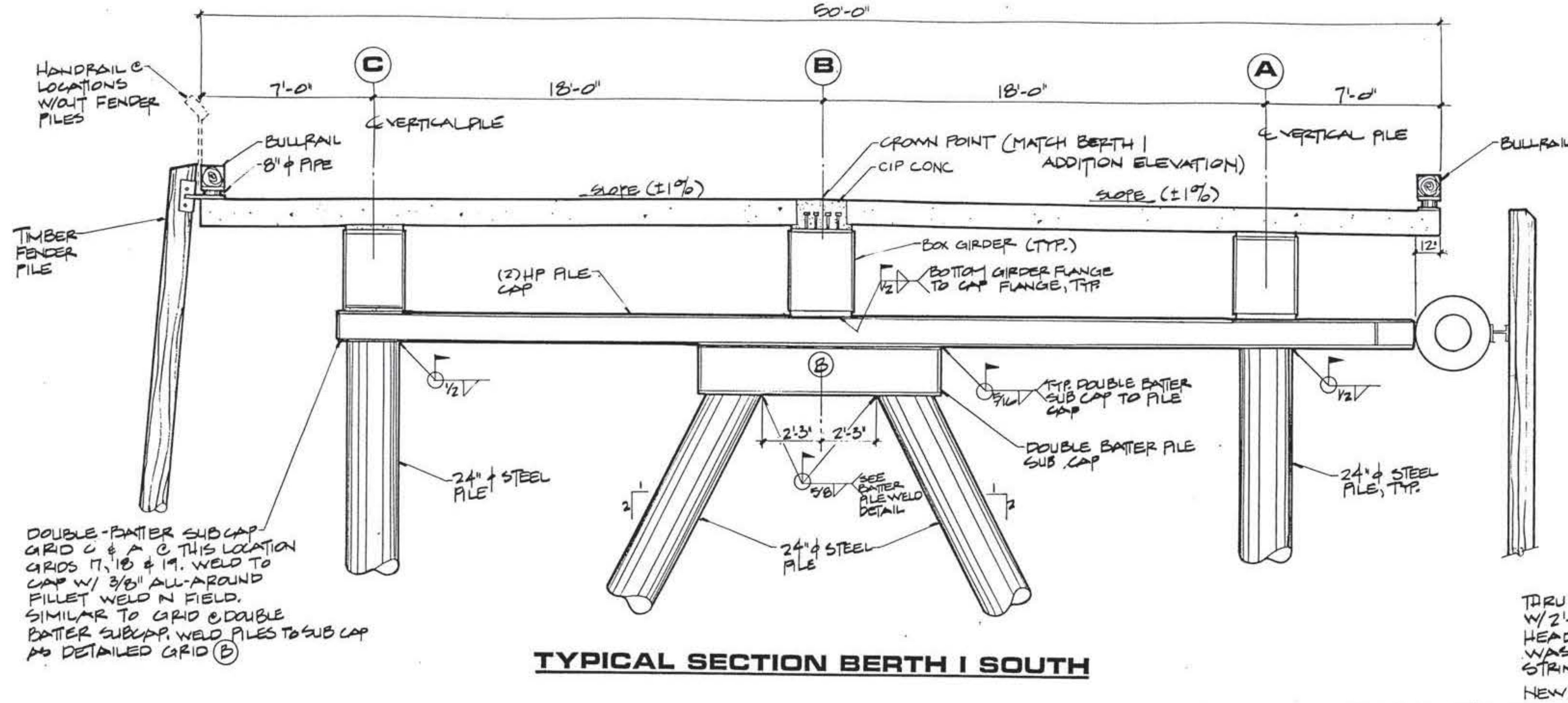
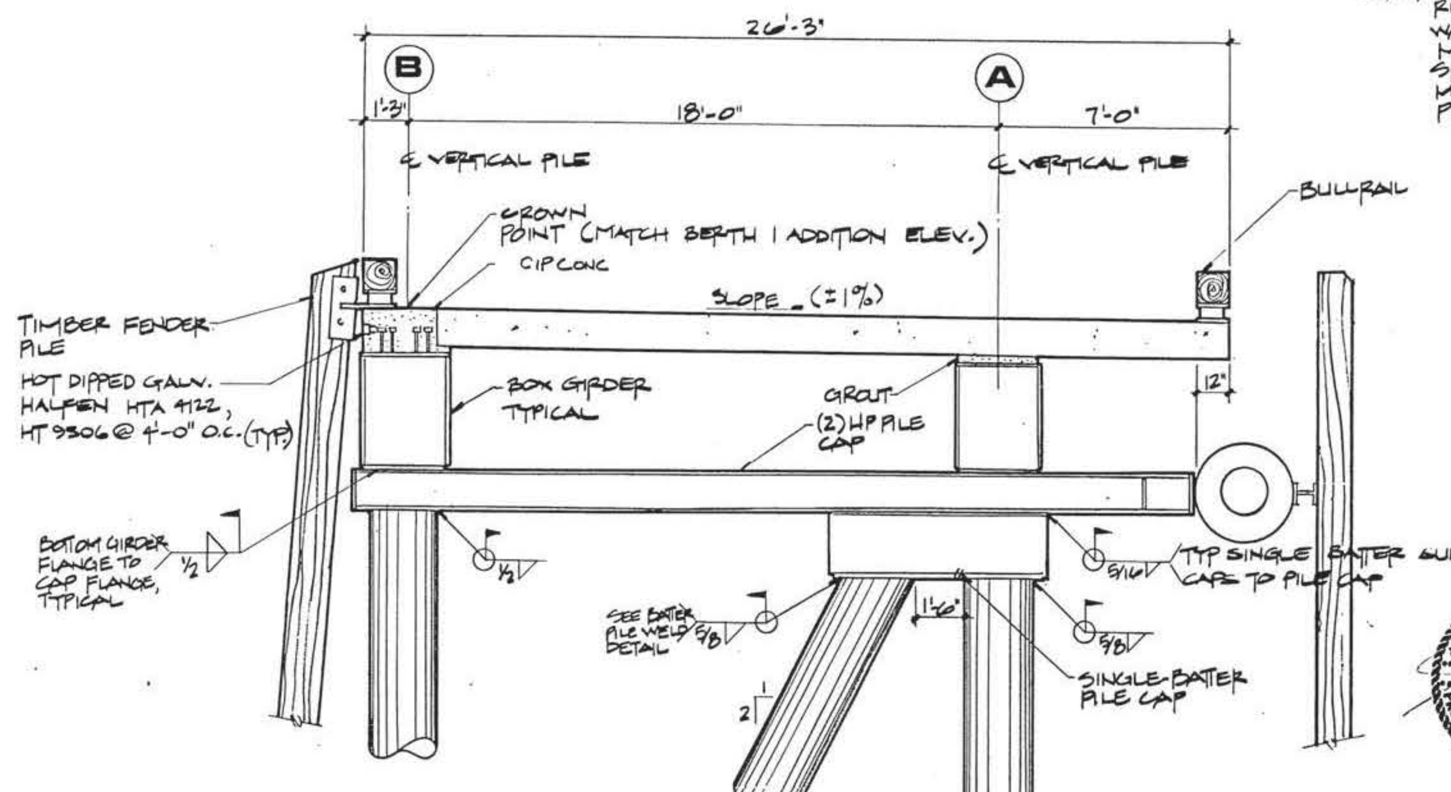
Juneau, AK 99801
(907) 586-2093

BERTH I ADDITION SECTION & DETAILS

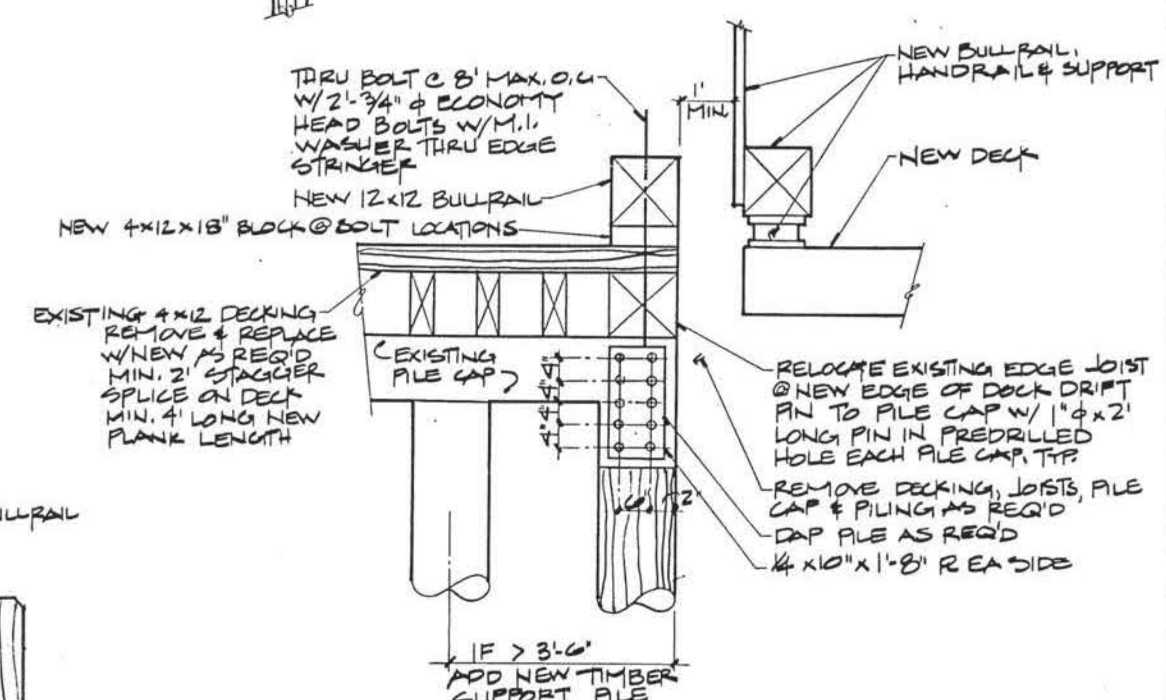
sheet 7 of 21



TYPICAL SECTION BERTH I SOUTH



TYPICAL SECTION BERTH I SOUTH EXTENSION



SECTION SPRUCE MILL DOCK MODIFICATION

KETCHIKAN BERTH I SOUTH

Designed: CG
Drawn: AFM
Checked: TN
Project No. 93219.01

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Juneau, AK 99801
(907) 586-2093

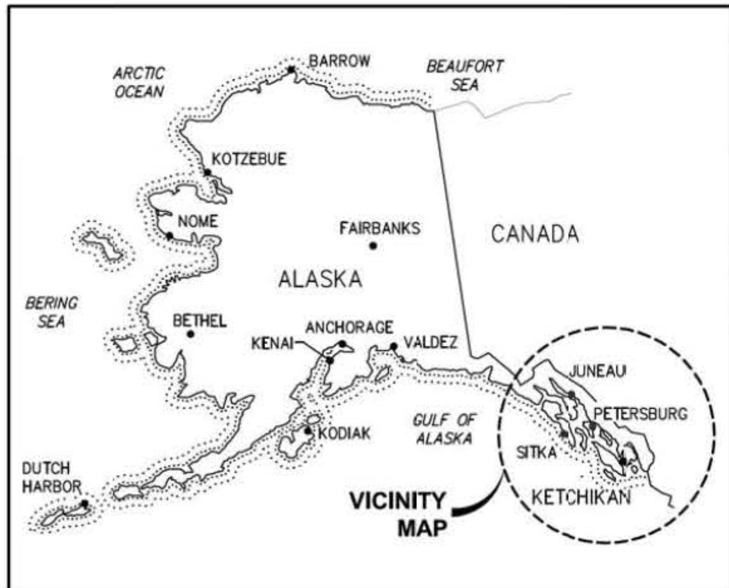
Date: SEPT. 93
Scale:

BERTH I SOUTH TYPICAL SECTIONS

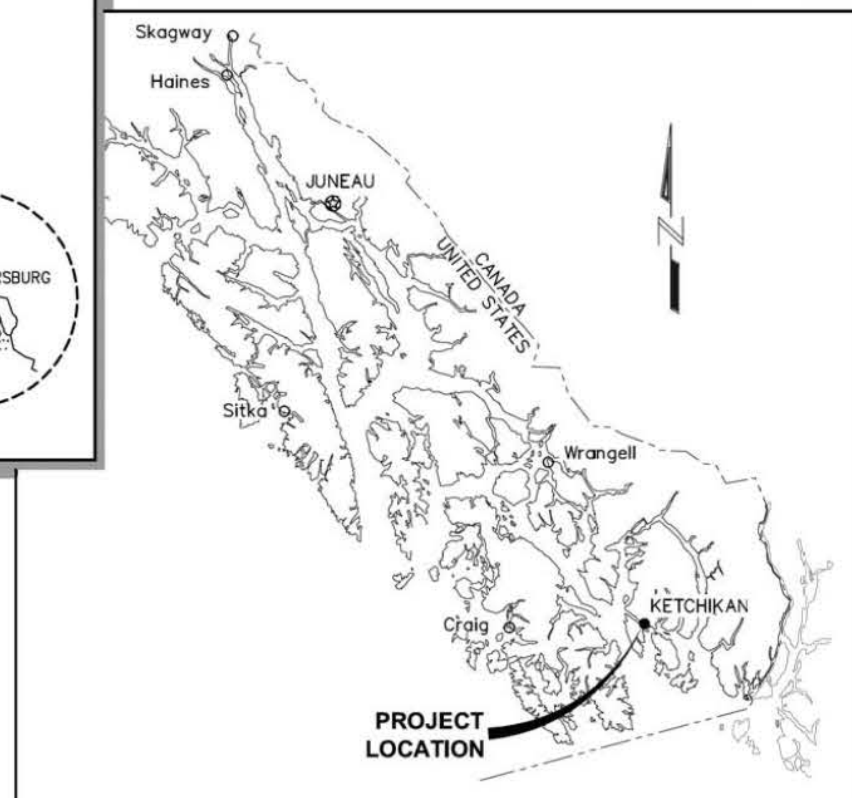
sheet 8 of 21

CONTRACT 11-02

CITY OF KETCHIKAN
BERTHS I AND II REHABILITATION
PHASE I



ALASKA KEY MAP



VICINITY MAP

LOCATION MAP
EXISTING CONDITIONS PRIOR TO PHASE I CONSTRUCTION

TIDAL DATA	ELEV. (FT)
HIGHEST OBSERVED WATER LEVEL (12/2/1967)	+21.3
MEAN HIGHER HIGH WATER (MHHW)	+15.4
MEAN HIGH WATER (MHW)	+14.5
MEAN LOW WATER (MLW)	+1.6
MEAN LOWER LOW WATER (MLLW)	0.0
LOWEST OBSERVED WATER LEVEL (1/1/1991)	−5.2

CONFORMED SET 2 ⚠

P N D ENGINEERS, INC.
811 First Avenue, Suite 570
Seattle, Washington 98104
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Fax: 206-624-1388
mail@pndengineers.com

City of Ketchikan

REVISIONS

REV	DATE	DESCRIPTION
2	3/20/12	CONFORMED SET 2
1	5/31/11	CONFORMED SET

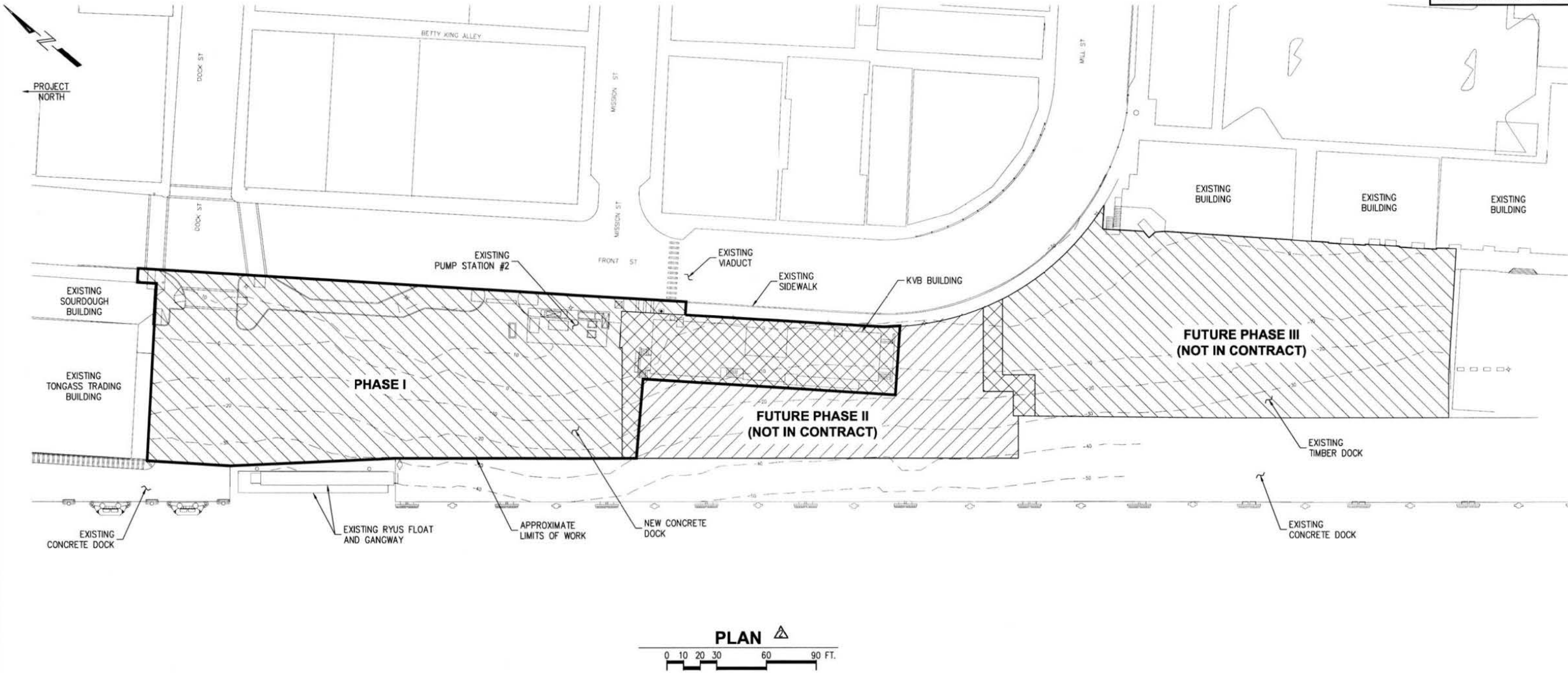
PROJECT: BERTHS I AND II REHABILITATION PHASE I

TITLE: TITLE SHEET AND TIDAL DATA

DESIGNED BY: BKP	PROJECT NO:	074047.02	FIGURE NO:	G1.01
DRAWN BY: ALR	DATE:	MARCH 2012		
CHECKED BY:	SCALE:	NOTED		

3/12/12
Drawings\2007\074047.02 Berths I & II Rehabilitation\Phase I\Conformed Set 2\074047.02-G1.01.dwg

CONTRACT 11-02



PLAN 2

CONFORMED SET 2

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811 First Avenue, Suite 570
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Fax: 206-624-1388
mail@pndengineers.com

City of Ketchikan

STATE OF ALASKA 49TH Todd R. Dueck No. 12727 REGISTERED PROFESSIONAL ENGINEER 3/22/12

REVISIONS		
2	3/20/12	CONFORMED SET 2
1	5/31/11	CONFROMED SET
REV	DATE	DESCRIPTION

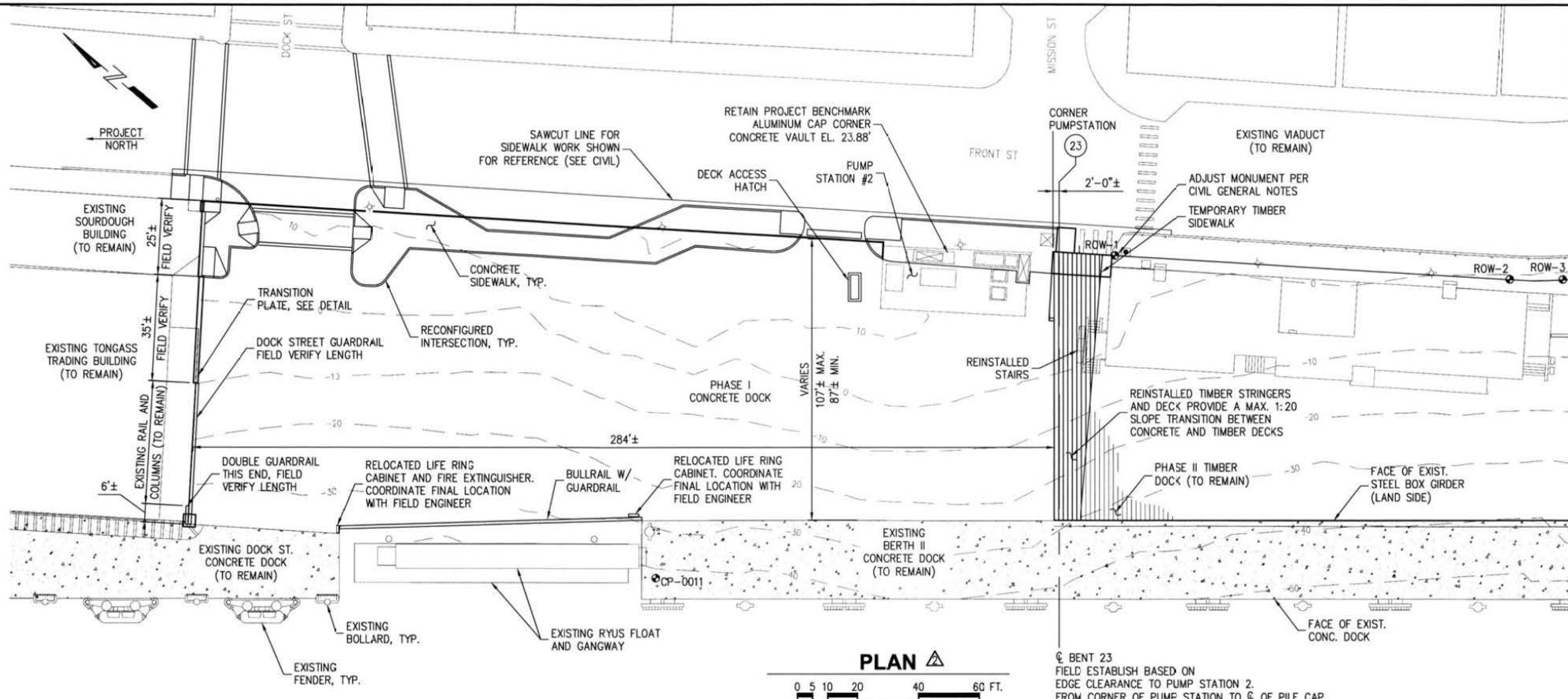
PROJECT: **BERTHS I AND II REHABILITATION PHASE I**

TITLE: **OVERALL SITE PLAN**

DESIGNED BY: BKP/OT	PROJECT NO: 074047.02	FIGURE NO:
DRAWN BY: GRD	DATE: MARCH 2012	**G3.01**
CHECKED BY:	SCALE: NOTED	

3/12/12
Drawings\2007\074047.02 Berths I & II Rehabilitation\Phase I\Conformed Set 2\074047.02-G3.01.dwg

CONTRACT 11-02

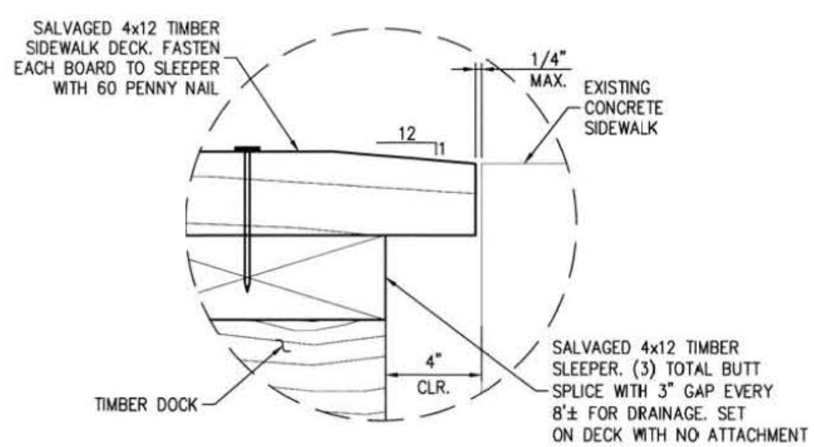


PLAN 2

CONTROL POINT TABLE

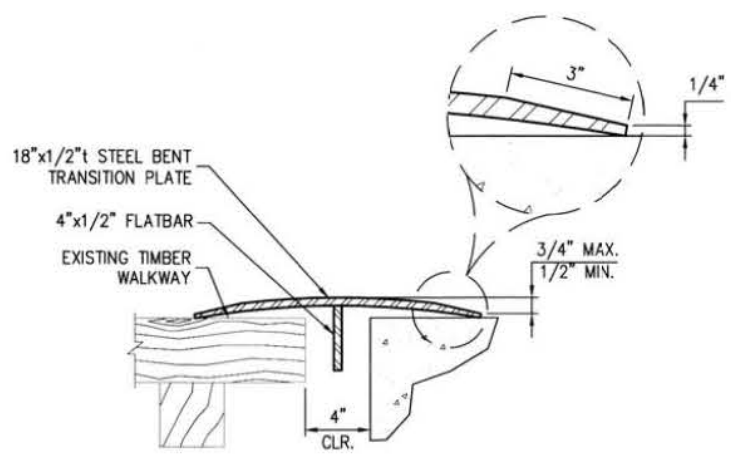
POINT No.	NORTHING	EASTING
CP-0011	1287098.91	3106183.40
ROW-1	1287050.92	3106362.08
ROW-2	1286946.20	3106439.75
ROW-3	1286932.78	3106450.92

LOCATION CONTROL NOTES
GRID LINES AND DIMENSIONS ARE PERPENDICULAR OR PARALLEL FROM THE EXISTING BERTH II CONCRETE DOCK. FOR ALL TOP OF NEW DOCK ELEVATIONS REFER TO CIVIL GRADING PLANS.



TEMPORARY TIMBER SIDEWALK DETAIL

ALL ADJACENT RAISED SURFACES SIMILAR



TRANSITION PLATE

(AT TONGASS TRADING)

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Seattle, Washington 98104
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mail@pndengineers.com

City of Ketchikan

STATE OF ALASKA 49TH Todd W. Belsick No. 12727 REGISTERED PROFESSIONAL ENGINEER 3/22/12

REVISIONS

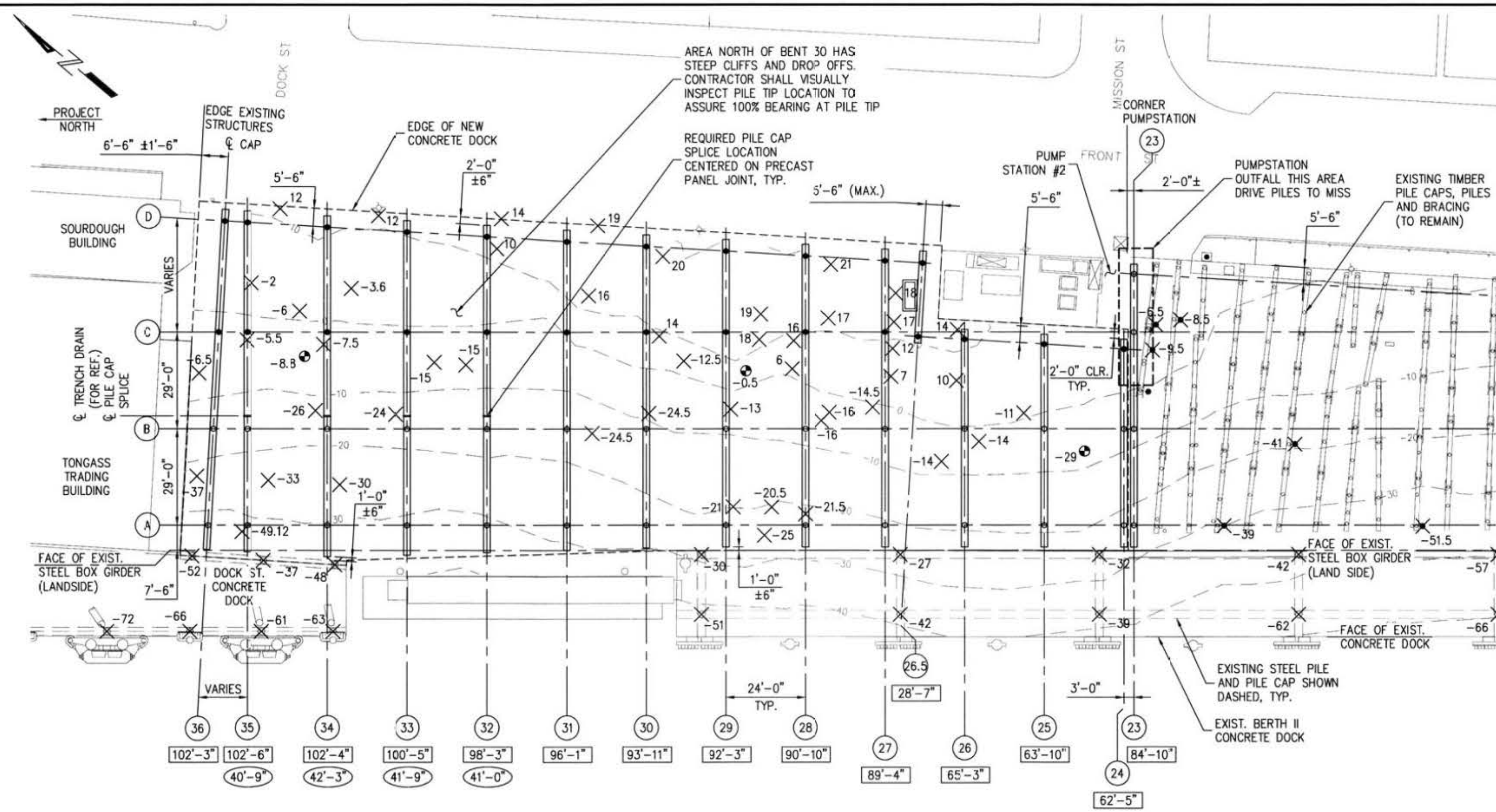
REV	DATE	DESCRIPTION
2	3/20/12	CONFORMED SET 2
1	5/31/11	CONFROMED SET

PROJECT: **BERTHS I AND II REHABILITATION PHASE I**

TITLE: **GENERAL ARRANGEMENT PLAN**

DESIGNED BY: BKP	PROJECT NO: 074047.02	FIGURE NO:	
DRAWN BY: GRD	DATE: MARCH 2012	**S2.01**	
CHECKED BY:	SCALE: NOTED		

3/12/12
Drawings\2007\074047.02 Berths I & II Rehabilitation\Phase I\Conformed Set 2\074047.02-S2.01.dwg

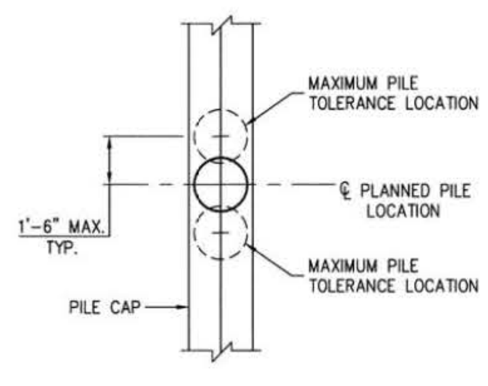


PLAN

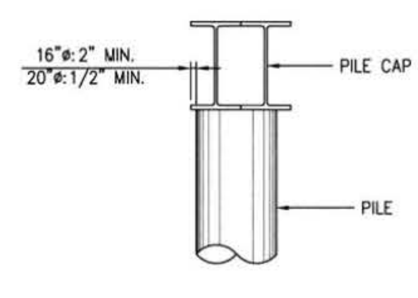
0 5 10 20 40 60 FT.

NOTES:

1. MAXIMUM PILE CAP SPAN = 32'-0"
2. MAXIMUM PILE CAP CANTILEVER SPAN = 10'-0"
3. ALL PILE CAP SUPPLY LENGTHS SHALL BE FIELD VERIFIED PRIOR TO FABRICATION
4. FOR CAPS THAT DO NOT HAVE A WEST PILE CAP SUPPLY LENGTH INDICATED, CONTRACTOR MAY SPLICE CAP AS REQUIRED.



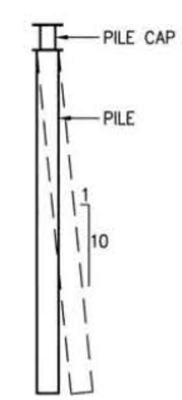
PLAN



ELEVATION

PILE TOLERANCE

(20"ø PILE SHOWN)



NOTE:
THE DESIGN INTENT FOR PILE INSTALLATION IS FOR ALL PILES TO BE DRIVEN PLUMB AND TRUE. HOWEVER, DUE TO UNFORESEEABLE BOTTOM OBSTRUCTIONS, VERTICAL PILES MAY BE DRIVEN AS MUCH AS 1:10 OUT OF PLUMB AS LONG AS IT DOES NOT INTERFERE WITH ADJACENT STRUCTURES. ENGINEER MAY LIMIT TOLERANCE FOR PILES ADJACENT TO ANY OUT OF PLUMB PILES ON A CASE BY CASE BASIS. OUT OF PLUMB PILES ARE SUBJECT TO APPROVAL BY ENGINEER.

VERTICAL PILE PLUMBNESS

LOCATION CONTROL NOTES
GRID LINES AND DIMENSIONS ARE PERPENDICULAR OR PARALLEL FROM EXISTING BERTH II CONCRETE DECK WITH THE EXCEPTION OF GRIDS 26.5 AND 36. FOR ALL TOP OF NEW DOCK ELEVATIONS REFER TO CIVIL GRADING PLANS FOR DETAILS.

LEGEND

- • 16"ø PILE–SOCKETED
- o 20"ø PILE–DRIVEN
- −29 APPROX. BOREHOLE BEDROCK ELEVATION
- −33 × APPROX. EXISTING PILE TIP ELEVATION (SELECT PILES)
- 97'-8" PILE CAP SUPPLY LENGTH
- (39'-4") WEST PILE CAP SUPPLY LENGTH

CONFORMED SET 2 △

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Fax: 206-624-1388
mail@pndengineers.com

City of Ketchikan

STATE OF ALASKA 49TH Todd A. Baisch No. 12727 REGISTERED PROFESSIONAL ENGINEER 3/22/12

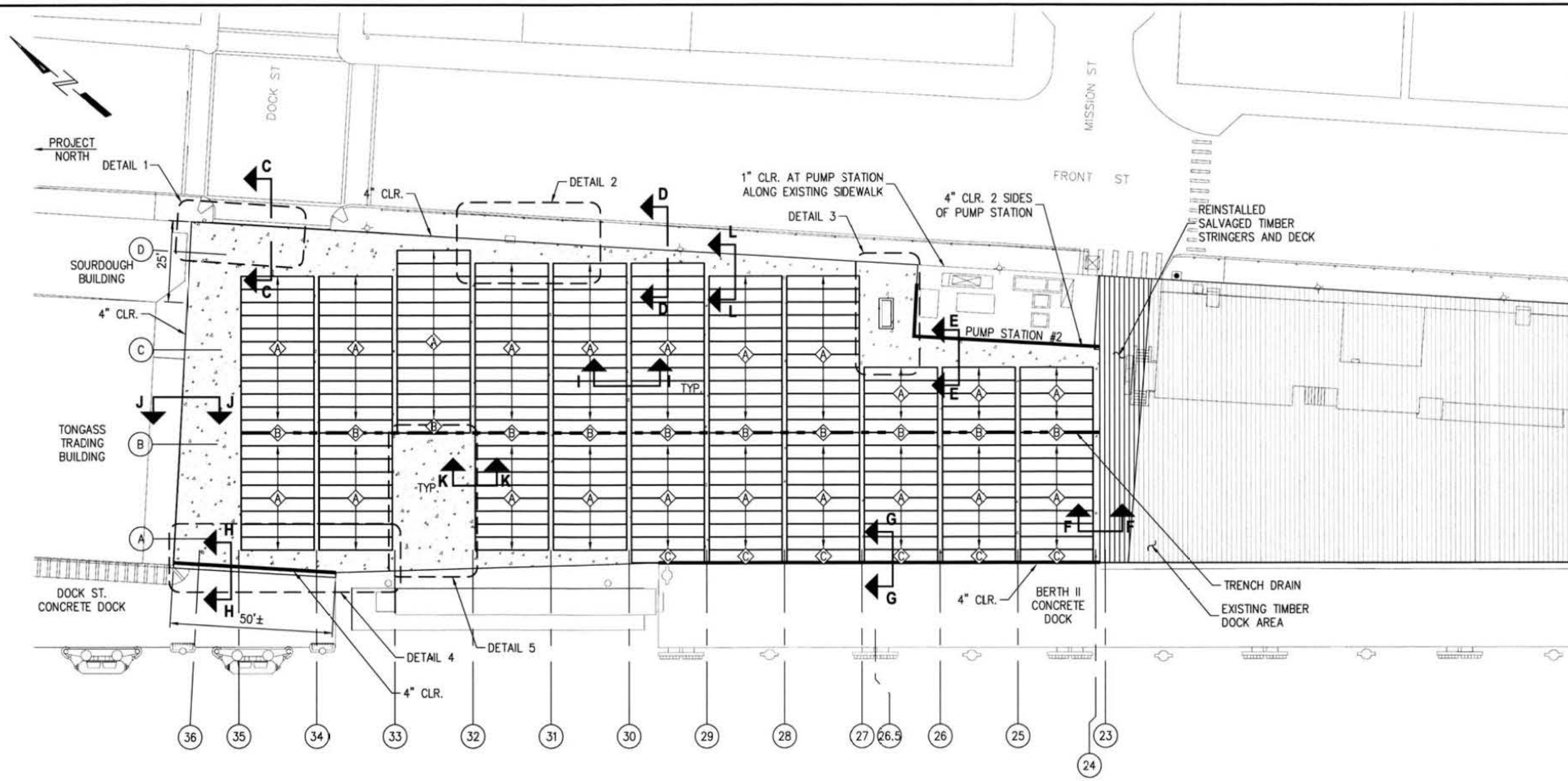
REVISIONS		
2	3/20/12	CONFORMED SET 2
1	5/31/11	CONFORMED SET
REV	DATE	DESCRIPTION

PROJECT: **BERTHS I AND II REHABILITATION PHASE I**

TITLE: **PILE AND PILE CAP PLAN**

DESIGNED BY: BKP	PROJECT NO: 074047.02	FIGURE NO:	
DRAWN BY: GRD	DATE: MARCH 2012	S2.05	
CHECKED BY:	SCALE: NOTED		

CONTRACT 11-02



PLAN

0 5 10 20 40 60 FT.

LEGEND

- EXPANSION JOINT
- TRENCH DRAIN
- PANEL DESIGNATOR
- CAST-IN-PLACE CONCRETE

NOTES:
1) FOR CONCRETE DOCK ELEVATIONS, SIDEWALK EXPANSION JOINTS AND GRADING PLAN, SEE CIVIL DRAWINGS.
2) SEE CIVIL DRAWINGS FOR EXPANSION JOINTS AT NEW SIDEWALKS ALONG FRONT STREET. NEW SIDEWALKS NOT SHOWN ON THIS SHEET.

CONFORMED SET 2 2

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Fax: 206-624-1388
mail@pndengineers.com

City of Ketchikan

STATE OF ALASKA 49TH Todd W. Belsick No. 12727 REGISTERED PROFESSIONAL ENGINEER 3/20/12

REVISIONS

REV	DATE	DESCRIPTION
2	3/20/12	CONFORMED SET 2
1	5/31/11	CONFORMED SET

PROJECT: **BERTHS I AND II REHABILITATION PHASE I**

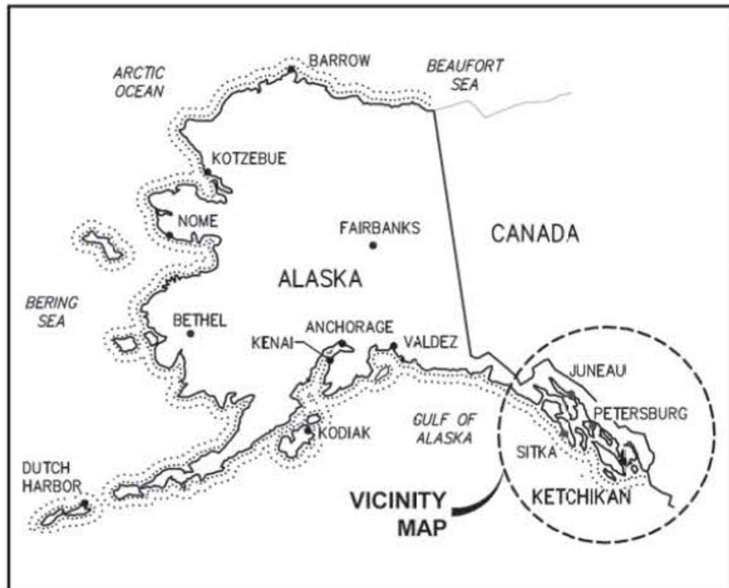
TITLE: **CONCRETE PANEL AND DECK LAYOUT**

DESIGNED BY: BKP	PROJECT NO: 074047.02	FIGURE NO:	
DRAWN BY: GRD	DATE: MARCH 2012	**S2.09**	
CHECKED BY:	SCALE: NOTED		

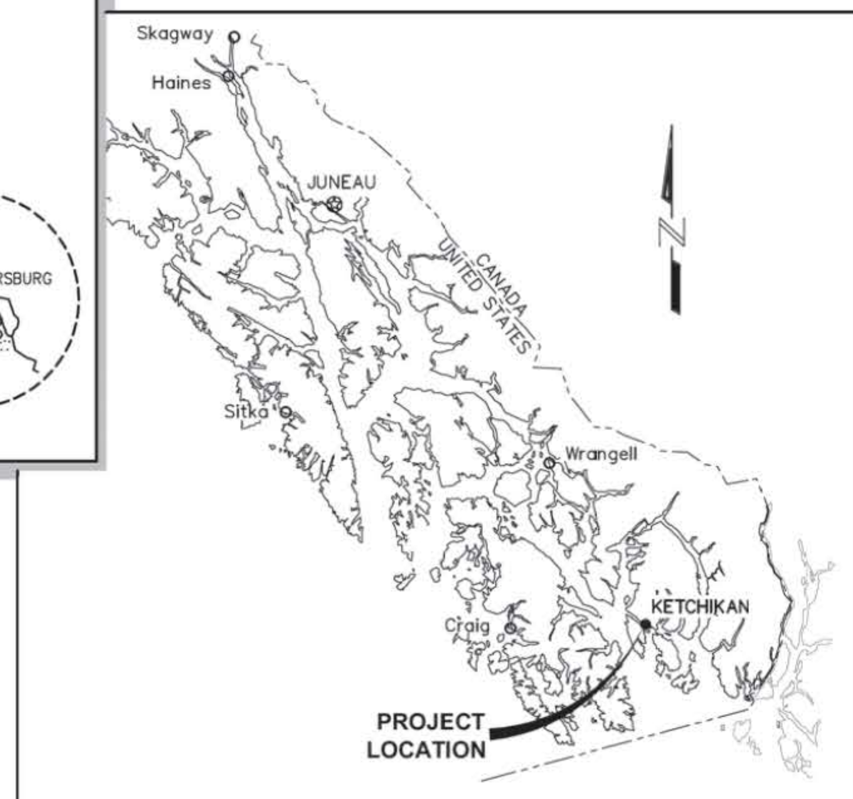
3/12/12
Drawings\2007\074047.02 Berths I & II Rehabilitation\Phase I\Conformed Set 2\074047.02-S2.09.dwg

CONTRACT 12-19

CITY OF KETCHIKAN
BERTHS I AND II REHABILITATION
PHASE II



ALASKA KEY MAP



VICINITY MAP

LOCATION MAP

EXISTING CONDITIONS PRIOR TO PHASE I CONSTRUCTION

TIDAL DATA	ELEV. (FT)
HIGHEST OBSERVED WATER LEVEL (12/2/1967)	+21.3
MEAN HIGHER HIGH WATER (MHHW)	+15.4
MEAN HIGH WATER (MHW)	+14.5
MEAN LOW WATER (MLW)	+1.6
MEAN LOWER LOW WATER (MLLW)	0.0
LOWEST OBSERVED WATER LEVEL (1/1/1991)	−5.2

6/27/12
Drawings\2007\074047.03 – Phase B Design Services\Phase II\Conformed Set\074047.03–G1.01.dwg

CONFORMED SET

City of Ketchikan

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REVISIONS

REV	DATE	DESCRIPTION

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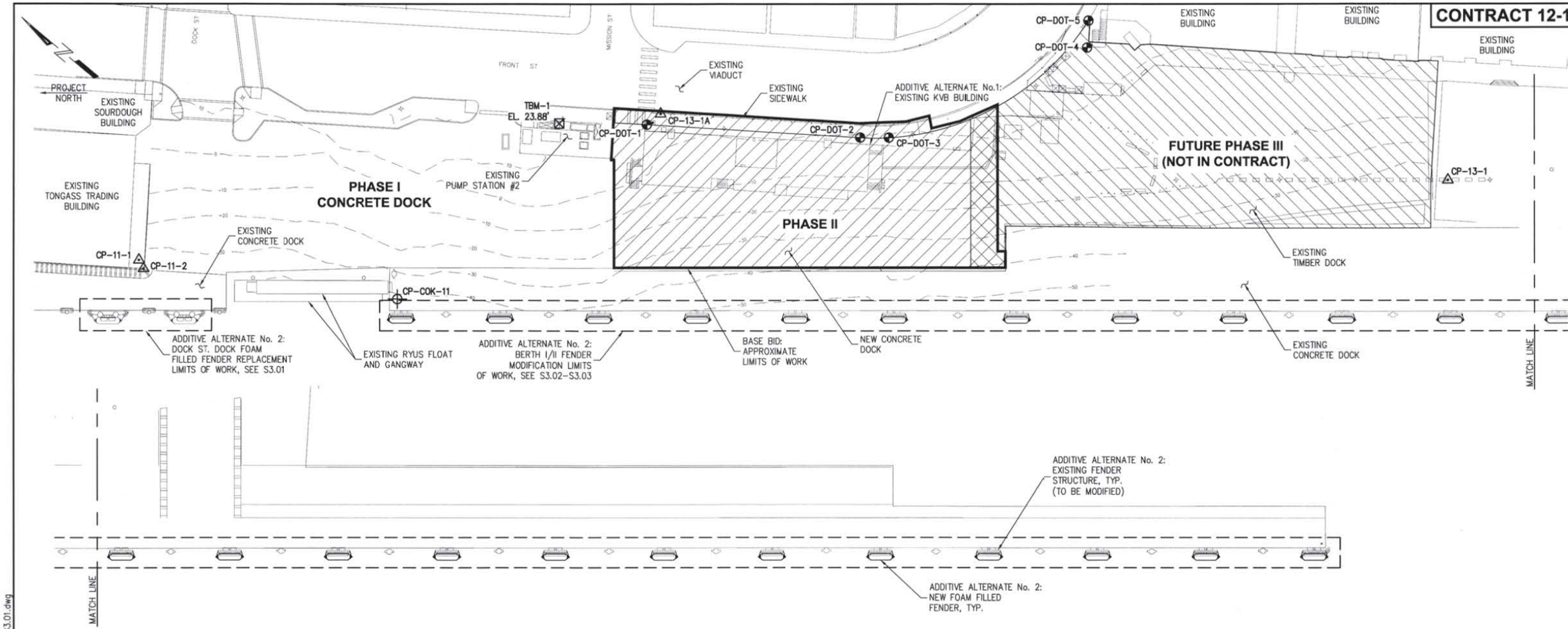
PROJECT: BERTHS I AND II REHABILITATION PHASE II

TITLE: TITLE SHEET AND TIDAL DATA

DESIGNED BY:	BKP	PROJECT NO:	074047.03	FIGURE NO:
DRAWN BY:	GRD	DATE:	JULY 2012	G1.01
CHECKED BY:		SCALE:	NOTED	

CONTRACT 12-19



PLAN

CONTROL POINT TABLE		
CONTROL POINT #	NORTHING	EASTING
CP-COK-11	1287098.91	3106183.40
CP-11-1	1287234.59	3106100.51
CP-11-2	1287229.03	3106098.34
CP-13-1A	1287048.67	3106372.45
CP-13-1	1286655.44	3106649.84
TBM-1	1287092.15	3106328.32
CP-DOT-1	1287050.92	3106362.08
CP-DOT-2	1286946.20	3106439.75
CP-DOT-3	1286932.78	3106450.92
CP-DOT-4	1286875.41	3106570.47
CP-DOT-5	1286885.28	3106583.49

ALL DATA IS ALASKA STATE PLANE, ZONE 2, NAD83.

LEGEND

- CITY OF KETCHIKAN CONTROL POINT
- ALASKA DOT&PF MONUMENT ALUMINUM CAP*
- CONTROL POINT
- TBM ALUMINUM CAP

*ROW MONUMENTS TO BE REPLACED IN-KIND ACCORDING TO ADOT&PF SECTION 613.

6/27/12
Drawings\2007\074047.03 - Phase B Design Services\Phase II\Conformed Set\074047.03-G3.01.dwg

CONFORMED SET

City of Ketchikan

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STATE OF ALASKA 49th Todd M. Batsick No. 12727 REGISTERED PROFESSIONAL ENGINEER 7/6/12

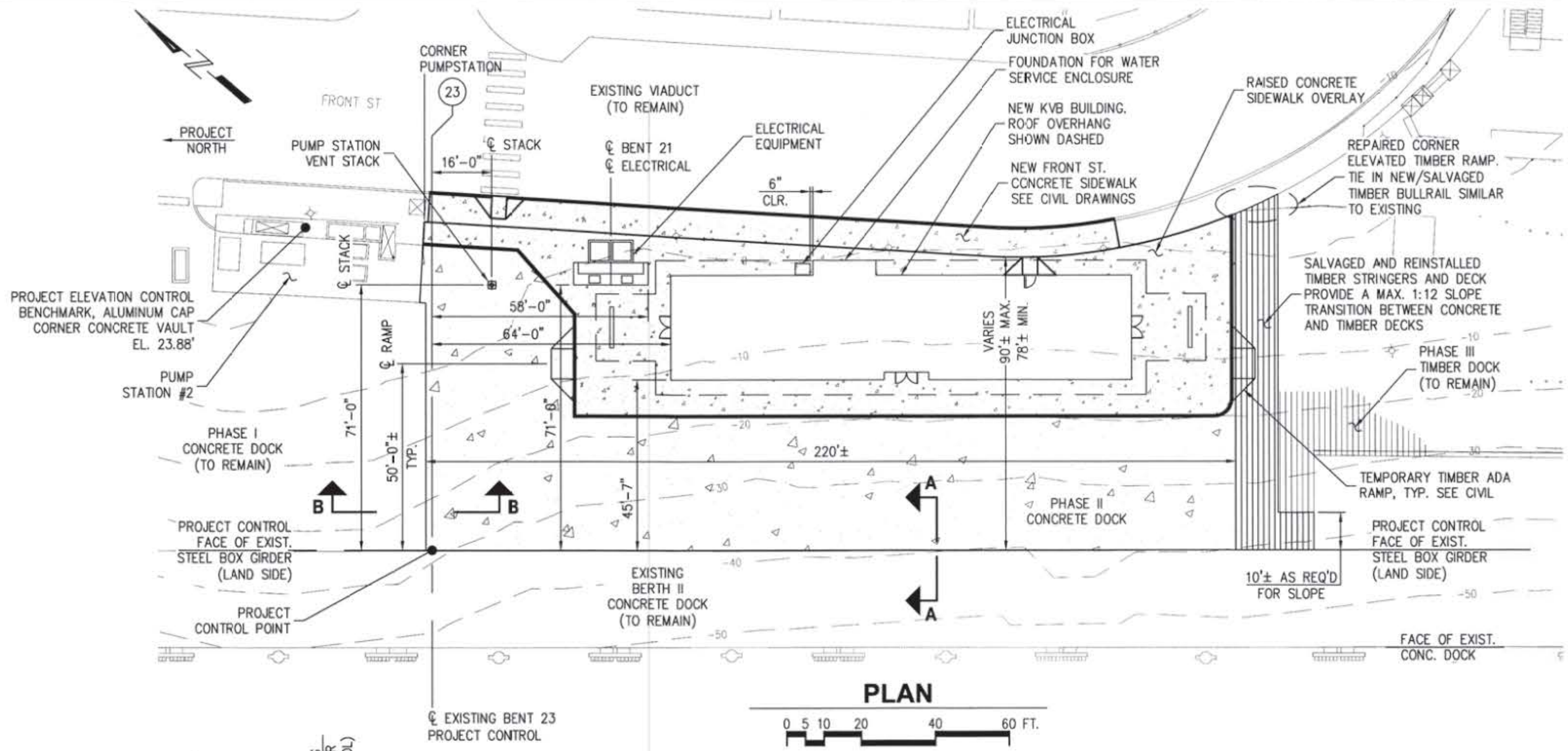
REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: **BERTHS I AND II REHABILITATION PHASE II**

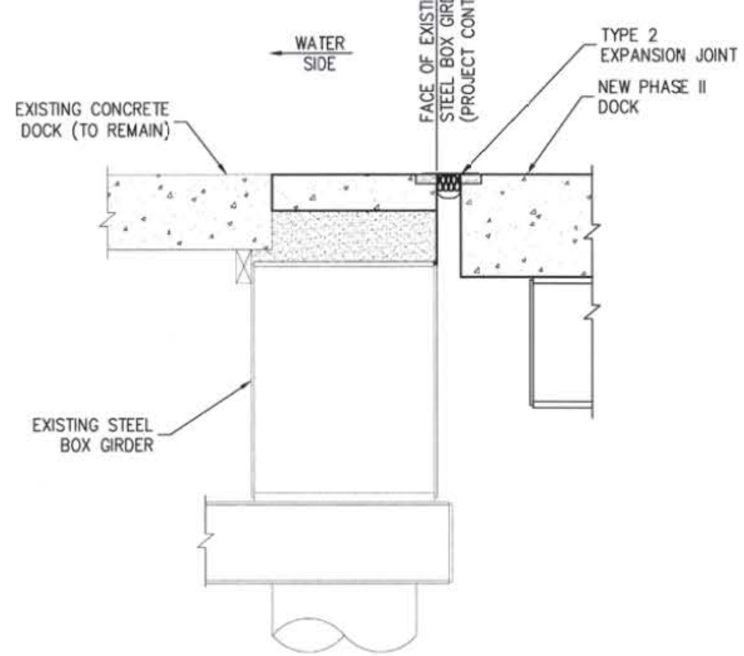
TITLE: **OVERALL SITE PLAN**

DESIGNED BY: TWB	PROJECT NO:	074047.03	FIGURE NO:	**G3.01**
DRAWN BY: GRD	DATE:	JULY 2012		
CHECKED BY:	SCALE:	NOTED		

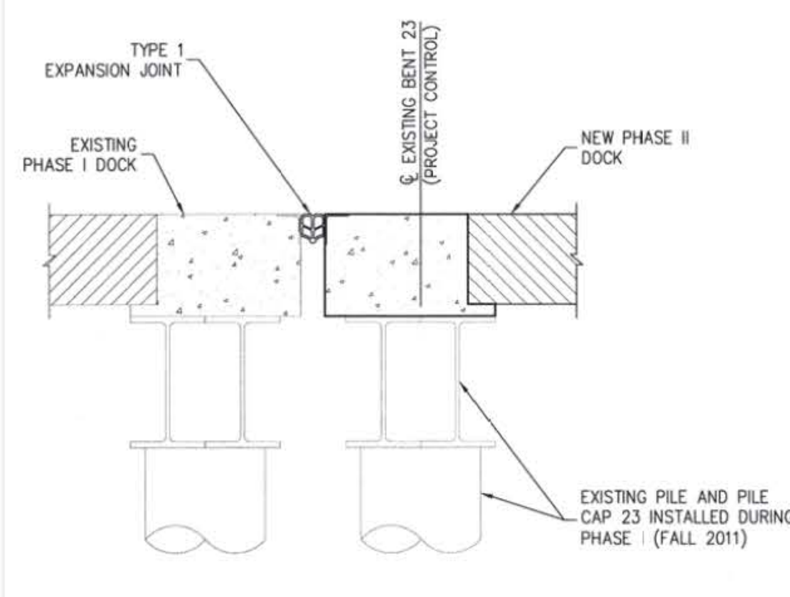
CONTRACT 12-19



PLAN



SECTION A-A
(PROJECT CONTROL)



SECTION B-B
(PROJECT CONTROL)

LOCATION CONTROL NOTES
GRID LINES AND DIMENSIONS ARE PERPENDICULAR OR PARALLEL FROM THE EXISTING BERTH II CONCRETE DOCK. FOR ALL TOP OF NEW DOCK ELEVATIONS REFER TO CIVIL GRADING PLANS.

CONFORMED SET

City of Ketchikan

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STATE OF ALASKA 49TH Todd W. Belsick No. 12727 REGISTERED PROFESSIONAL ENGINEER 7/6/12

REVISIONS		
REV	DATE	DESCRIPTION

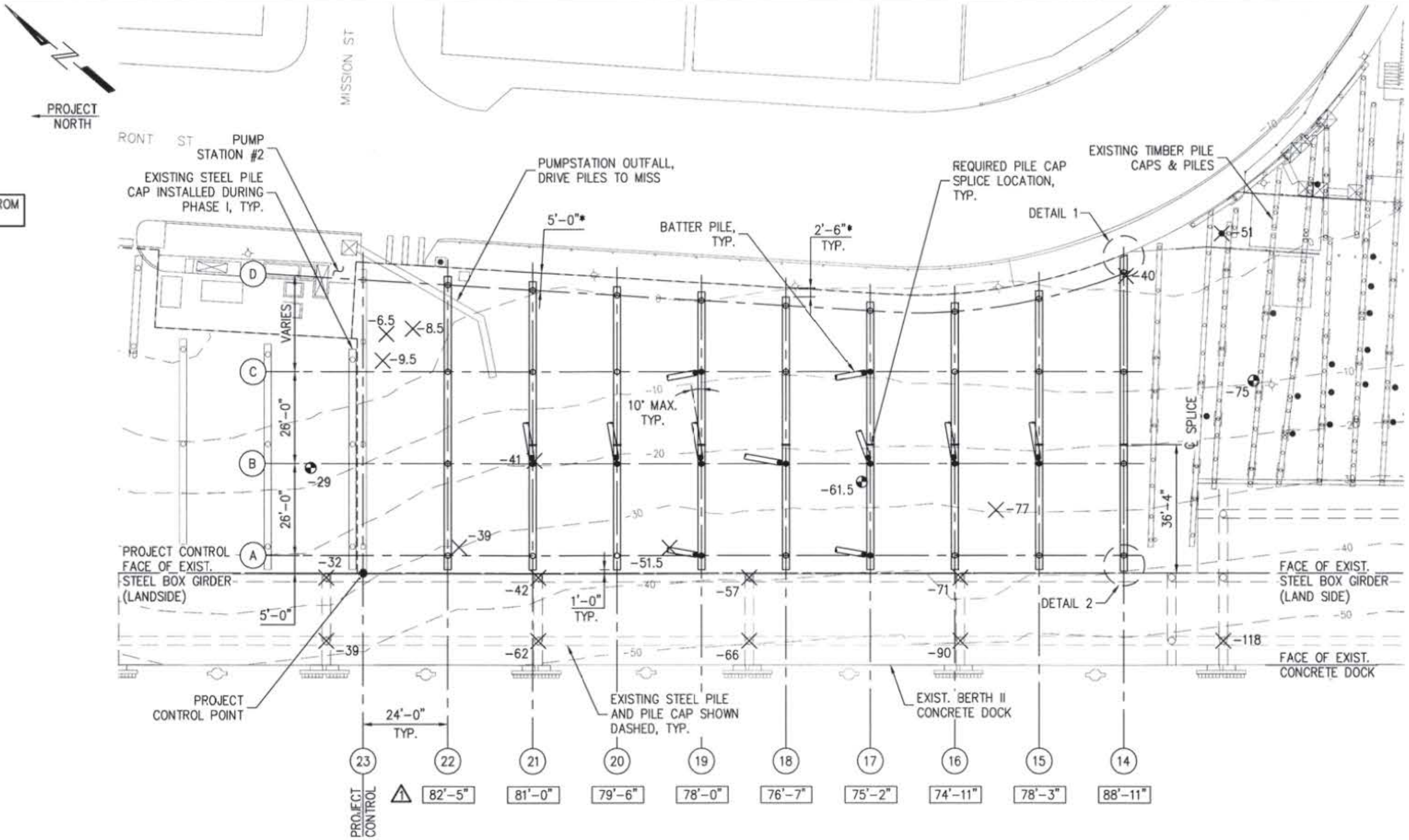
PROJECT: **BERTHS I AND II REHABILITATION PHASE II**

TITLE: **GENERAL ARRANGEMENT AND PROJECT CONTROL PLAN**

DESIGNED BY: BKP	PROJECT NO:	074047.03	FIGURE NO:	S1.03
DRAWN BY: GRD	DATE:	JULY 2012		
CHECKED BY:	SCALE:	NOTED		

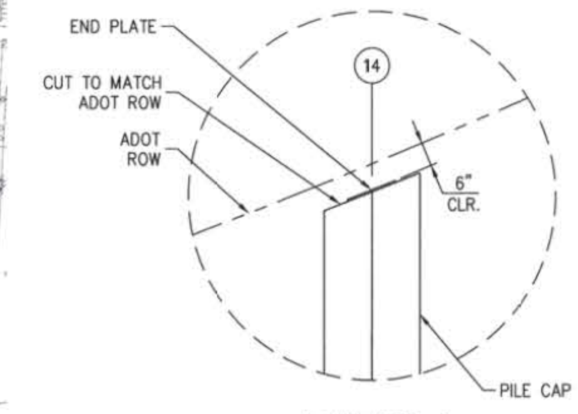
6/27/12 Drawings\2007\074047.03 - Phase B Design Services\Phase II\Conformed Set\074047.03-S1.03.dwg

CONTRACT 12-19



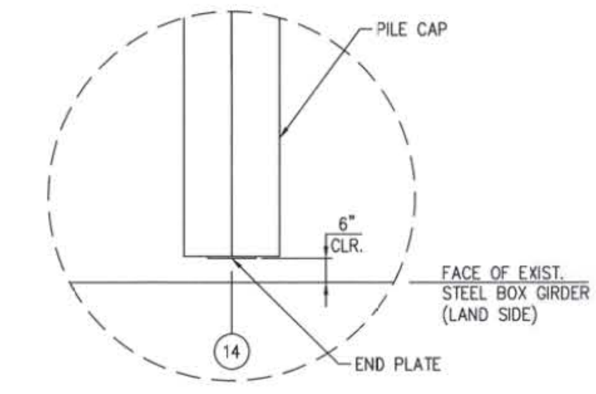
PLAN

0 5 10 20 40 60 FT.



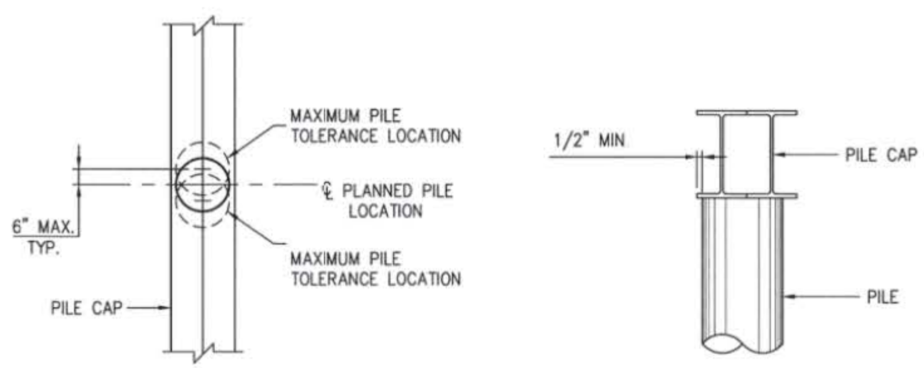
DETAIL 1

AT BENT 14 ONLY.



DETAIL 2

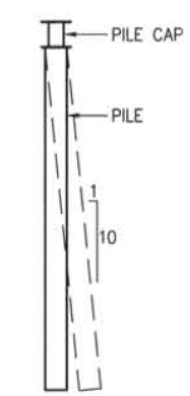
AT BENT 14 ONLY.



PLAN — ELEVATION

PILE TOLERANCE

NOTE:
ALL ESTIMATED PILE CAP SUPPLY LENGTHS PROVIDED SHALL BE FIELD VERIFIED PRIOR TO FABRICATION.



VERTICAL PILE PLUMBNESS

NOTE:
THE DESIGN INTENT FOR PILE INSTALLATION IS FOR ALL PILES TO BE DRIVEN PLUMB AND TRUE. HOWEVER, DUE TO UNFORESEEABLE BOTTOM OBSTRUCTIONS, VERTICAL PILES MAY BE DRIVEN AS MUCH AS 1:10 OUT OF PLUMB AS LONG AS IT DOES NOT INTERFERE WITH ADJACENT STRUCTURES. ENGINEER MAY LIMIT TOLERANCE FOR PILES ADJACENT TO ANY OUT OF PLUMB PILES ON A CASE BY CASE BASIS. OUT OF PLUMB PILES ARE SUBJECT TO APPROVAL BY ENGINEER.

LOCATION CONTROL NOTES
GRID LINES AND DIMENSIONS ARE PERPENDICULAR OR PARALLEL FROM THE EXISTING BERTH II CONCRETE DECK. FOR ALL TOP OF NEW DOCK ELEVATIONS REFER TO CIVIL GRADING PLANS FOR DETAILS.

LEGEND
- ○ PILE–DRIVEN
- ● ROCK ANCHOR PILE
- VERTICAL AND BATTER PILE GROUP
- −29 APPROX. BOREHOLE BEDROCK ELEVATION
- −33 × APPROX. EXISTING PILE TIP ELEVATION (SELECT PILES)
- 97'-8" ESTIMATED PILE CAP SUPPLY LENGTH, FOR BID PURPOSES ONLY.

CONFORMED SET

City of Ketchikan

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STATE OF ALASKA 49th Todd W. Bebeck No. 12727 REGISTERED PROFESSIONAL ENGINEER 7/6/12

REVISIONS

REV	DATE	DESCRIPTION

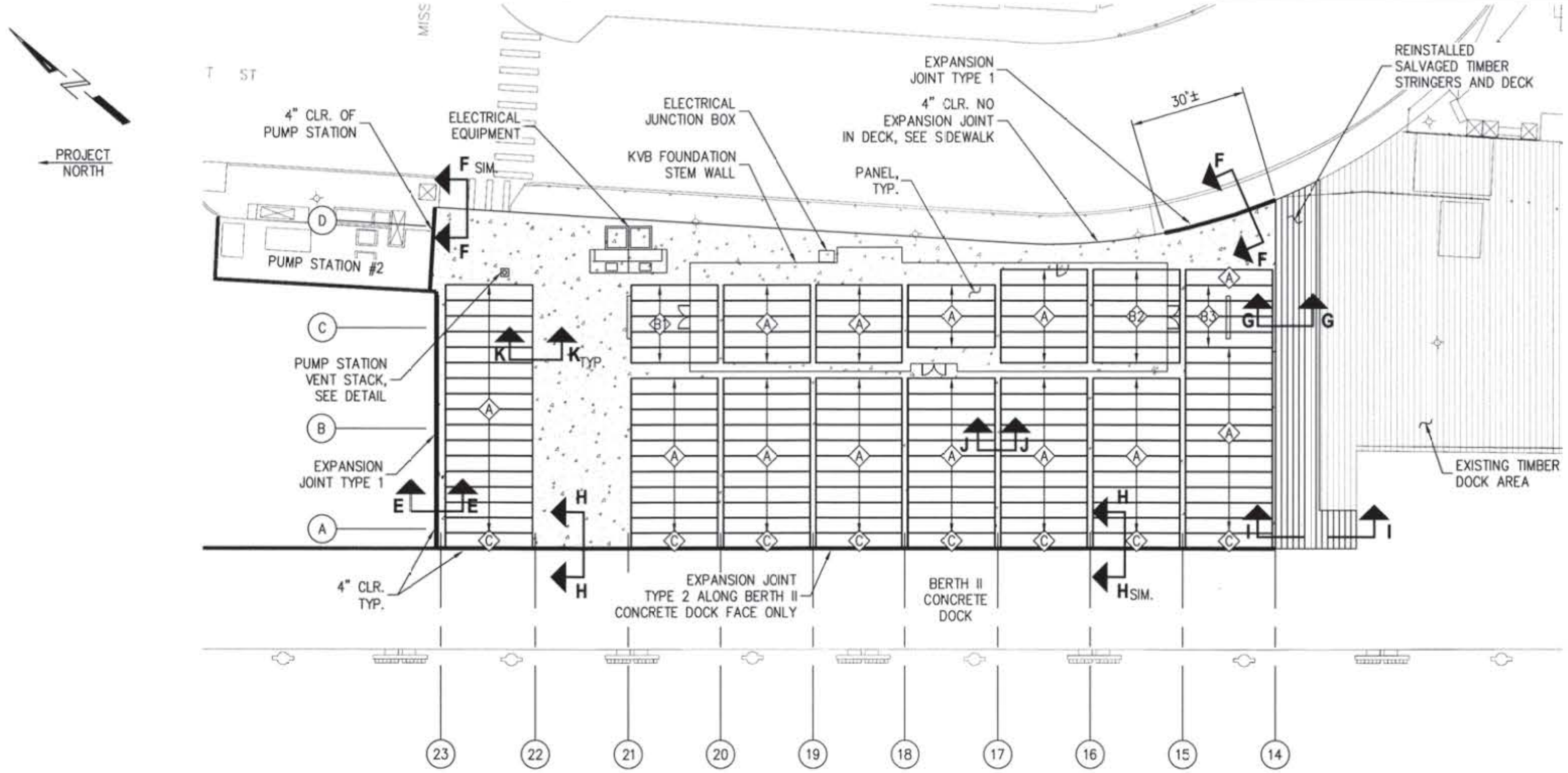
PROJECT: **BERTHS I AND II REHABILITATION PHASE II**

TITLE: **PILE AND PILE CAP PLAN**

DESIGNED BY: BKP	PROJECT NO:	074047.03	FIGURE NO:	
DRAWN BY: GRD	DATE:	JULY 2012	**S1.05**	
CHECKED BY:	SCALE:	NOTED		

6/27/12 Drawings\2007\074047.03 – Phase B Design Services\Phase II\Conformed Set\074047.03-S1.05.dwg

CONTRACT 12-19



PLAN

0 5 10 20 40 60 FT.

LEGEND

———	EXPANSION JOINT
— — —	TRENCH DRAIN
◇X	PANEL DESIGNATOR
▭	CAST–IN–PLACE CONCRETE

NOTE: FOR CONCRETE DOCK ELEVATIONS AND GRADING PLAN, SEE CIVIL DRAWINGS.

CONFORMED SET

City of Ketchikan

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STATE OF ALASKA 49TH Todd W. Batalck No. 12727 REGISTERED PROFESSIONAL ENGINEER 7/6/12

REVISIONS		
REV	DATE	DESCRIPTION

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PROJECT: **BERTHS I AND II REHABILITATION PHASE II**

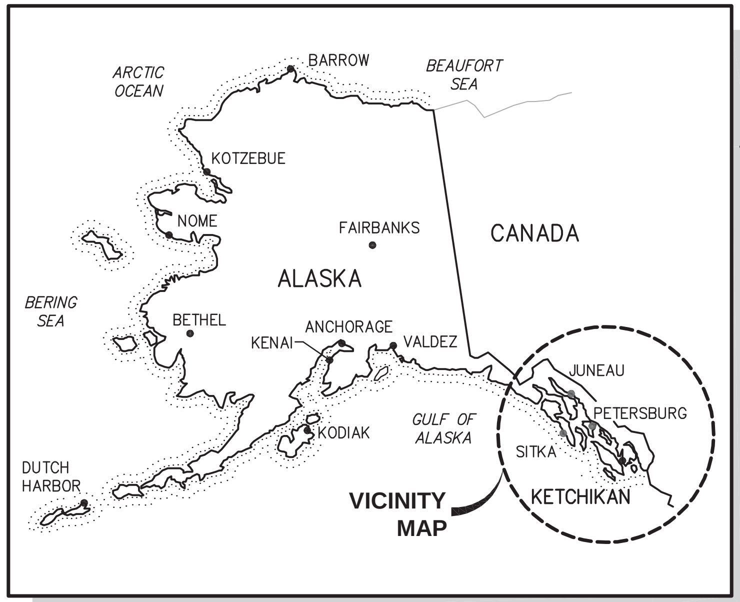
TITLE: **CONCRETE PANEL AND DECK LAYOUT**

DESIGNED BY: BKP	PROJECT NO:	074047.03	FIGURE NO:	
DRAWN BY: GRD	DATE:	JULY 2012	**S1.10**	
CHECKED BY:	SCALE:	NOTED		

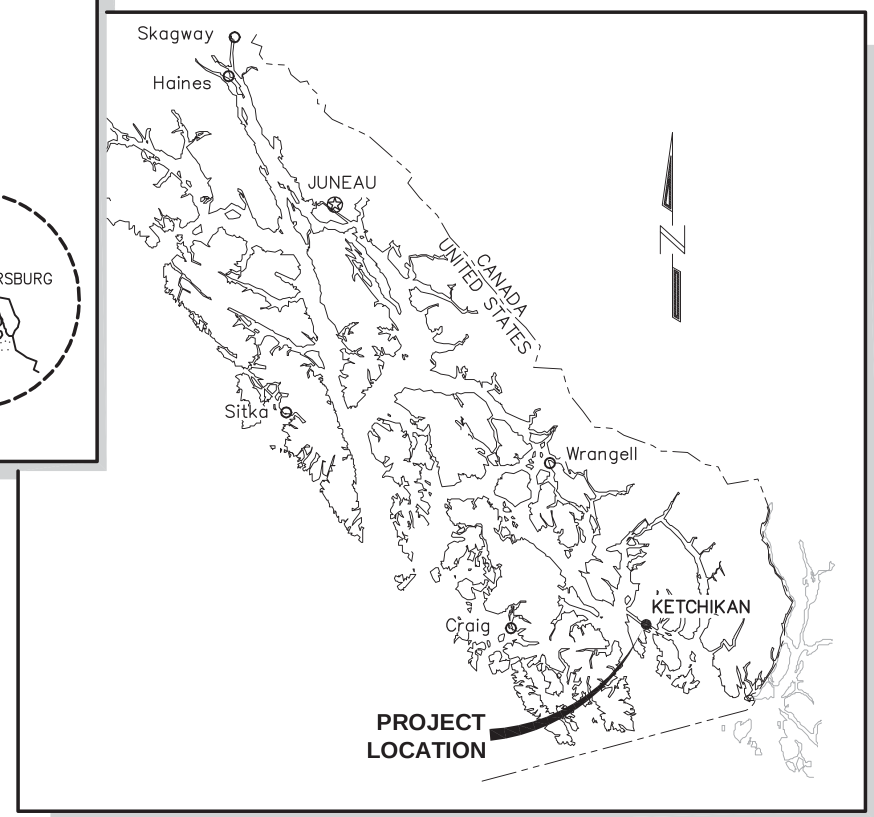
6/27/12 Drawings\2007\074047.03 – Phase B Design Services\Phase II\Conformed Set\074047.03–S1.10.dwg

CONTRACT 13-08

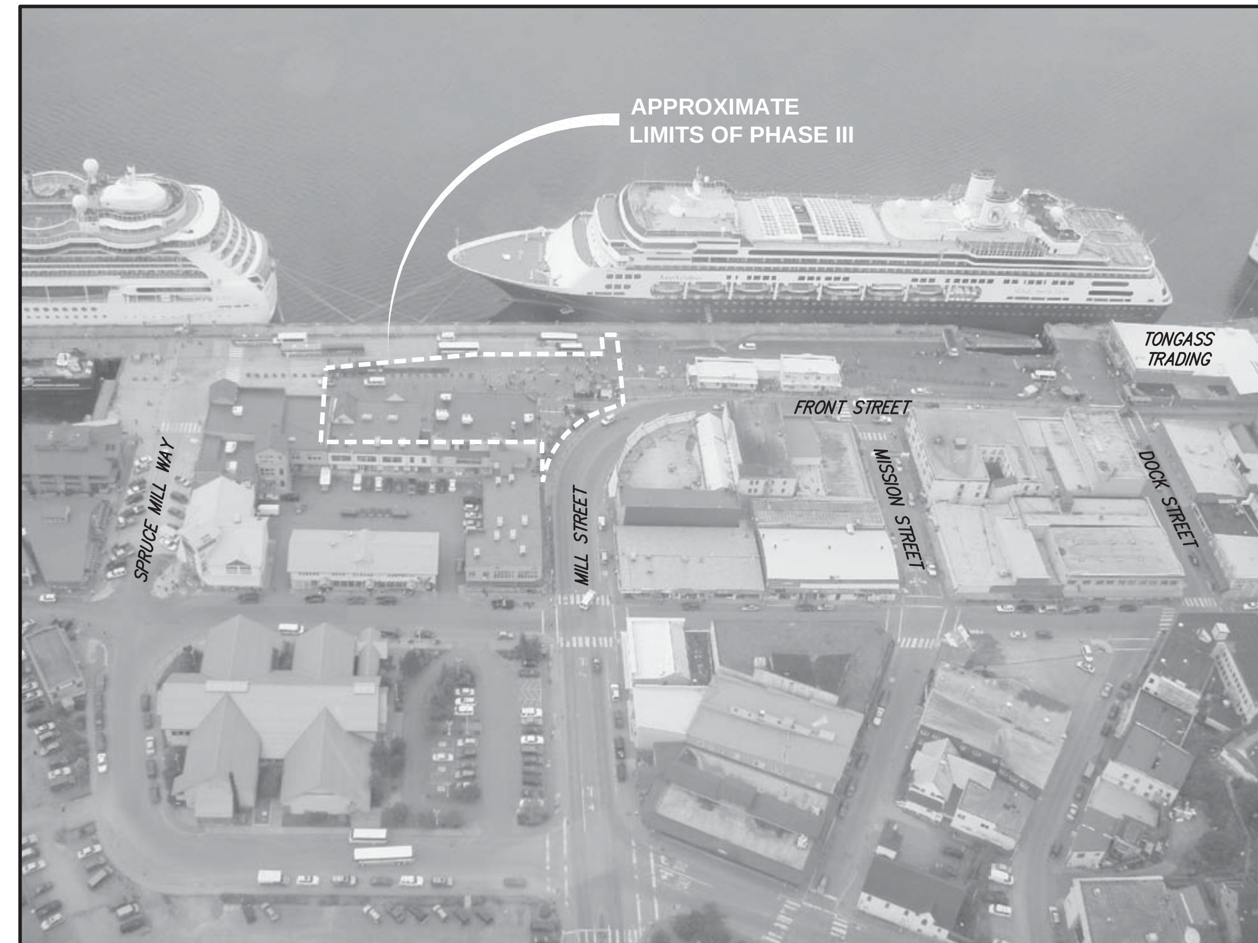
CITY OF KETCHIKAN
BERTHS I AND II REHABILITATION
PHASE III



ALASKA KEY MAP



VICINITY MAP



LOCATION MAP
(EXISTING CONDITIONS PRIOR TO PHASE I AND II CONSTRUCTION)

TIDAL DATA	ELEV. (FT)
HIGHEST OBSERVED WATER LEVEL (12/2/1967)	+21.3
MEAN HIGHER HIGH WATER (MHHW)	+15.4
MEAN HIGH WATER (MHW)	+14.5
MEAN LOW WATER (MLW)	+1.6
MEAN LOWER LOW WATER (MLLW)	0.0
LOWEST OBSERVED WATER LEVEL (1/1/1991)	-5.2

2/12/13
Drawings\2007\074047.04 – Berths I & II Phase C Design Services\Phase III\For Bid\074047.04–G1.01.dwg

FOR BID

City of Ketchikan

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REVISIONS		
REV	DATE	DESCRIPTION

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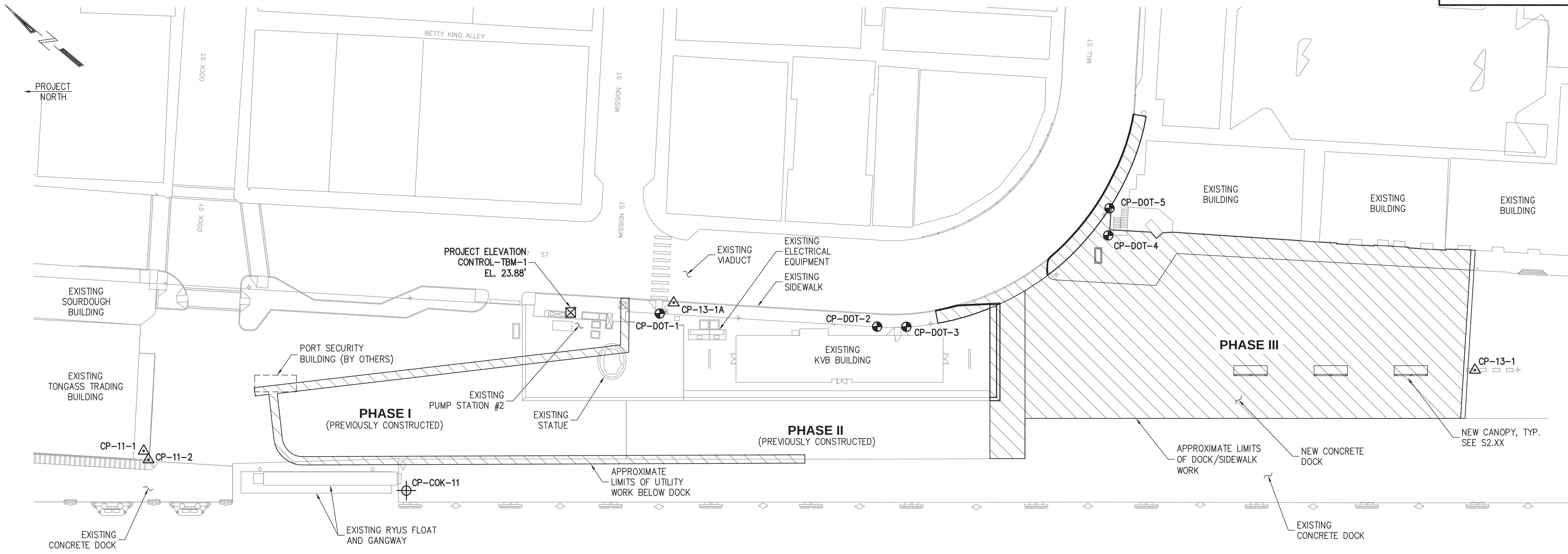
PROJECT: **BERTHS I AND II REHABILITATION PHASE III**

TITLE: **TITLE SHEET AND TIDAL DATA**

DESIGNED BY: BKP	PROJECT NO:	074047.04	FIGURE NO:	
DRAWN BY: GRD	DATE:	APRIL 15, 2013		**G1.01**
CHECKED BY:	SCALE:	NOTED		

CONTRACT 13-08



PLAN

CONTROL POINT TABLE

CONTROL POINT #	NORTHING	EASTING
CP-COK-11	1287098.91	3106183.40
CP-11-1	1287234.59	3106100.51
CP-11-2	1287229.03	3106098.34
CP-13-1A	1287048.67	3106372.45
CP-13-1	1286655.44	3106649.84
TBM-1	1287092.15	3106328.32
CP-DOT-1	1287050.92	3106362.08
CP-DOT-2	1286946.20	3106439.75
CP-DOT-3	1286932.78	3106450.92
CP-DOT-4	1286875.41	3106570.47
CP-DOT-5	1286885.28	3106583.49

ALL DATA IS ALASKA STATE PLANE, ZONE 2, NAD83. LOCATED BY R&M ENGINEERING 9/6/2007 SURVEY

LEGEND

- CITY OF KETCHIKAN CONTROL POINT
- ALASKA DOT&PF MONUMENT ALUMINUM CAP*
- CONTROL POINT
- TBM ALUMINUM CAP

*ROW MONUMENTS TO BE REPLACED IN-KIND WITH THE SAME INFORMATION ON THE CAP ACCORDING TO ADOT&PF STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION 2004, SECTIONS 642 AND 613.

FOR BID

City of Ketchikan

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STATE OF ALASKA 49TH Todd W. Baker No. 12727 REGISTERED PROFESSIONAL ENGINEER 4/12/13

REVISIONS

REV	DATE	DESCRIPTION

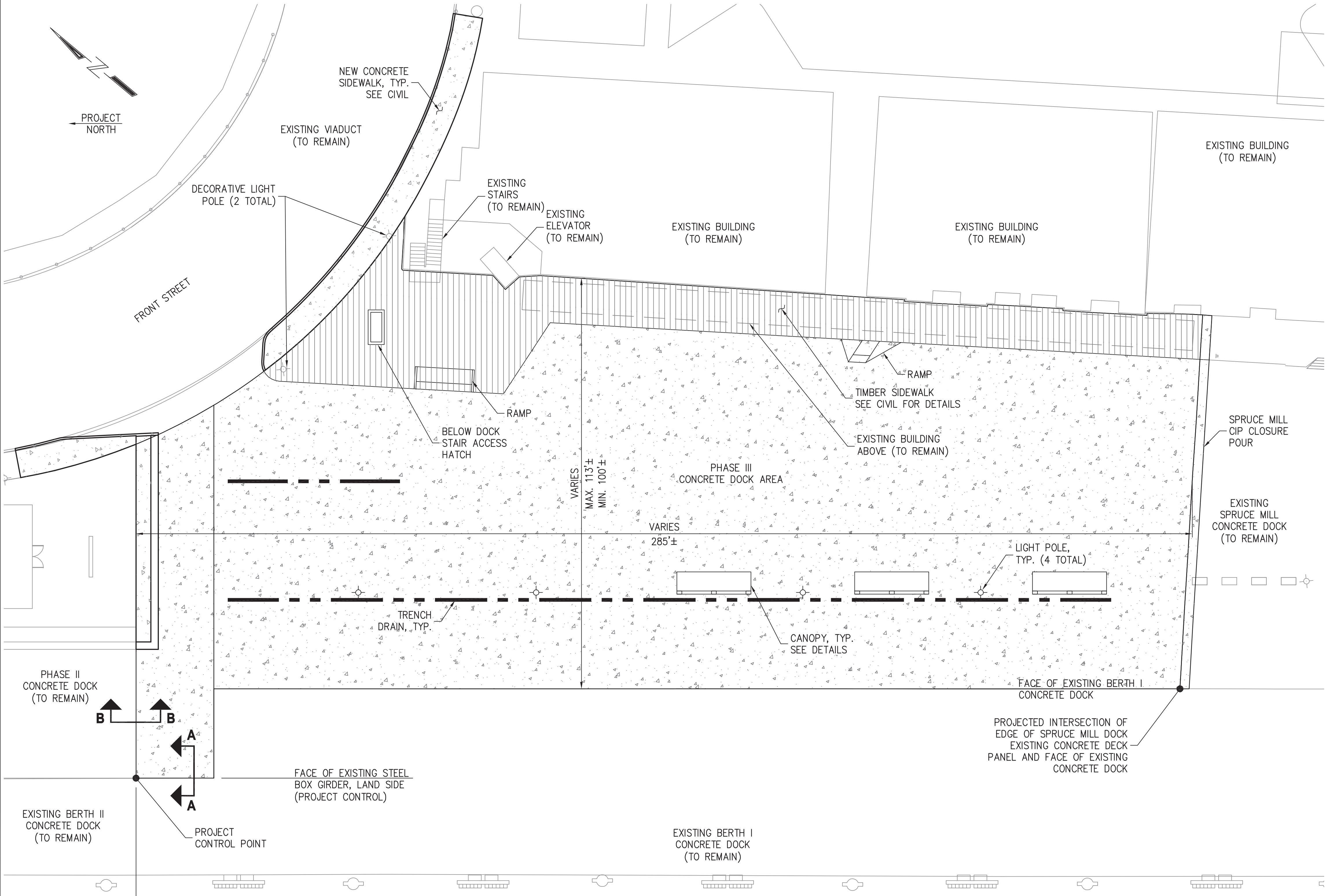
PROJECT: **BERTHS I AND II REHABILITATION PHASE III**

TITLE: **OVERALL SITE PLAN**

DESIGNED BY:	BKP/SR	PROJECT NO:	074047.04	FIGURE NO:
DRAWN BY:	GRD	DATE:	APRIL 15, 2013	G3.01
CHECKED BY:	TWB	SCALE:	NOTED	

4/5/13 Drawings\2007\074047.04 - Berths I & II Phase C Design Services\Phase III\For Bid\074047.04-G3.01.dwg

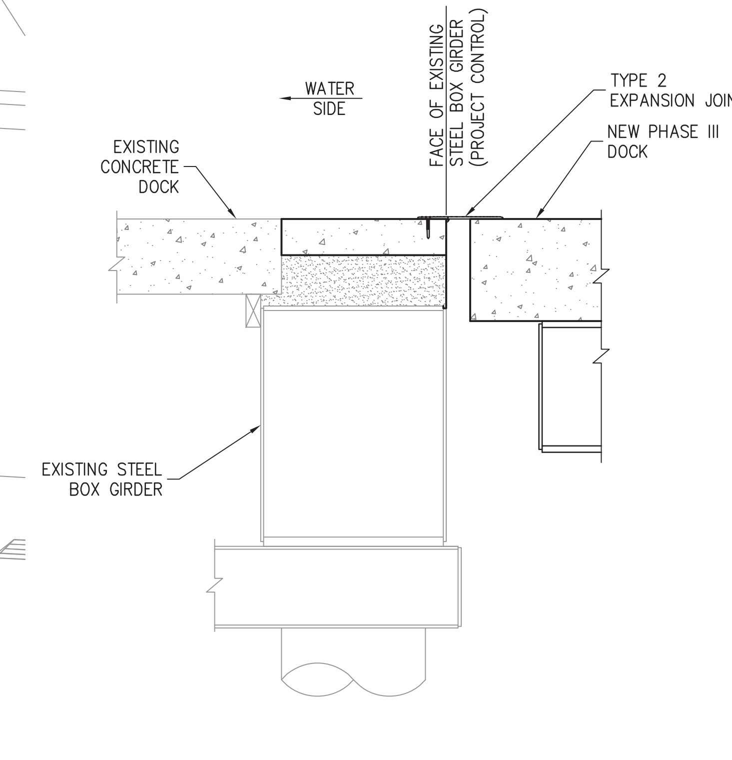
CONTRACT 13-08



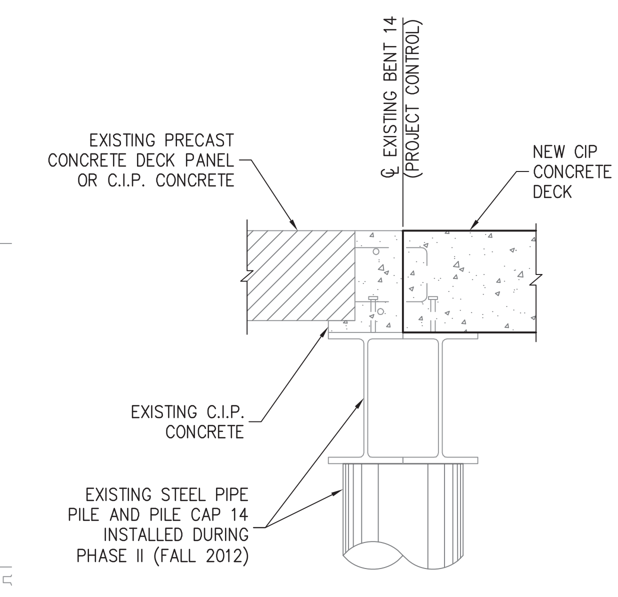
PLAN

LOCATION CONTROL NOTES

1) GRID LINES AND DIMENSIONS ARE PERPENDICULAR OR PARALLEL FROM EXISTING BERTH I CONCRETE DOCK.
2) FOR ALL TOP OF NEW DOCK ELEVATIONS REFER TO CIVIL GRADING PLANS FOR DETAILS.
3) HORIZONTAL PROJECT CONTROL POINT IS THE INTERSECTION BETWEEN CENTERLINE OF EXISTING BENT 14 PILE CAP AND THE LAND SIDE FACE OF EXISTING BERTH I STEEL BOX GIRDER AS NOTED ON THE PLANS.
4) VERTICAL PROJECT CONTROL PER ALUMINUM CAP MONUMENT LOCATED AT PUMP STATION NORTH OF PROJECT SITE. ELEVATION 23.88'. SEE SHEET G3.01.



SECTION A-A
(PROJECT CONTROL)



SECTION B-B
(PROJECT CONTROL)

FOR BID

City of Ketchikan

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STATE OF ALASKA 49TH Todd W. Baker No. 12727 REGISTERED PROFESSIONAL ENGINEER 4/12/13

REVISIONS

REV	DATE	DESCRIPTION

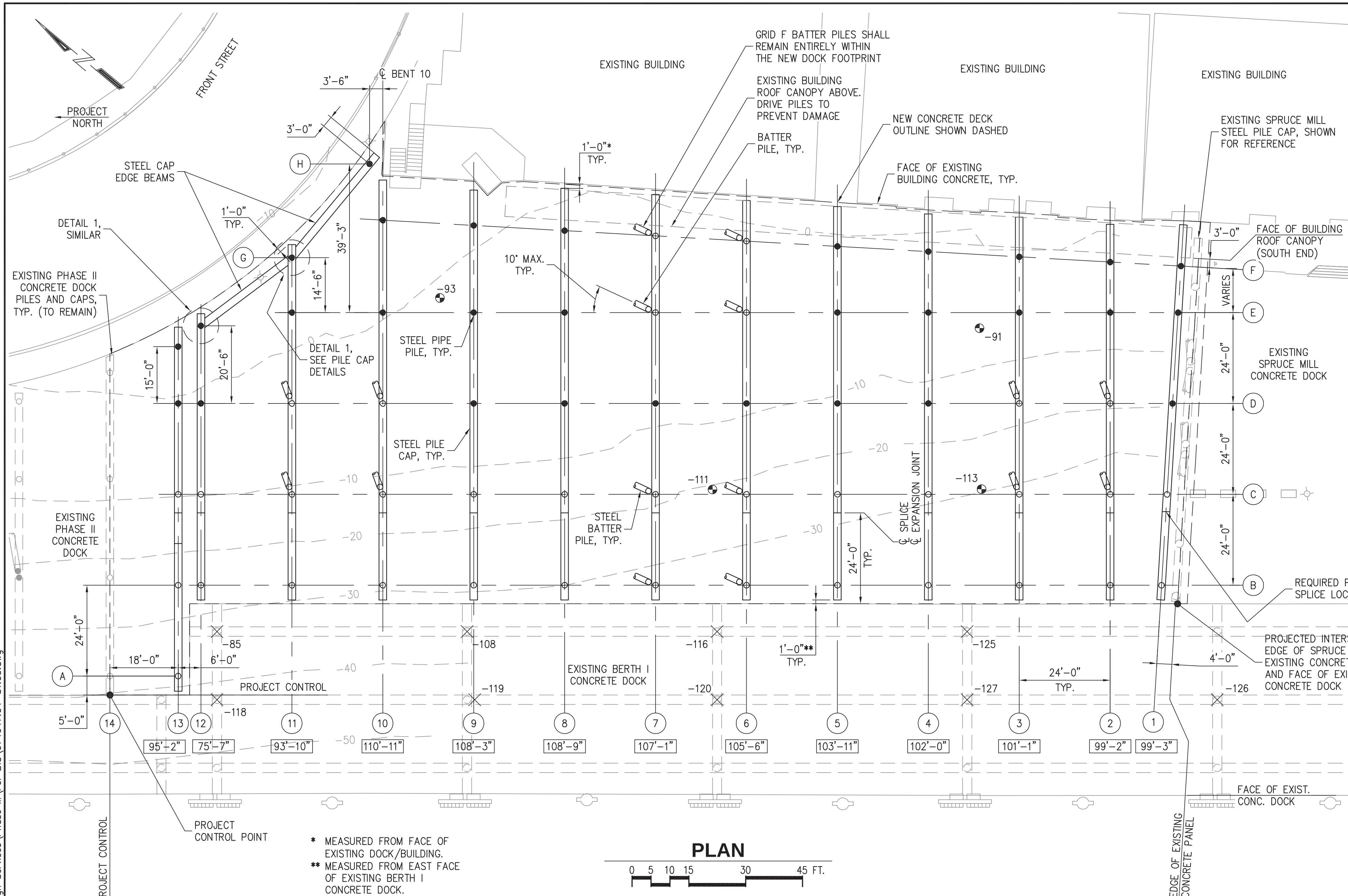
PROJECT: **BERTHS I AND II REHABILITATION PHASE III**

TITLE: **GENERAL ARRANGEMENT PLAN**

DESIGNED BY: BKP	PROJECT NO: 074047.04	FIGURE NO:
DRAWN BY: GRD	DATE: APRIL 15, 2013	**S1.03**
CHECKED BY: TWB	SCALE: NOTED	

4/12/13 Drawings\2007\074047.04 – Berths I & II Phase C Design Services\Phase III\For Bid\074047.04–S1.03.dwg

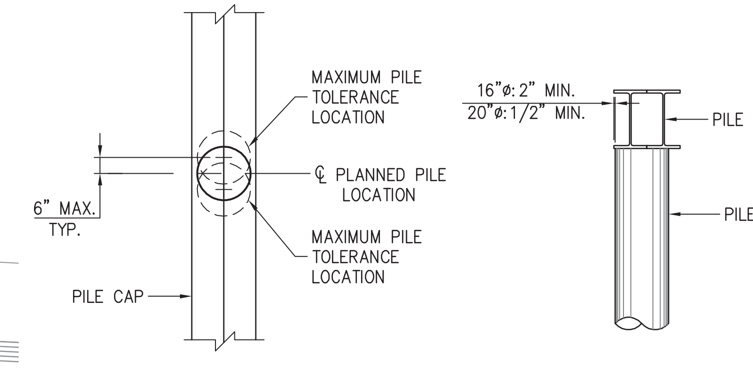
CONTRACT 13-08



* MEASURED FROM FACE OF EXISTING DOCK/BUILDING.
** MEASURED FROM EAST FACE OF EXISTING BERTH I CONCRETE DOCK.

PLAN

0 5 10 15 30 45 FT.

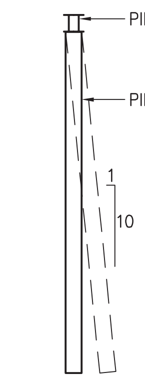


PLAN

ELEVATION

PILE TOLERANCE

20"ø PILE SHOWN.



VERTICAL PILE PLUMBNESS

NOTE:
THE DESIGN INTENT FOR PILE INSTALLATION IS FOR ALL PILES TO BE DRIVEN PLUMB AND TRUE. HOWEVER, DUE TO UNFORESEEABLE BOTTOM OBSTRUCTIONS, VERTICAL PILES MAY BE DRIVEN AS MUCH AS 1:10 OUT OF PLUMB AS LONG AS IT DOES NOT INTERFERE WITH ADJACENT STRUCTURES. ENGINEER MAY LIMIT TOLERANCE FOR PILES ADJACENT TO ANY OUT OF PLUMB PILES ON A CASE BY CASE BASIS. OUT OF PLUMB PILES ARE SUBJECT TO APPROVAL BY ENGINEER.

LEGEND

- ● 16"ø PILE
- ○ 20"ø
- 20"ø VERTICAL AND BATTER PILE GROUP WITH SPIN FIN PILE TIPS – DRIVEN
- –29 APPROX. BOREHOLE BEDROCK ELEVATION
- –33 × APPROX. EXISTING PILE TIP ELEVATION (SELECT PILES)
- 97'-8" ESTIMATED PILE CAP SUPPLY LENGTH, FOR BIDDING PURPOSES ONLY

NOTES:
1) ALL ESTIMATED PILE CAP SUPPLY LENGTHS PROVIDED SHALL BE FIELD VERIFIED PRIOR TO FABRICATION.
2) SEE PILE SCHEDULE FOR PILE SIZE AND DETAILS.

LOCATION CONTROL NOTES
1) GRID LINES AND DIMENSIONS ARE PERPENDICULAR OR PARALLEL FROM EXISTING BERTH I CONCRETE DOCK, WITH THE EXCEPTION OF BENT 1, WHICH IS ALIGNED PARALLEL TO EXISTING ADJACENT SPRUCE MILL DOCK PILE CAP BENT.
2) FOR ALL TOP OF NEW DOCK ELEVATIONS REFER TO CIVIL GRADING PLANS FOR DETAILS.

FOR BID

City of Ketchikan

P N D ENGINEERS, INC.

STATE OF ALASKA 49TH Todd W. Bennett No. 12727 REGISTERED PROFESSIONAL ENGINEER 4/12/13

REVISIONS		
REV	DATE	DESCRIPTION

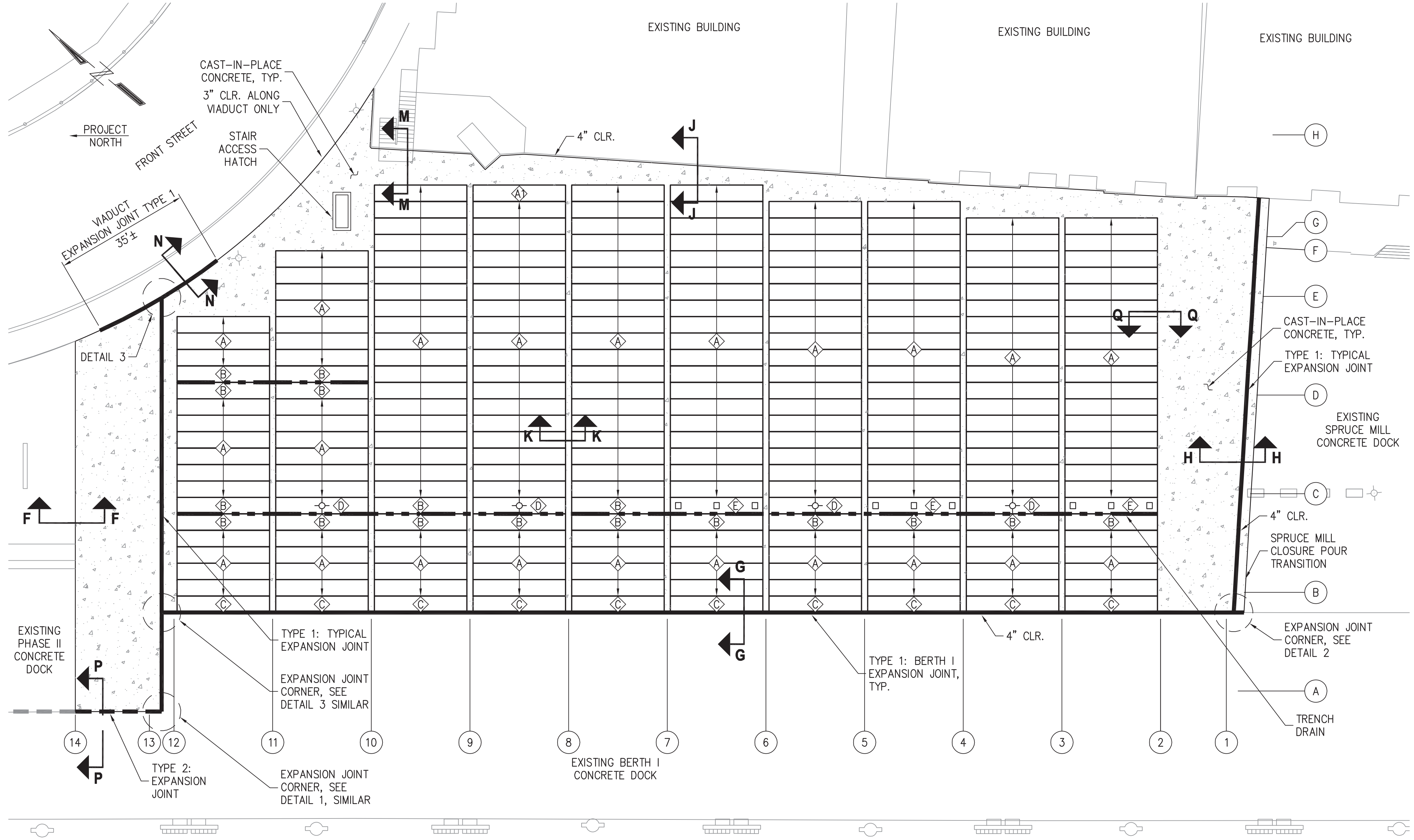
PROJECT: BERTHS I AND II REHABILITATION PHASE III

TITLE: PILE AND PILE CAP PLAN

DESIGNED BY: BKP	PROJECT NO:	074047.04	FIGURE NO:	
DRAWN BY: GRD	DATE:	APRIL 15, 2013	S1.05	
CHECKED BY: TWB	SCALE:	NOTED		

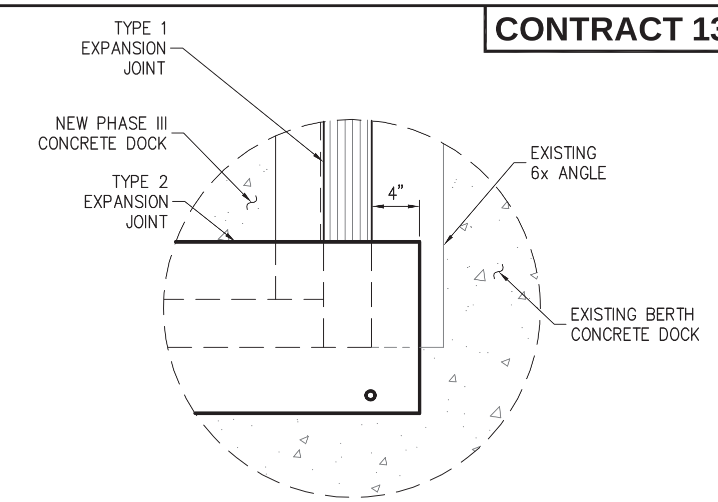
4/12/13 Drawings\2007\074047.04 – Berths I & II Phase C Design Services\Phase III\For Bid\074047.04-S1.05.dwg

CONTRACT 13-08

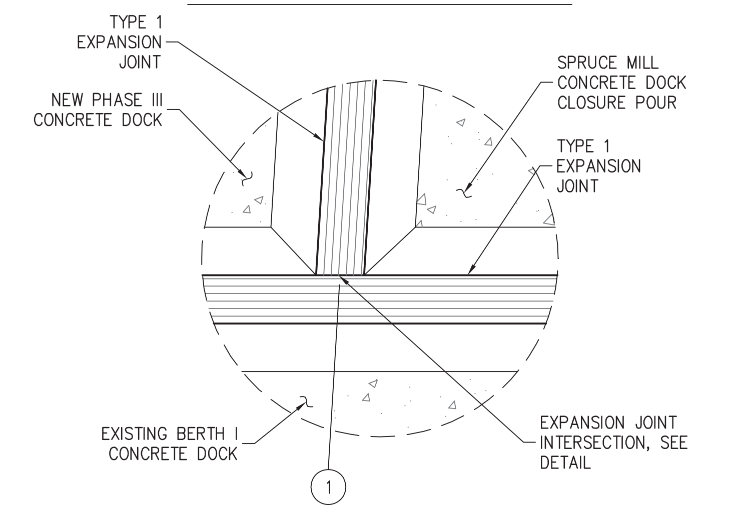


PLAN

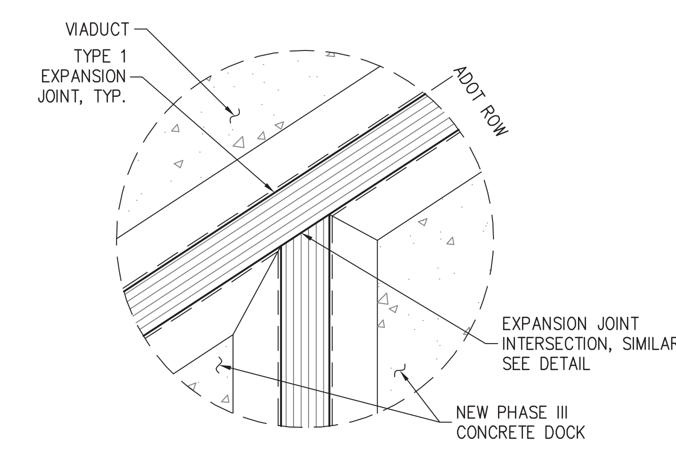
0 5 10 15 30 45 FT.



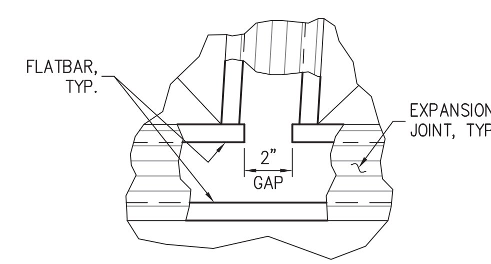
DETAIL 1



DETAIL 2



DETAIL 3



EXPANSION JOINT INTERSECTION

NOTES:
1) FOR CONCRETE DOCK ELEVATIONS AND GRADING PLAN, SEE CIVIL DRAWINGS.
2) EXPANSION JOINTS SHOWN ON THIS SHEET IS FOR ALL EXPANSION JOINTS AT DOCK ELEVATION. FOR EXPANSION JOINTS AT SIDEWALK ELEVATION, SEE CIVIL DRAWINGS.

LEGEND
- EXPANSION JOINT TYPE 1
- EXPANSION JOINT TYPE 2
- TRENCH DRAIN
- PANEL DESIGNATOR
- SALVAGED LIGHT POLE

FOR BID

City of Ketchikan

P N D ENGINEERS, INC.

STATE OF ALASKA 49TH Todd W. Burk No. 12727 REGISTERED PROFESSIONAL ENGINEER 4/12/13

REVISIONS

REV	DATE	DESCRIPTION

PROJECT: BERTHS I AND II REHABILITATION PHASE III

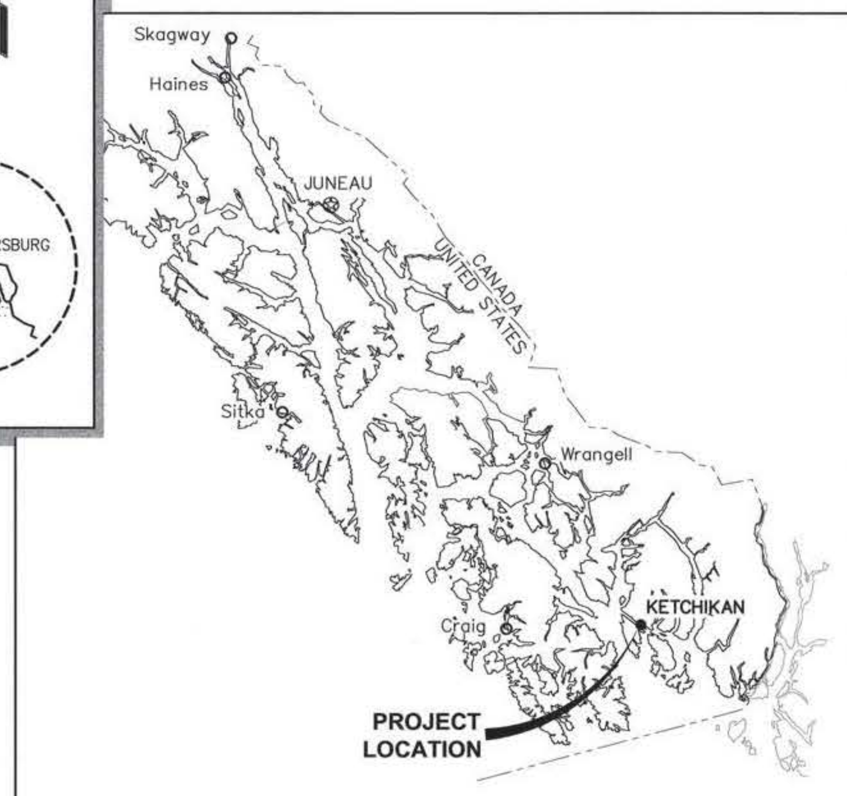
TITLE: CONCRETE PANEL AND DECK LAYOUT

DESIGNED BY: BKP	PROJECT NO: 074047.04	FIGURE NO:
DRAWN BY: GRD	DATE: APRIL 15, 2013	S1.10
CHECKED BY: TWB	SCALE: NOTED	

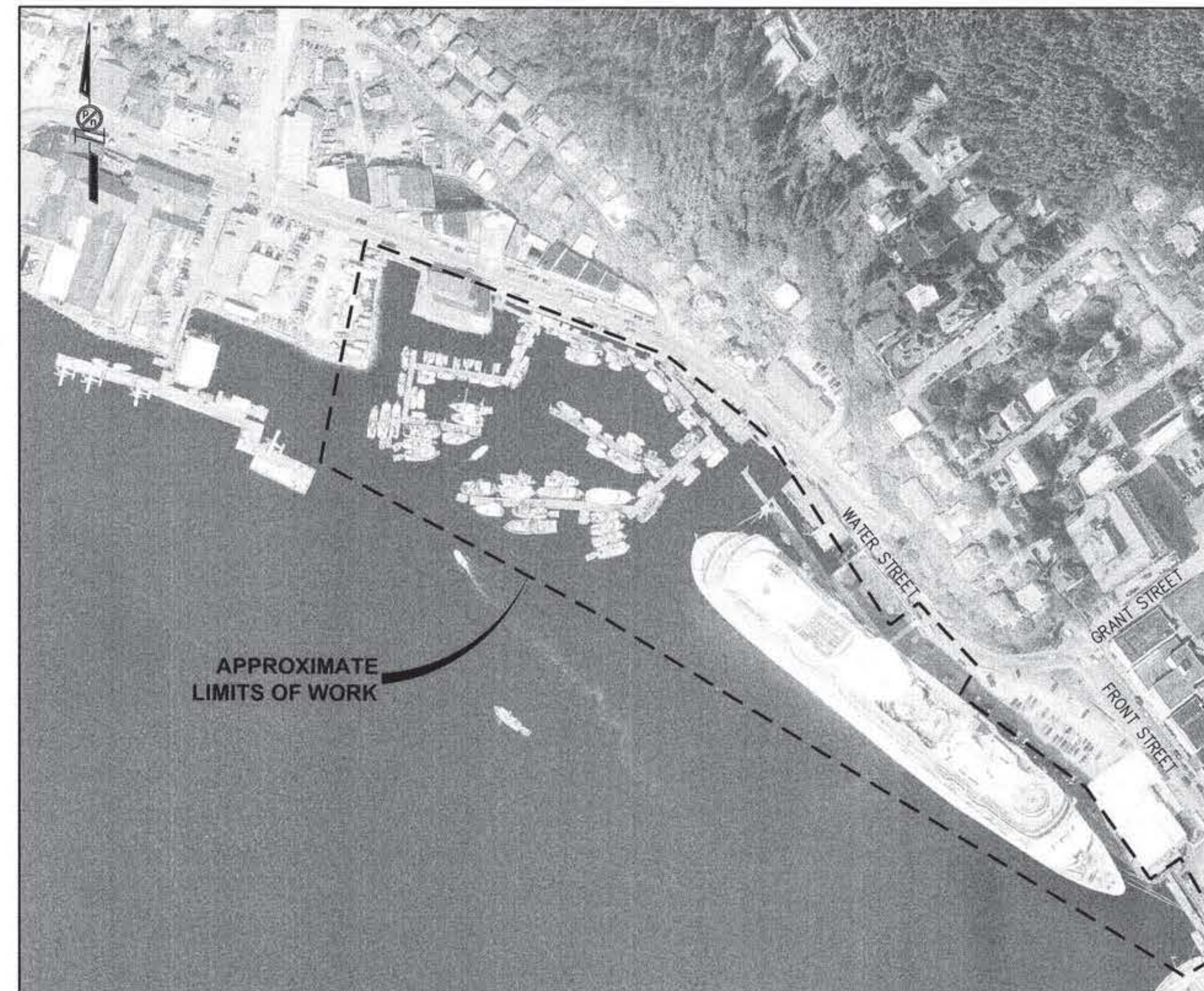
2/25/13 Drawings\2007\074047.04 – Berths I & II Phase C Design Services\Phase III\For Bid\074047.04-S1.10.dwg

CITY OF KETCHIKAN
PORT BERTH RECONFIGURATION
CONFORMED SET

ALASKA KEY MAP



VICINITY MAP



LOCATION MAP
(EXISTING CONDITIONS)

STRUCTURAL/GEOTECHNICAL/CIVIL:
PND Engineers, Inc.
811 First Avenue, Suite 570
Seattle, WA 98104
Phone: 206-624-1387

NAVAL ARCHITECTURE:
Columbia-Sentinel Engineers Incorporated
4000 Delridge Way SW, Suite 300
Seattle, WA 98106
Phone: 206-923-1380

ARCHITECTURE:
Jensen Yorba Lott, Incorporated
522 West 10th Street
Juneau, AK 99801
Phone: 907-586-1070

BUILDING MECHANICAL:
Murray and Associates, P.C.
907 Capitol Avenue
Juneau, Alaska 99802
Phone: 907-780-6151

ELECTRICAL:
Haight & Associates, Incorporated
526 Main Street
Juneau, AK 99801
Phone: 907-586-9788

TIDAL DATA	ELEV. (FT)
HIGHEST OBSERVED WATER LEVEL (12/2/1967)	+21.3
MEAN HIGHER HIGH WATER (MHHW)	+15.4
MEAN HIGH WATER (MHW)	+14.5
MEAN LOW WATER (MLW)	+1.6
MEAN LOWER LOW WATER (MLLW)	0.0
LOWEST OBSERVED WATER LEVEL (1/1/1991)	-5.2

City of Ketchikan

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STATE OF ALASKA 49th
Todd Nottingham
CE-7958
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	DESCRIPTION
1	5/26/06	CONFORMED SET

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: TITLE SHEET AND TIDAL DATA

DESIGNED BY: TWB	PROJECT NO:	054048.01	SHEET NO:	
DRAWN BY: GRD	DATE:	APRIL 3, 2006		G1.01
CHECKED BY: TN	SCALE:	NTS		

5/26/06
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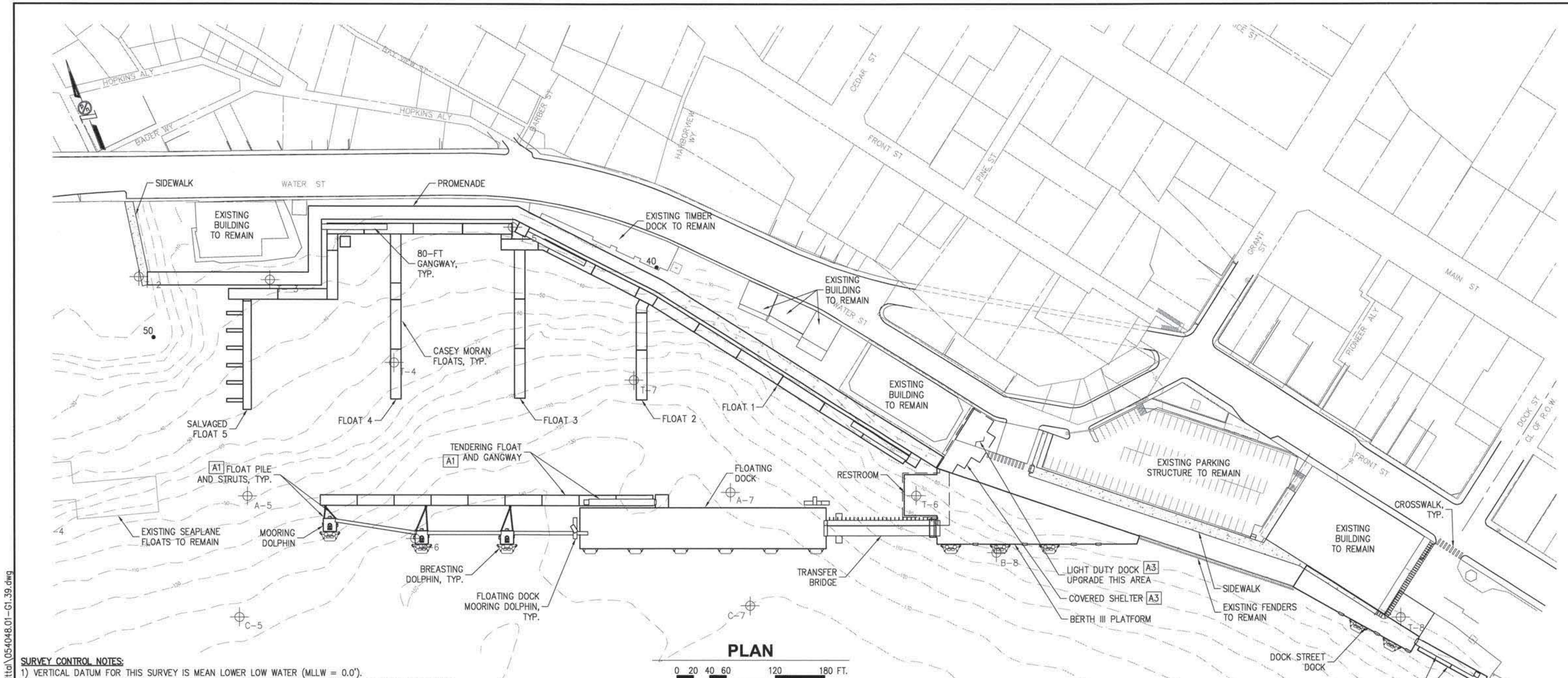

SURVEY CONTROL NOTES:

1) VERTICAL DATUM FOR THIS SURVEY IS MEAN LOWER LOW WATER (MLLW = 0.0').
2) BASIS OF VERTICAL DATUM FOR THIS SURVEY IS FROM TIDAL BENCH MARK "NO. 37 1956" ELEVATION 35.09' MLLW (SEE NOTE 1), LOCATED ON TOP OF A CONCRETE RETAINING WALL NEAR THE U.S.C.G. ADMINISTRATION BUILDING IN KETCHIKAN, ALASKA. FOR FURTHER DESCRIPTION AND INFORMATION REFER TO THE NOAA WEB SITE STATION I.D. "9450460".
3) BASIS OF BEARING FOR THIS SURVEY IS S76°59'38"E BETWEEN PND CONTROL POINTS 40 AND 50. SAID BEARING IS A ALASKA STATE PLANE NAD 83 ZONE 1 GRID BEARING DERIVED BY GPS STATIC OBSERVATIONS.
4) BASIS OF COORDINATES FOR THIS SURVEY IS CONTROL POINT 50, WHICH IS A NAD 83 ALASKA STATE PLANE ZONE 1 VALUE. THE COORDINATE FOR POINT 50 WAS DERIVED BY GPS STATIC OBSERVATIONS BETWEEN CONTROL POINT 50 AND BENCH MARK NO. 37 (SEE NOTE 2) WITH A NGS PUBLISHED VALUE OF 55°19'58.65991" LATITUDE, 131°37'31.82053" LONGITUDE. ALL OTHER DISTANCES AND COORDINATES HAVE BEEN SCALED TO GROUND VALUES.

PROJECT CONTROL

PT #	NORTHING	EASTING	ELEVATION	DESCRIPTION
40	1287941.260	3105421.122	22.83	SET SURVEY NAIL
50	1288080.684	3104817.505	20.01	SET SPIKE

(SEE SURVEY SHEET 1 FOR ADDITIONAL INFORMATION)

BID ITEM NOTE:

ALL ITEMS INCLUDED IN THE BASE BID UNLESS OTHERWISE NOTED WITH THE FOLLOWING:

- A1 ADDITIVE ALTERNATE No. 1
- A2 ADDITIVE ALTERNATE No. 2
- A3 ADDITIVE ALTERNATE No. 3

NOTE:
ADDITIVE ALTERNATE No. 4 NOT SHOWN

SEE BID ITEM DESCRIPTIONS FOR ADDITIONAL INFORMATION.

LEGEND

X-# APPROXIMATE BORE HOLE LOCATION

NOTE:
SEE "GEOTECHNICAL BORING LOCATIONS" SHEET FOR ADDITIONAL INFORMATION.

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STATE OF ALASKA 49TH Todd Nottingham CE-7950 REGISTERED PROFESSIONAL ENGINEER 3/29/06

REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: OVERALL SITE PLAN

DESIGNED BY:	TWB	PROJECT NO:	054048.01	SHEET NO:
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	G1.39
CHECKED BY:	TN	SCALE:	NTS	

3/20/06
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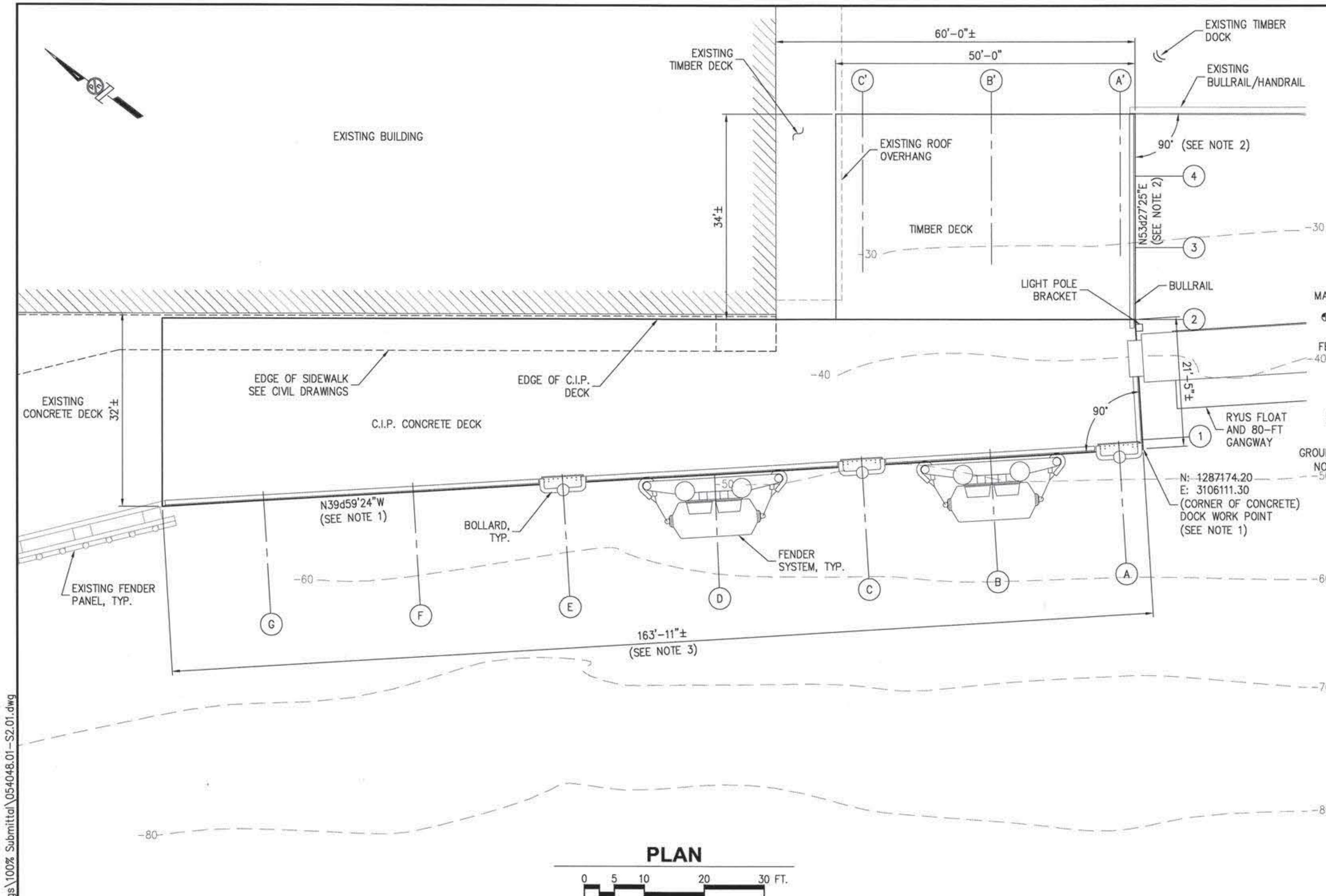
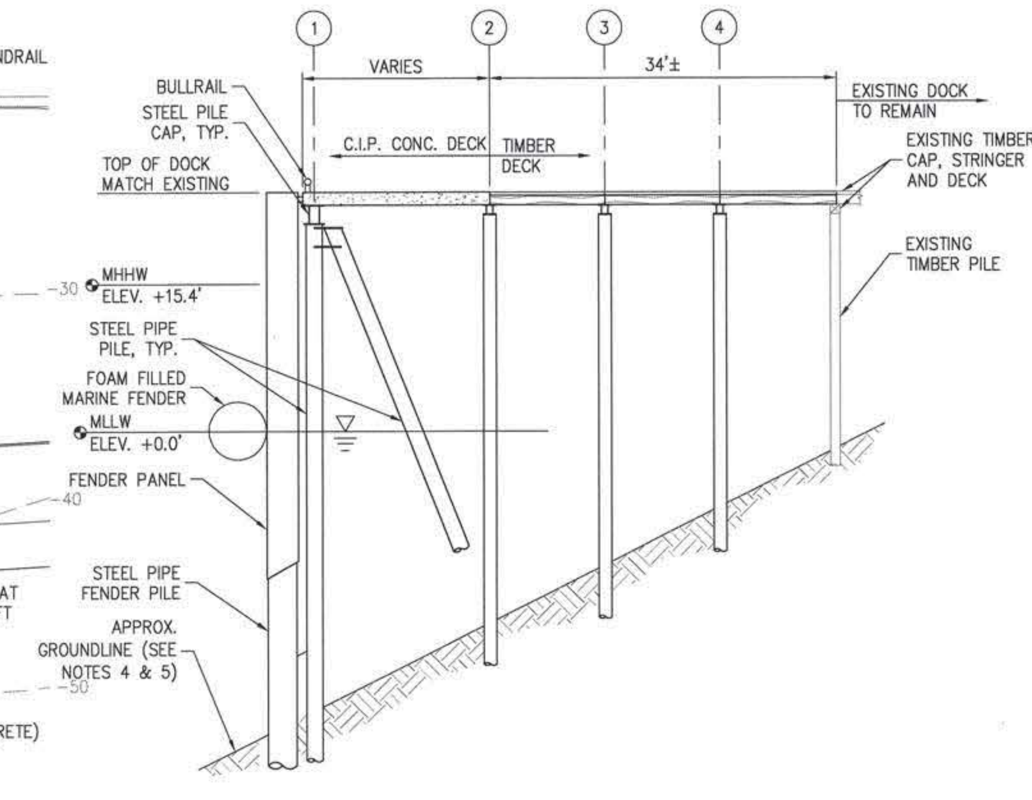
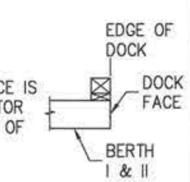




TYPICAL SECTION AT FENDER

NOTE:

1) THE INTENT OF THE ALIGNMENT & LOCATION OF THE DOCK FACE IS TO ALIGN WITH BERTH I & II DOCK FACE TO SOUTH. CONTRACTOR SHALL VERIFY ALIGNMENT AND LOCATION BY BEST FIT SURVEY OF AT LEAST 10 POINTS ALONG BERTH I & II. COORDINATE WITH ENGINEER.
2) THE INTENT OF THE BEARING SHOWN IS TO PROVIDE 90° INTERSECTION TO EXISTING DOCK.
3) DIMENSION TO BE FIELD CONFIRMED BASED UPON PRECAST PANEL SPACING AND CONDITION.
4) SOIL CONFIGURATION IS FOR ILLUSTRATION AND MAY NOT REPRESENT ACTUAL CONDITIONS.
5) SEE PILE SCHEDULE AND DETAILS FOR PILE/BEDROCK INTERFACE REQUIREMENTS.



3/20/06
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City of Ketchikan

P N D Incorporated
CONSULTING ENGINEERS

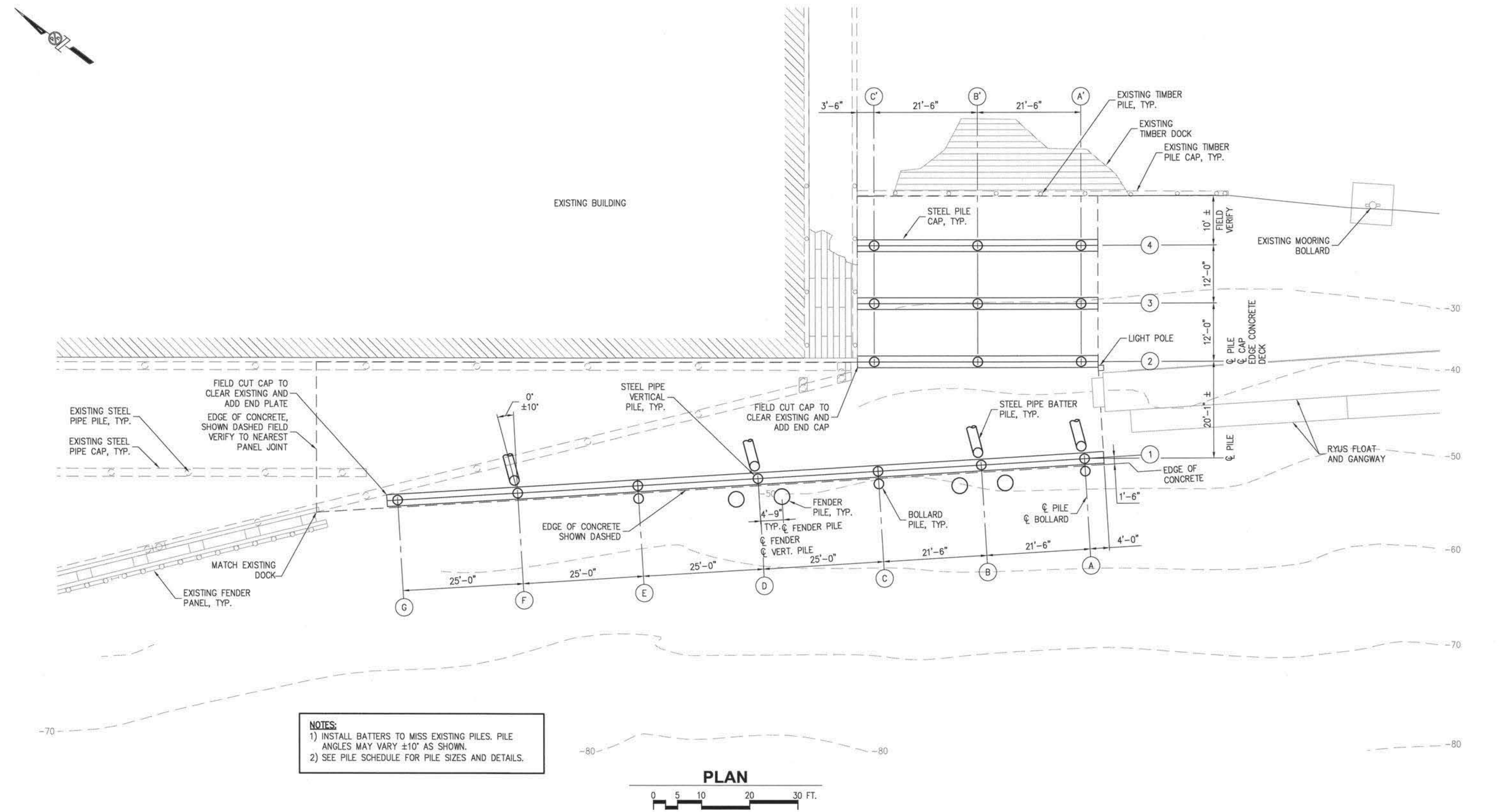
STATE OF ALASKA
Todd Nottingham
CE-7958
REGISTERED PROFESSIONAL ENGINEER

REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: **CITY OF KETCHIKAN PORT BERTH RECONFIGURATION**

TITLE: **DOCK STREET DOCK GENERAL ARRANGEMENT PLAN AND SECTION**

DESIGNED BY:	BKP	PROJECT NO:	054048.01	SHEET NO:
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	**S2.01**
CHECKED BY:	TN	SCALE:	NOTED	



NOTES:
1) INSTALL BATTERS TO MISS EXISTING PILES. PILE ANGLES MAY VARY ±10° AS SHOWN.
2) SEE PILE SCHEDULE FOR PILE SIZES AND DETAILS.

3/28/06
Drawings\2005\054048.01 Ketchikan berth Expansion\Design Drawings\100% Submittal\054048.01-S2.02.dwg

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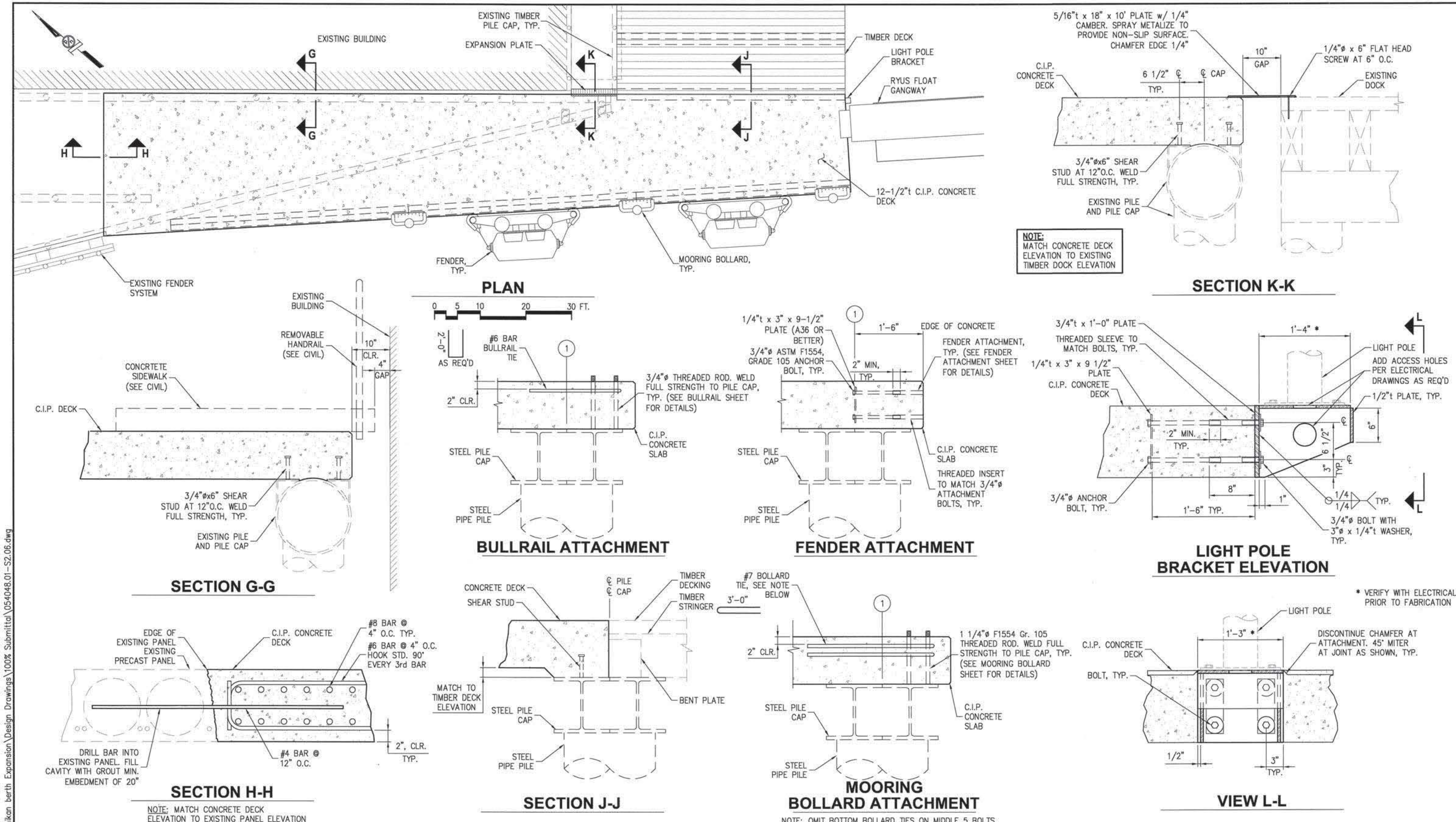
STATE OF ALASKA 49TH Todd Nottingham CE-7958 REGISTERED PROFESSIONAL ENGINEER

REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: DOCK STREET DOCK PILE AND CAP PLAN

DESIGNED BY: BKP	PROJECT NO: 054048.01	SHEET NO:	
DRAWN BY: GRD	DATE: APRIL 3, 2006	S2.02	
CHECKED BY: TN	SCALE: NOTED		



3/20/06
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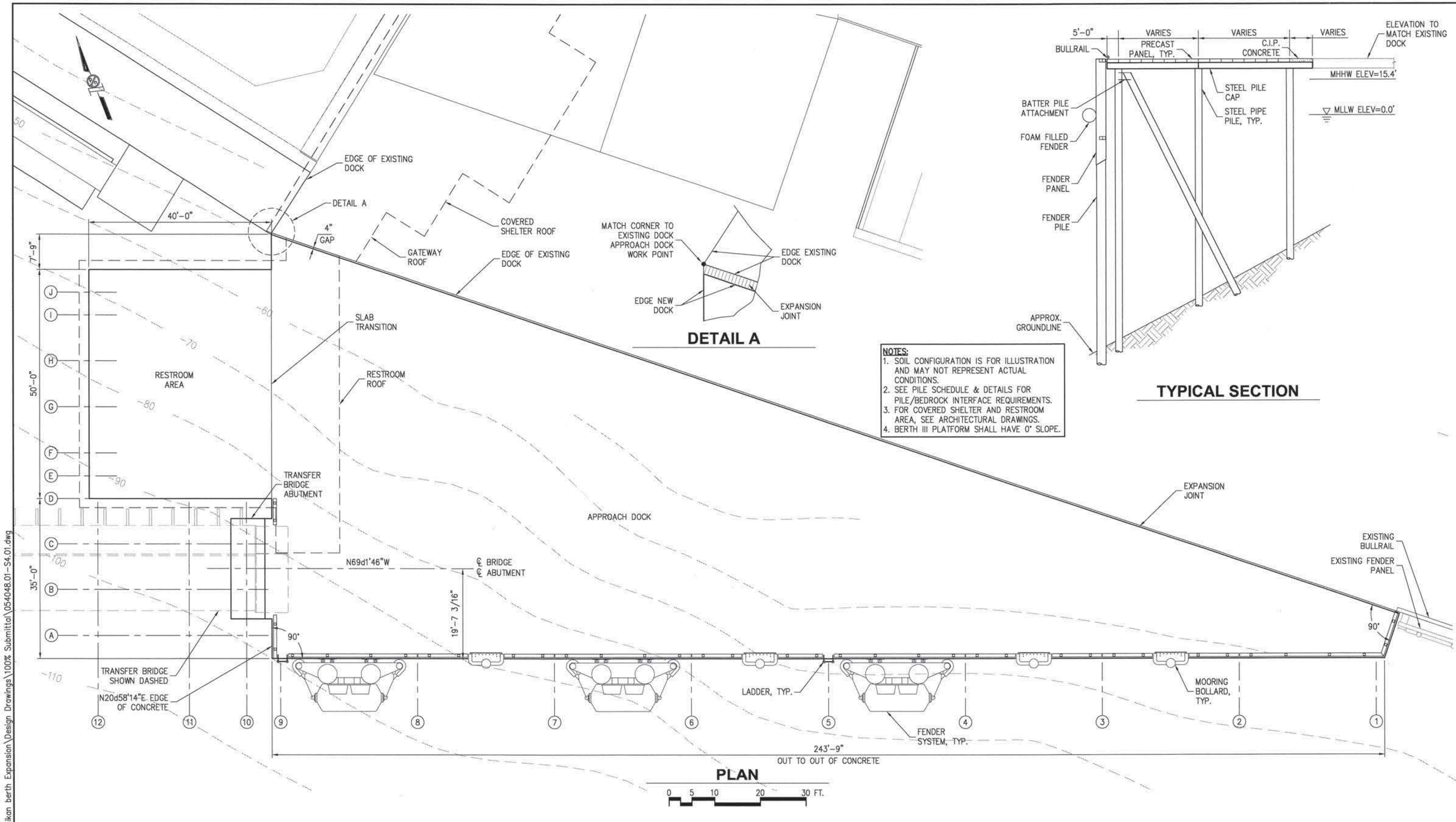
STATE OF ALASKA 49TH Todd Nottingham CE-7950 REGISTERED PROFESSIONAL ENGINEER

REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: DOCK STREET DOCK CONCRETE DECK PLAN AND DETAILS

DESIGNED BY:	BKP	PROJECT NO:	054048.01	SHEET NO:
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	S2.06
CHECKED BY:	TN	SCALE:	NOTED	



NOTES:
1. SOIL CONFIGURATION IS FOR ILLUSTRATION AND MAY NOT REPRESENT ACTUAL CONDITIONS.
2. SEE PILE SCHEDULE & DETAILS FOR PILE/BEDROCK INTERFACE REQUIREMENTS.
3. FOR COVERED SHELTER AND RESTROOM AREA, SEE ARCHITECTURAL DRAWINGS.
4. BERTH III PLATFORM SHALL HAVE 0' SLOPE.

3/20/06
Drawings\2005\054048.01 Ketchikan berth Expansion\Design Drawings\100% Submittal\054048.01-S4.01.dwg

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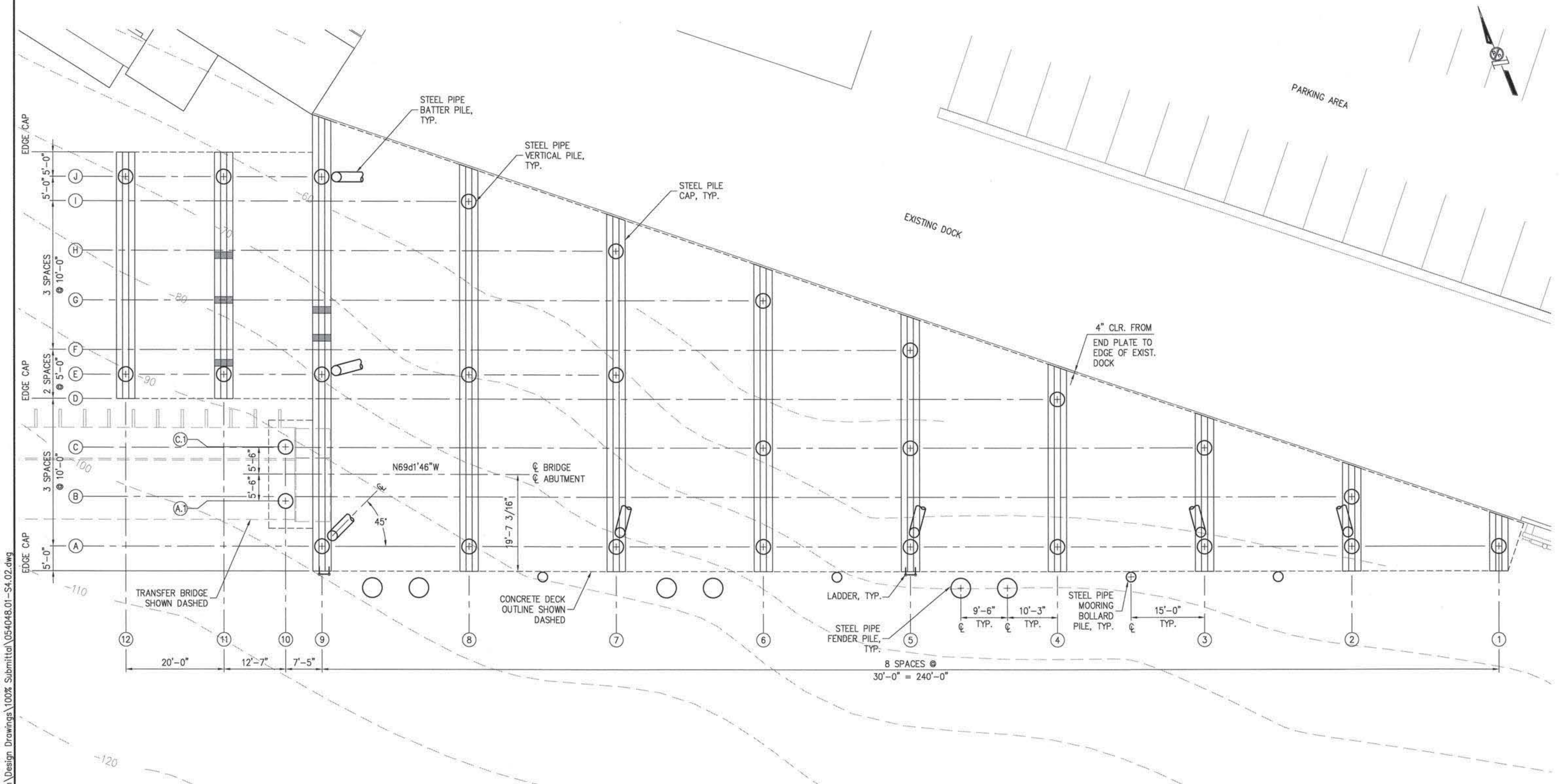
REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: BERTH III PLATFORM GENERAL ARRANGEMENT PLAN AND SECTION

DESIGNED BY:	BKP	PROJECT NO:	054048.01	SHEET NO: S4.01
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	
CHECKED BY:	TN	SCALE:	NOTED	



NOTES:

1. BATTER PILES MAY VARY, AS SHOWN, ± 10' TO MISS ADJACENT VERTICAL PILES, TYP. UNLESS NOTED OTHERWISE.
2. SEE PILE SCHEDULE FOR PILE SIZES AND DETAILS.

LEGEND

SLEEVE THRU CAP (COORDINATE WITH RESTROOM, ARCHITECTURAL AND MECHANICAL FOR LOCATIONS)

PLAN

0 5 10 20 30 FT.

City of Ketchikan

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STATE OF ALASKA 49TH Todd Nottingham CE-7958 REGISTERED PROFESSIONAL ENGINEER

REVISIONS

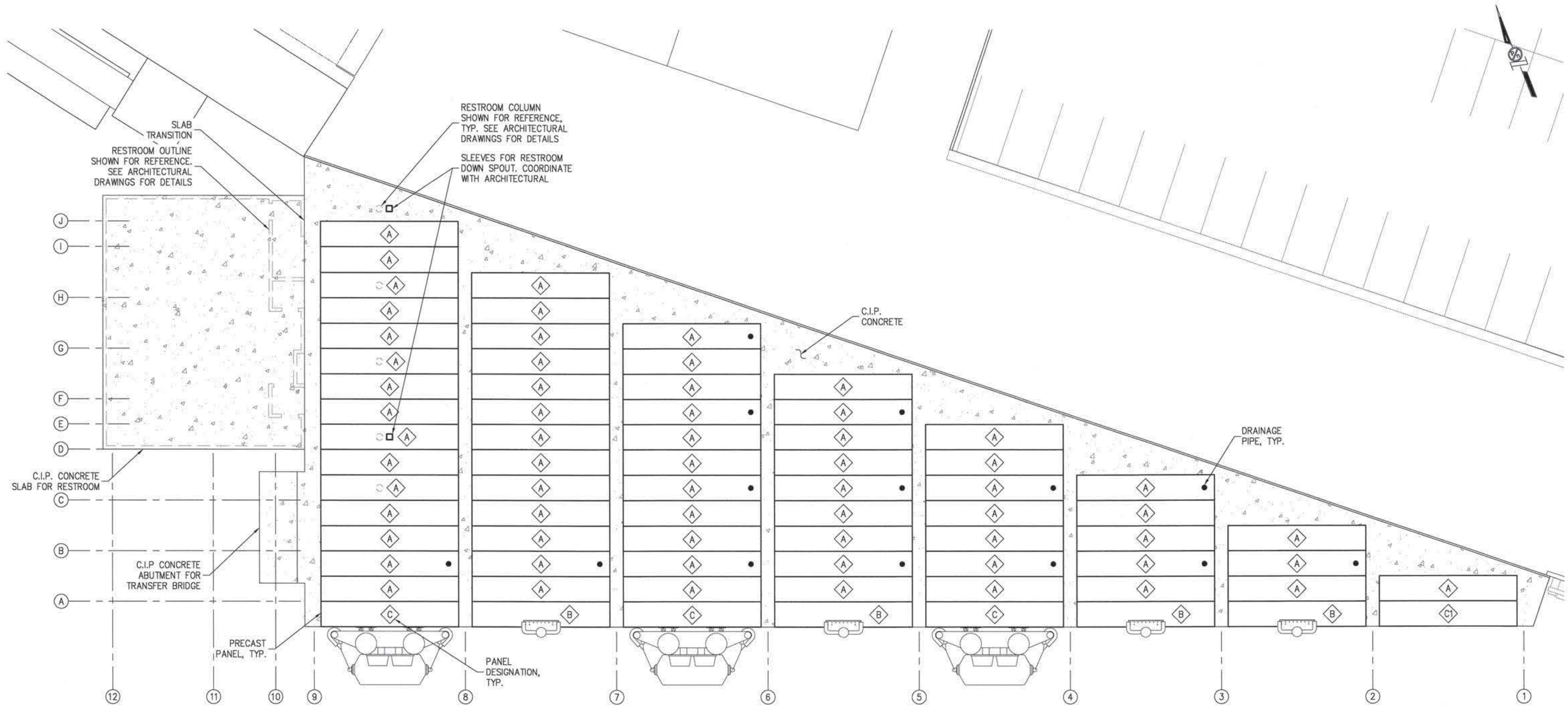
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: BERTH III PLATFORM PILE AND CAP PLAN

DESIGNED BY:	BKP	PROJECT NO:	054048.01	SHEET NO:
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	S4.02
CHECKED BY:	TN	SCALE:	NOTED	

3/28/06 Drawings\2005\054048.01 Ketchikan berth Expansion\Design Drawings\100% Submittal\054048.01-S4.02.dwg



NOTE:
COVERED SHELTER NOT SHOW FOR CLARITY. SEE ARCHITECTURAL DRAWINGS.

PLAN

0 5 10 20 30 FT.

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STATE OF ALASKA
49TH
Todd Nottingham
CE-7958
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

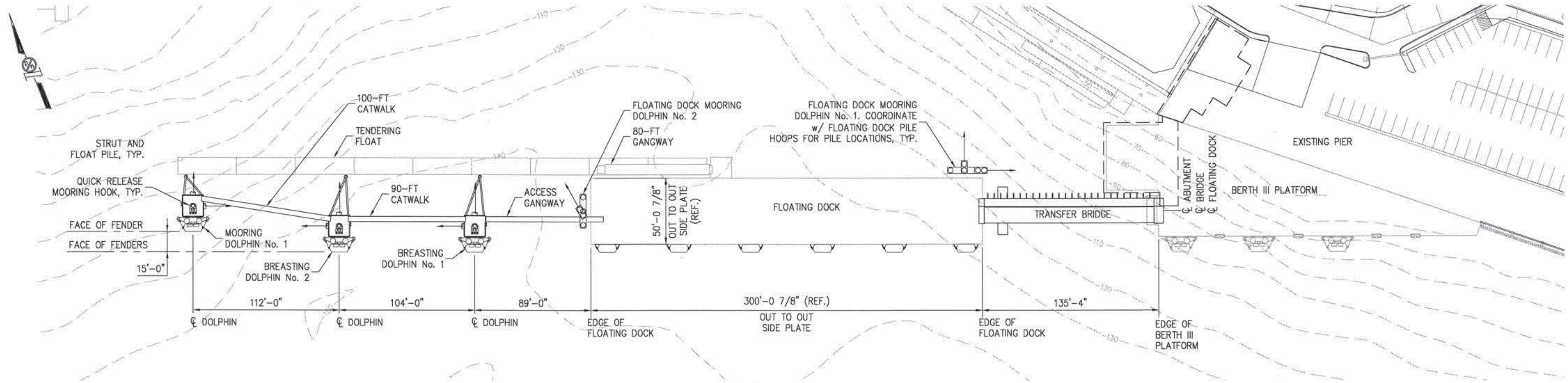
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN
PORT BERTH RECONFIGURATION

TITLE: BERTH III PLATFORM
PANEL AND C.I.P. CONCRETE PLAN

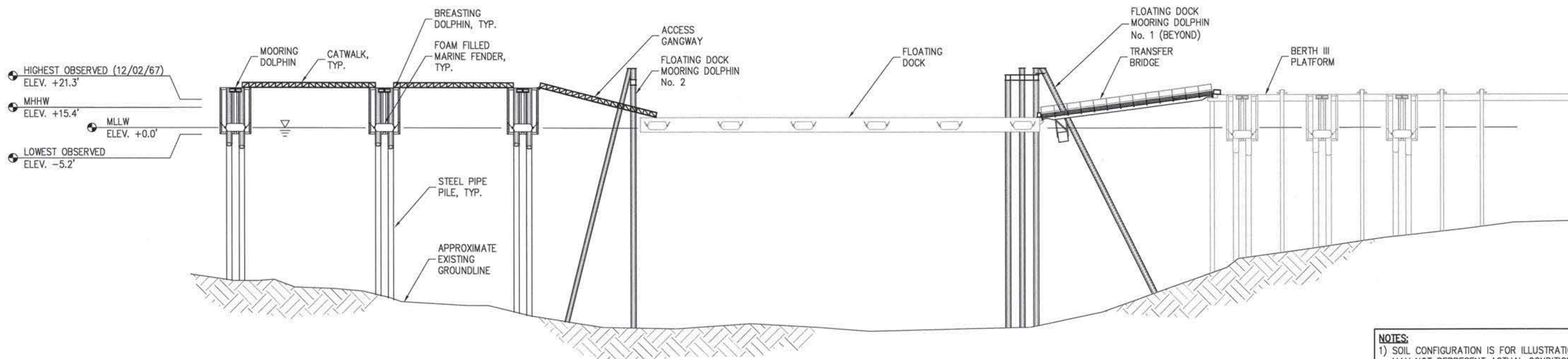
DESIGNED BY: BKP	PROJECT NO: 054048.01	SHEET NO:
DRAWN BY: GRD	DATE: APRIL 3, 2006	S4.05
CHECKED BY: TN	SCALE: NOTED	

3/28/06
Drawings\2005\054048.01 Ketchikan berth Expansion\Design Drawings\100% Submittal\054048.01-S4.05.dwg



PLAN

0 10 20 40 80 120 FT.



SOUTH ELEVATION

0 10 20 40 80 120 FT.

NOTES:
1) SOIL CONFIGURATION IS FOR ILLUSTRATION AND MAY NOT REPRESENT ACTUAL CONDITIONS.
2) SEE PILE SCHEDULE & DETAILS FOR PILE/BEDROCK INTERFACE REQUIREMENTS

3/28/06
Drawings\2005\054048.01 Ketchikan berth Expansion\Design Drawings\100% Submittal\054048.01-S6.01.dwg

City of Ketchikan

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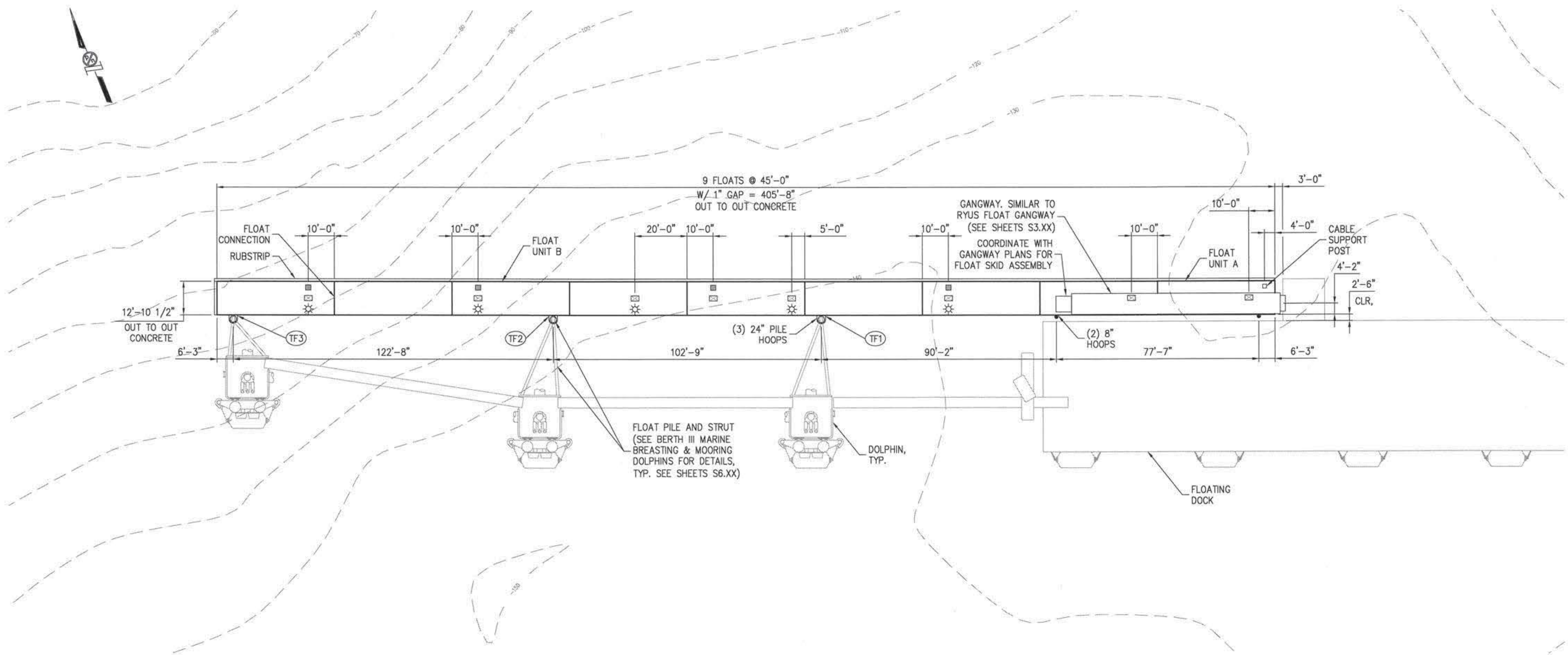
STATE OF ALASKA — 49TH — Todd Nottingham CE-7959 — REGISTERED PROFESSIONAL ENGINEER

REVISIONS		
REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: BERTH III MARINE GENERAL ARRANGEMENT PLAN AND ELEVATION

DESIGNED BY: TWB	PROJECT NO:	054048.01	SHEET NO:	
DRAWN BY: GRD	DATE:	APRIL 3, 2006	S6.01	
CHECKED BY: TN	SCALE:	NTS		



PLAN

0 5 10 20 40 60 FT.

LEGEND

(TF1)	PILE DESIGNATION
☼	LIGHT POLE
▭	HANDHOLE
■	POWER PEDESTAL

NOTES:
1) DIMENSIONS ARE FROM EDGE OF CONCRETE ON REFERENCED FLOAT TO CENTER OF HANDHOLE, PEDESTAL OR LIGHT POLE, AS INDICATED.
2) COORDINATE CUT OFF ELEVATION OF TENDERING FLOAT PILES WITH DOLPHIN PLANS.

3/20/06
Drawings\2005\054048.01 Kethikan berth Expansion\Design Drawings\100% Submittal\054048.01-S7.01.dwg

City of Ketchikan

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STATE OF ALASKA 49TH Todd Nottingham CE-7958 REGISTERED PROFESSIONAL ENGINEER

REVISIONS

REV	DATE	DESCRIPTION

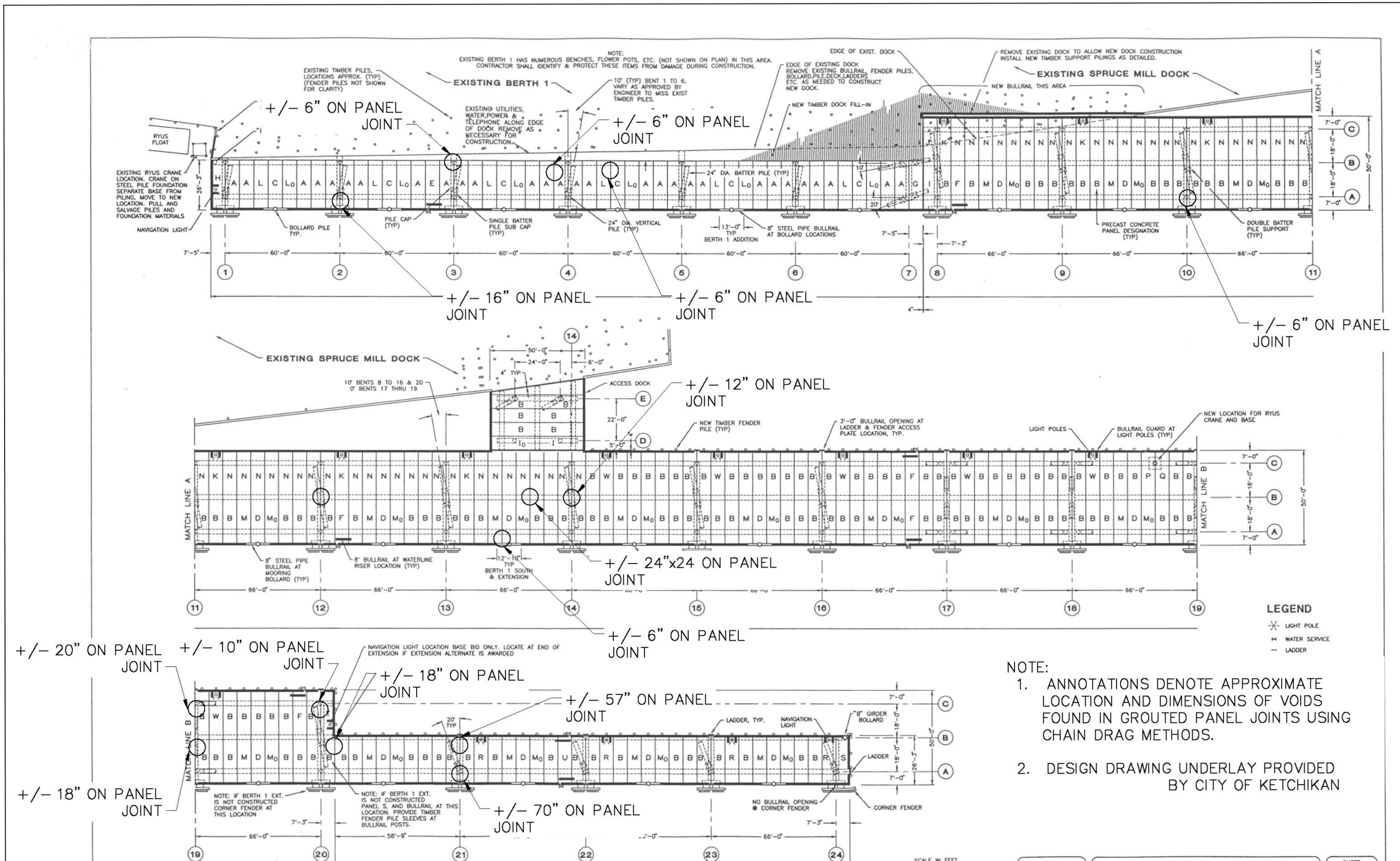
PROJECT: CITY OF KETCHIKAN
PORT BERTH RECONFIGURATION

TITLE: TENDERING FLOAT
GENERAL ARRANGEMENT PLAN

DESIGNED BY:	JDO	PROJECT NO:	054048.01	SHEET NO:
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	S7.01
CHECKED BY:	TN	SCALE:	NOTED	

Appendix B

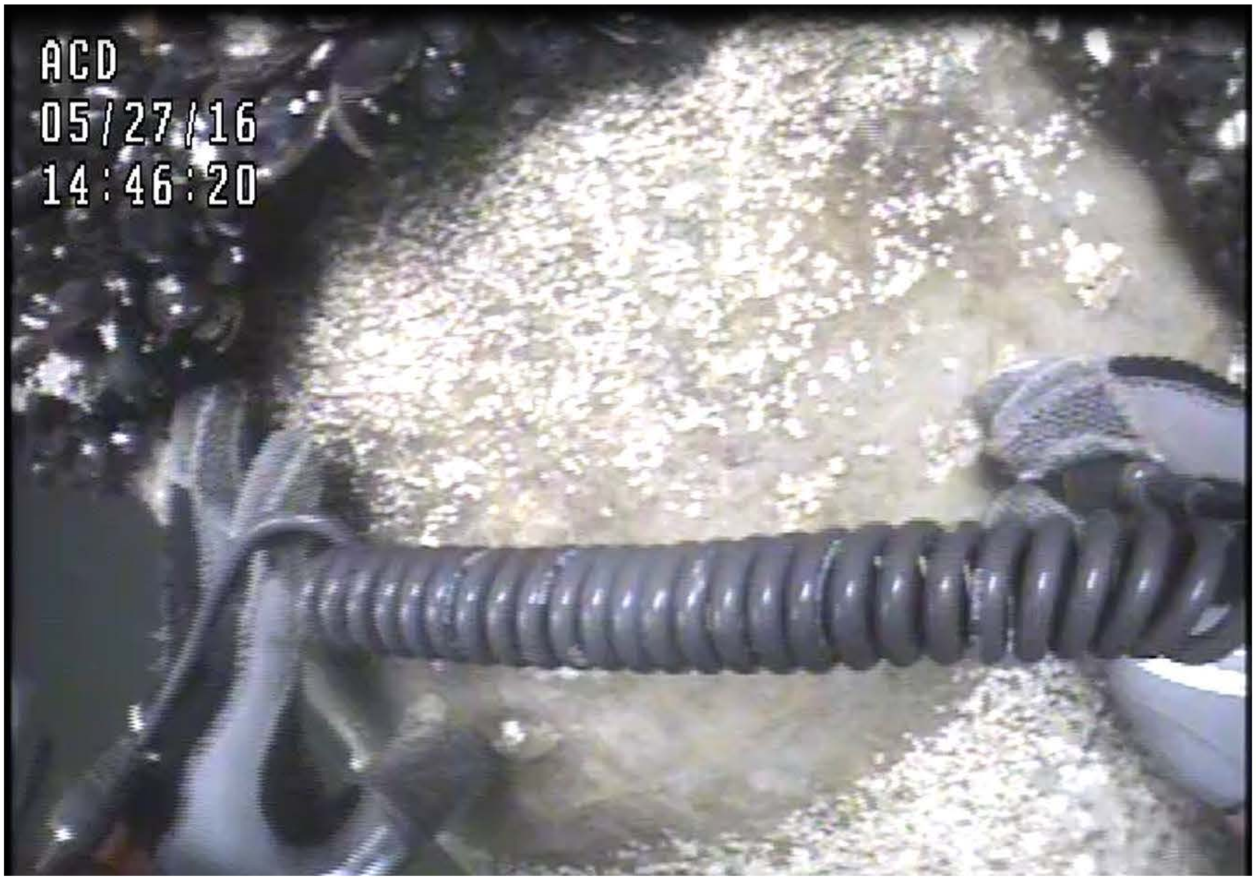
Grout Void Survey Results:



GROUT VOID SURVEY

Appendix C

Ultrasonic Thickness and Anode Condition Logs:



moffatt & nichol

Desrciption:
Ultrasonic thickness readings presented below were collected by Alaska Commercial Divers, with support from Moffatt and Nichol Staff during the week of 5/23/2016. All measurements are presented in inches, and where multiple measurements were taken in one area, the average reading is presented. The Cygnus dive underwater thickness gauge used for the inspection,reads to the nearest .005 inches. It should be noted "design" wall thickness presented below is the nominal value. Minimum permissible wall thickness for new piling is 0.875x the nominal value, according to ASTM A 252. A table is included below to show the nominal vs minimum design wall thickness for the piling inspected.

		Pile Wall Thickness												
	Grid:	A			B			C			Other			
Bent #	Location	Reading	Design	Type	Reading	Design	Type	Reading	Design	Type	Reading	Design	Type	Additional Notes, Comments.
	Surface													
1	Midwater		0.5	plumb	**0.47**	0.5	Plumb	**0.47**	0.5	plumb				
	Mudline				**0.415**			**0.485**						
	Surface	**0.48**			**0.47**			**0.465**						43' deep, Anode on grid C 35% depleted
2	Midwater		0.5	plumb		0.5	Plumb		0.5	plumb				
	Mudline	**0.475**			**0.48**			**0.475**						
	Surface	**0.48**			**0.475**			**0.48**						Anode on Grid C 30% depleted
3	Midwater		0.5	plumb		0.5	Plumb		0.5	plumb				
	Mudline	**0.475**			**0.485**			**0.475**						
	Surface	**0.48**			**0.485**									Anode on Grid C 30% depleted
4	Midwater	**0.475**	0.5	plumb		0.5	Plumb		0.5	plumb				
	Mudline	**0.48**			**0.475**			**0.48**						
	Surface	**0.525**			**0.48**			**0.48**						
5	Midwater	**0.47**	0.5	plumb	**0.475**	0.5	Plumb	**0.475**	0.5	plumb			Fender	
	Mudline	**0.475**									**0.365**	0.375		
	Surface	**0.485**			**0.485**			**0.48**						Anode on Grid A 30 Remaining
6	Midwater	**0.475**	0.5	plumb	**0.475**	0.5	Plumb	**0.485**	0.5	plumb				
	Mudline	**0.47**			**0.475**			**0.485**						
	Surface	**0.48**			**0.48**									
7	Midwater	**0.48**	0.5	plumb	**0.475**	0.5	Plumb		0.5	plumb				
	Mudline	**0.48**			**0.48**									
	Surface	**0.48**			**0.47**									Anode on Grid A 40% Remaining
8	Midwater	**0.48**	0.5	plumb	**0.475**	0.5	Plumb		0.5	plumb				
	Mudline	**0.475**			**0.475**									
	Surface	**0.47**			**0.475**									Anode on Grid B 40% Remaining
9	Midwater	**0.505**	0.5	plumb	**0.475**	0.5	Plumb		0.5	plumb				
	Mudline	**0.475**			**0.475**									
	Surface	**0.47**			**0.475**									Anode on Grid A 25% Remaining
10	Midwater	**0.475**	0.5	plumb	**0.485**	0.5	Plumb		0.5	plumb				
	Mudline	**0.475**			**0.47**									
	Surface													
11	Midwater		0.5	plumb		0.5	Plumb		0.5	plumb				
	Mudline													
	Surface													
12	Midwater		0.5	plumb		0.5	Plumb		0.5	plumb				
	Mudline													
	Surface	**0.425**												
13	Midwater	**0.425**	0.5	plumb	**0.465**	0.5	Batter		0.5	plumb				
	Mudline	**0.475**			**0.465**									
	Surface													Anode on Grid A 50% Remaining
14	Midwater	**0.43**	0.5	plumb	**0.48**	0.5	Batter		0.5	plumb				
	Mudline	**0.5**			**0.475**									
	Surface	**0.475**			**0.475**									Anode on Grid B, 60% Remaining
15	Midwater	**0.48**	0.5	plumb		0.5	Batter		0.5	plumb				
	Mudline	**0.465**			**0.475**									
	Surface													
16	Midwater	**0.47**	0.5	plumb	**0.47**	0.5	Batter	**0.47**	0.5	plumb	**0.47**	0.5	A, Batter	
	Mudline	**0.47**			**0.475**			**0.475**			**0.475**			

		Pile Wall Thickness												
	Grid:	A			B			C			Other			
Bent #	Location	Reading	Design	Type	Reading	Design	Type	Reading	Design	Type	Reading	Design	Type	
	Surface													Anodes at Grid A, 50% Remaining
17	Midwater	0.47	0.5	Batter	0.47	0.5	Batter		0.5	plumb	0.47	0.5	A,batter	
	Mudline	0.46			0.46						0.47			
	Surface													Anode at Grid A, 30% Remaining
18	Midwater	0.475	0.5	Batter	0.47	0.5	Batter		0.5	plumb	0.47	0.5	A, Batter	
	Mudline	0.475			0.47						0.47			
	Surface													
19	Midwater	0.465	0.5	Batter	0.465	0.5	Batter		0.5	Batter				
	Mudline	0.475			0.475			0.465						
	Surface	0.48			0.47			0.47			0.48			
20	Midwater		0.5	plumb		0.5	Batter		0.5	plumb		0.5	Fender	
	Mudline	0.465			0.475									
	Surface	0.48			0.475						0.47			
21	Midwater		0.5	plumb		0.5	Batter		0.5	plumb		0.5	A, Batter	
	Mudline	0.475									0.47			
	Surface	0.465			0.475						0.475			Anode at Grid A Plumb, 70%
22	Midwater	0.475	0.5	plumb		0.5	Batter		0.5	plumb		0.5	A, Batter	
	Mudline	0.475									0.475			
	Surface	0.47			0.475						0.475			Anode at Grid A Batter, 70% Remaining
23	Midwater	0.48	0.5	plumb		0.5	Batter		0.5	plumb	0.475	0.5	A, Batter	
	Mudline	0.47									0.47			
	Surface	0.475			0.48						0.475			Anode at Grid A, 60% Remaining
24	Midwater	0.465	0.5	plumb		0.5	Batter		0.5	plumb	0.475	0.5	A,Batter	
	Mudline	0.475									0.47			

Berth 3

		Pile Wall Thickness									
Dolphin	Location	Reading	Design	Type	Reading	Design	Type	Reading	Design	Type	
Mooring Dolphin	Surface	0.995									
	Midwater	0.98	1.0	plumb			plumb			plumb	
	Mudline	0.985									
Breasting Dolphin #1	Surface	1									
	Midwater	0.965	1.0	plumb			plumb			plumb	
	Mudline	0.95									
Breasting Dolphin #2	Surface										
	Midwater		1.0	plumb			plumb			plumb	
	Mudline										
BFMD North	Surface	1.02									
	Midwater	0.995	1.0	W, plumb		1.0	Mid, plumb		1.0	E, plumb	
	Mudline	1.01			0.998			0.99			
BFMD South	Surface	0.725			0.730			0.7350			
	Midwater	0.735	0.875	W, plumb	0.735	0.88	Mid, plumb	0.7450	0.875	E, plumb	
	Mudline	0.74			0.720			0.7450			

Nominal Wall Thickness Vs Minimum Wall Thickness	
Nominal (in)	Minimum (in)
0.375	0.328
0.500	0.438
0.875	0.766
1.000	0.875

Appendix D

Excerpt from ASCE *Waterfront Facilities Inspection Manual*:

Table 2-14. Condition Assessment Ratings

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.

Appendix B

Berths 1, 2 and 3: Tier 2 Inspection Report

PORT OF KETCHIKAN

BERTHS 1, 2, AND 3

KETCHIKAN, AK

TIER 2 INSPECTION REPORT

Prepared by:

Presented to:

moffatt & nichol

880 H Street, Suite 208

Anchorage, AK 99501

12/16/2016

PORT OF KETCHIKAN

BERTHS 1,2, AND 3

KETCHIKAN, AK

TIER 2 INSPECTION REPORT

STATE OF ALASKA
49TH
CHARLES G BALZARINI
No. CE-13854
12/16/2016
REGISTERED PROFESSIONAL ENGINEER

Rev No	1	2		–	–	–
Issue Purpose	Draft Report	Final Report				
Date	11/11/2016	12/16/2016				
By	CB	CB				
Checked	PW	PW				
Approved	SM	SM				

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Table of Contents

Appendices

1. 2016 BERTHS 1,2, AND 3 CORROSION AND CATHODIC PROTECTION EVALUATION REPORT (CCPE REPORT)

1- INTRODUCTION

A tier 2 inspection was performed at Port of Ketchikan's Berths 1, 2, and 3 in October, 2016. Moffatt and Nichol performed a tier 1 level inspection and prepared the "Port of Ketchikan Berths 1, 2, and 3 Condition Assessment Report", dated August 8, 2016. Based on that report, tier 2 inspection was commissioned by the City of Ketchikan.

Moffatt and Nichol (M&N) received a contract modification to conduct the tier 2 inspection, which involved more detailed evaluation of those areas identified in the tier 1 inspection as being potentially deleterious to future safe operations. For the tier 2 at Ketchikan, the inspection effort focused on coating failure, corrosion, and cathodic protection issues at the Berth 1 and 2 steel superstructure and piling. The steel pipe piles at the Berth 3 platform were also inspected.

Taku Engineering was retained by M&N to serve as corrosion control and coating experts. Taku's NACE certified inspectors mobilized to Ketchikan, and with support from M&N personnel, performed the detailed tier 2 inspection tasks.

The scope included selection of seven (7) representative pile bents at Berths 1 and 2 for a detailed corrosion and coating assessment; including visual examination, ultrasonic thickness testing, manual pit gauging, and coating thickness measurements. Additional piles were also selected for detailed investigation, during the field investigation. A cathodic protection survey was included to assess the presence and functionality of the existing cathodic protection systems. A sampling of sea shield pile wraps were selected to be opened, to allow for assessment of their condition and effectiveness at protecting the piling in the intertidal range.

This report addresses the structural impacts of the tier 2 inspection findings, generally, and provides recommendations based on the findings of the Corrosion and Cathodic Protection Evaluation (CCPE) report prepared by Taku Engineering. The CCPE report is included as Appendix 1 of this report. In addition to inspection findings and recommendations pertaining to corrosion, cathodic protection, and coating systems, the CCPE report includes a description of the inspection approach. The CCPE report also contains a cathodic potential survey, detailed bent evaluations, photographs, and annotated drawings.

Figure 1.1 below shows many of the typical superstructure elements which are referenced in this and the CCPE report.

Figure 1.1 - Typical Superstructure

2- RESULTS AND DISCUSSION

The following subsections discuss the structural implications of the corrosion found on each of the superstructure and substructure elements. Section loss as a direct result of corrosion was found to be minor in nature, and does not impact the capacity of the structure.

2.1 BERTH 1 AND 2 BOX BEAMS

As indicated in the CCPE report, the box beams are showing signs of localized corrosion and coating failure. Generally, the corrosion impacts less than 15% of nominal steel sections and is primarily localized on the vertical web plates. The minor corrosion identified does not have a significant impact on the structural capacity of the members. Moderate corrosion and pitting were noted at some locations, though not widespread.

The worst case of localized corrosion identified, is on the shore side vertical plate of box beam B and pile bent 10. Figure 2.1 shows a typical box beam section with nominal thicknesses. The Taku report indicates a remaining wall thickness of 338 mils (11/32") from 438 mils (7/16") nominal. Total localized section loss is approximately 100 mills (< 1/8"). It should be noted that steel plate material can be expected to have an original thickness up to .010 inches less than nominal due to mill tolerances.

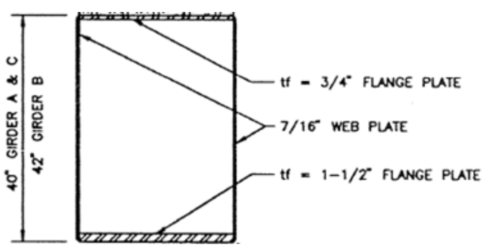

Figure 2.1, Typical Box Beam

Due to the discrete location and small size of this area of corrosion, it does not appear that the capacity of the member is impacted and structural repairs are not required. Should corrosion be allowed to continue unabated, the plate may become structurally compromised to the point of reducing the capacity of the member. Advanced corrosion would allow seawater infiltration of the box beam, which could add a significant dead load to the beam, and would promote corrosion of the bottom flange.

2.2 BERTH 1 AND 2 PILE BENT CAPS

The pile bent caps show only minor localized corrosion and pitting, with minimal section loss. The observed areas of coating failure are similarly localized. Figure 2.2 shows the general cross section of each pile cap, and identifies the primary components. Much of the localized corrosion is on the 1/4" vertical cover plates that seal the caps and keep seawater from corroding the inside faces of the HP sections. The minor section loss encountered on the cover plates were localized. The section loss on the cover plates were determined not to impact the capacity of the structure due to the location and size of effected areas. Corrosion on the flanges is potentially more serious. Since the top flanges are only experiencing very minor section loss due to corrosion, there is no expectation for reduced capacity.

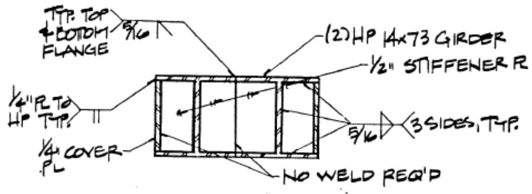

Figure 2.2, Typical Pile Bent Cap

2.3 BERTH 1 AND 2 BATTER PILE SUB CAPS

The elevation of the batter pile sub caps is lower than the other superstructure elements. As a result, these are exposed to more frequent wetting/drying cycles during tidal fluctuations. Figure 3.3 shows the general configuration of the sub caps. The corrosion found on the batter pile sub caps was described as uniform surface corrosion at areas of failed coating, with no significant pitting observed. Since no measurable loss of section has occurred, the capacity of the sub caps inspected has not been reduced by corrosion.

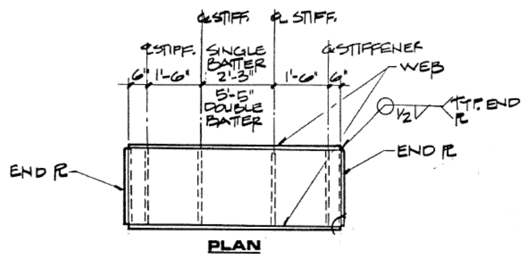

Figure 3.3, Typical Batter Pile Sub cap

2.4 BERTH 1 AND 2 SUPPORT PILES

Minor corrosion and pitting were noted on some of the vertical and batter piles. Figure 2.4 shows typical piles. The original design drawings specified steel pipe piles conforming to ASTM A252 Gr. 3 or API 5lX – 52. Based on those specifications, the measured wall thickness of each pile may be less than the nominal thickness by 12.5% or .125 x the wall thickness, to account for production tolerances. Of the piles inspected, none were observed to have a reduction in wall thickness of less than the minimum specified tolerance. This indicates that corrosion has not impacted the as designed structural capacity of the piles.

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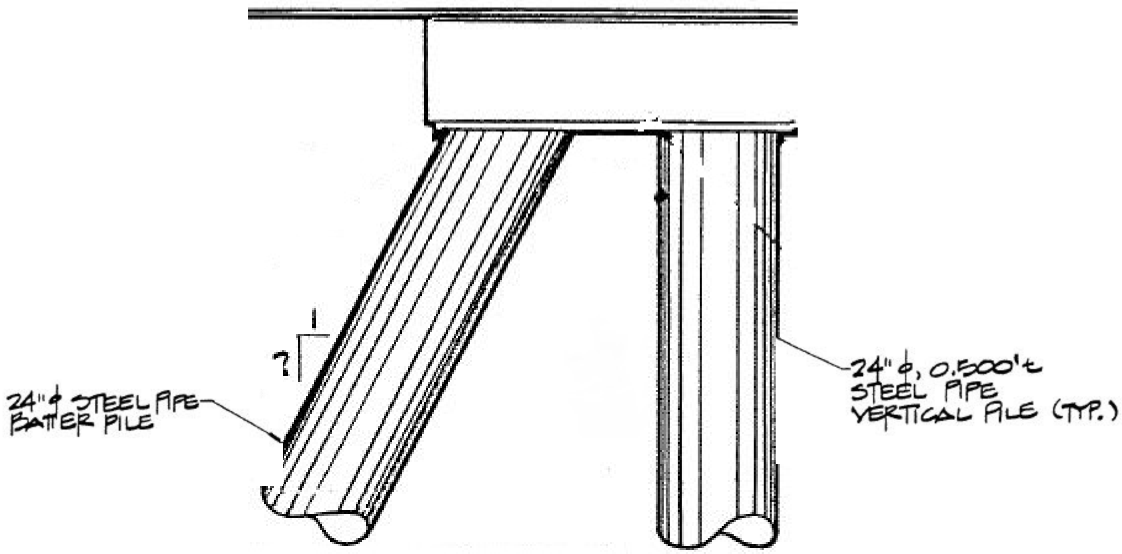

Figure 2.4, Typical Plumb/Batter Pile

2.5 BERTH 3 PILES

The piles at Berth 3 were found to have coating failure and corrosion in the tidal zone. The inspection did not reveal section loss in the pile or connections. This indicates that the piles do not have reduced structural capacity due to corrosion.

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3 - CONCLUSIONS AND RECOMMENDATIONS

3.1 STRUCTURAL CONSIDERATIONS

As indicated in section 2 above, the tier 2 inspection did not identify any deficiencies that require structural repair or modification. Should corrosion be allowed to continue without coating repair or cathodic protection, section loss may eventually compromise the structural capacity of effected elements.

3.2 SUPERSTRUCTURE AND PILING CORROSION CONSIDERATIONS

The CCPE report recommends measures be taken to mitigate continued corrosion of the superstructure. These recommendations are described and discussed below.

3.2.1. Seal the gaps between the pile caps and the box girders at Berths 1 and 2. This would prevent localized corrosion from seawater intruding between the two elements. The gaps are tight enough to prevent other forms of corrosion mitigation or re-coating, and corrosion in these locations would be difficult to assess. Sealing out the sea water is a viable solution to reducing the future corrosion impacts.

3.2.2. Repair failed coating at Berths 1 and 2. The CCPE recommends that the City begin planning activities for a coating repair project to repair the localized coating failures. This recommendation indicates that the need for coating repair is not urgent; however the planning process does need to begin in order to arrest corrosion of the elements in a timely manner.

3.2.3. Replace missing and damaged sea shield wraps. The missing pile wraps and sea shield jackets should be replaced to mitigate corrosion in the tidal zone. It may be noted that these areas do not show signs of corrosion. The absence of corrosion may be attributed to the effectiveness of the jacket system. It is therefore advisable that the jackets be replaced before corrosion begins.

3.2.4. Pile wraps are recommended in the tidal zone for the fender, bollard, and mooring dolphin piling, and at the Berth 3 platform to reduce the impacts of corrosion where a cathodic protection system is less effective. The mooring dolphin piling and Berth 3 support piling should be considered as more of a priority, as they are primary structural elements supporting the structures. Since reduced capacity of these piles would not have the same impact as that of a primary element, repairs to the bollard and dolphin piling may be considered less of a priority.

3.3 CATHODIC PROTECTION CONSIDERATIONS

Sacrificial anodes should be installed on the Berth 1 and 2 piling. The CCPE Report recommends installing these anodes on the piles that aren't currently adequately protected, and the piles that aren't cathodically protected at all. The underwater inspection in May of 2016 found that many of the anodes encountered had less than 50% of the material remaining, with the typical range being from about 25%-50% remaining. Since these anodes will likely become ineffective at protecting the structure in a relatively short time frame, it may be desirable to install new anodes on all piles to avoid a piecemeal replacement approach.

The CCPE report recommends electrical bonding straps be installed between bents 7 and 8 which are electrically isolated, and between fender / bollard piles and the rest of the structure. The electrical continuity created by thisis useful in maintaining the effectiveness of the cathodic protection systems.

As mentioned in the CCPE report and the 2016 condition assessment report, there is no cathodic protection installed on the Berth 3 platform piles. The CP survey readings indicated that the galvanized coating is no longer adequately protecting the steel, and additional protection is required to prevent deterioration of the piles. The CCPE report recommends the installation of either an impressed current system or a sacrificial anode system, similar to that installed at Berth 1 and 2.

4 - OPINION OF PROBABLE CONSTRUCTION COST

The following construction cost estimate is based on the construction of all recommended repairs as a single project. The costs are presented at a feasibility level and carry a contingency of +25%. The accuracy of the cost estimate can be improved as design progresses from basic ideas to well defined details.

Ketchikan Berths 1, 2 and 3 - Recommended Repairs [1]
Project: 9333 By: PBW/CGB Date: 111416
Order of Magnitude Opinion of Probable Construction Cost (OPCC)

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Item No.	Description	Approx. Quantity	Unit		Unit Cost ($) [1]		Extended Cost (Rounded)
1	Mobilization and Demobilization	1	LS	$	215,200.0	$	216,000
2	Blast and Spray Metalize Failed Coating Areas (25%) Berth 1 and 2 [3,4]	1	LS	$	1,505,625	$	1,506,000
2a	*Blast and Spray Metalize Entire Dock Superstructure* [2,3,4]	*1*	*LS*	*$*	*4,015,000*		
3	Furnish and Install Anodes on Support Piling Berths 1 and 2	155	EA	$	2,000	$	310,000
4	Furnish and Install Anodes on Bollard / Fender Piling Berth 1 and 2	68	EA	$	1,500	$	102,000
5	Furnish and install Anodes Berth 3 Platform	45	EA	$	200	$	9,000
6	Replace Damaged and Missing Pile Wrap Berth 1 and 2	10	EA	$	5,000	$	50,000
7	Furnish and Install Pile Wrap Berth 3	35	EA	$	5,000	$	175,000
		Estimated Bid Price				**$**	**2,368,000**
		Contingency[5]			(15%)	$	355,000
		Opinion of Probable Construction Cost				**$**	**2,723,000**
		Planning, Permitting, Design and Bid Documents			(10%)	$	272,000
		Contract Administration, Construction Inspection & Other Indirect Costs [4]			(5%)	$	136,000
		Estimated Project Cost				**$**	**3,131,000**

NOTES:

1. All estimates are in 2016 USD and rounded up to the nearest thousand dollars.

2. Blasting and spray metalizing entire steel superstructure is not included in project total.

3. Estimated costs for Items 2 and 2a are not directly proportional due to economy of scale. 25% failed coating, includes an allowance for continual coating failure prior to construciton.

4. Expected accuracy of above figures is +25%, -20%

5. Contingengecy is intended to account for additional construction costs which can not be reasonably ascertained at this level of development.

6. Includes only periodic site inspection during construction.

Appendix 1

2016 Berths 1, 2, and 3 Corrosion and Cathodic Protection Evaluation Report

2016 Berths 1, 2 and 3 Corrosion and Cathodic Protection Evaluation

FOR

The City of Ketchikan

AT

Ketchikan, Alaska

Prepared By:

taku engineering, llc

P.O. Box 241386
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November 2016

STATE OF ALASKA
49TH
William Richard Mott
MM 13391
REGISTERED PROFESSIONAL ENGINEER

Contents

City of Ketchikan Berths 1, 2 and 3 Corrosion and Cathodic Protection Evaluation

1.0 EXECUTIVE SUMMARY

In September 2016, Taku Engineering assisted Moffatt & Nichol with at Tier 2 assessment of two of the existing Ketchikan City Dock structures. Berths 1 and 2 were originally constructed in 1993 and underwent refurbishment in 2006. The 2006 refurbishment included installation of 196 ninety-pound aluminum alloy pier anodes, application of zinc spray metallizing on around 15,000 square feet of steel and installation of a Seashield piling wrap system in the tidal zone for all piles. Berth 3 was constructed in 2007 and does not currently have cathodic protection (CP) or piling wraps in the tidal zone.

The Tier 2 evaluation of the Berth 1 and 2 structure included a thorough visual examination of all bents and box girders, a detailed Level 3 corrosion examination at 7 of 24 bents, collection of cathodic protection readings at all piles (including fenders, bollards and the mooring dolphin) and an evaluation of the Seashield piling wrap system. The Berth 3 evaluation included collection of CP data and visual evaluation for 10 of 35 piles.

The evaluations were completed in accordance with the guidelines presented in the American Society of Civil Engineers (ASCE) *Waterfront Facilities Inspection and Assessment Manual* (Practice No. 130), section 3.2 "Routine Inspections". CP readings were conducted in accordance with NACE SP0176-2007, *Corrosion Control of Submerged Areas of Permanently Installed Steel Offshore Structures Associated with Petroleum Production*. The following report outlines the findings and recommendations generated over the course of this evaluation.

2.0 FINDINGS

Berths 1 and 2

1. The Berth 1 and 2 structure was found to be in overall Fair to Satisfactory condition (rating of 4-5 on a 1 to 6 scale) per Table 2-14 of the ASCE Practice No. 130. This rating reflects the minor to moderate coating defects present on the structure, as well as the areas of low CP observed on some pilings. *Appendix A* provides CP data for the berths, and *Appendix B* contains detailed corrosion examination reports.
2. Structure-to-electrolyte potential data collected show that 87 of 155 piles (56%) at the Berth 1 and 2 structure do not meet the requirements for adequate cathodic protection per NACE SP0176 criteria. The potentials also indicate that Bents 1 through 7 and the fender and bollard piles along the west face of the dock are not electrically continuous with the remainder of the dock structure. The fender and bollard piles do not have attached anodes or any other means of CP.
3. Structure-to-electrolyte potentials collected on three of the piles and fender piles at the Berth 1 and 2 mooring dolphin indicate that the structure does not meet the requirements for adequate cathodic protection per the NACE SP0176 criteria. Measured potentials were typical of unprotected steel in seawater. The mooring dolphin does not have any means of CP.
4. External corrosion evaluations were performed on seven bents, and found three areas classified

as moderate damage (MD) per the ASCE ranking system, due to wall loss exceeding 15% of nominal thickness (see ASCE Practice No. 130, Figure 2-3). One area was located on the north face of the Bent 1 piling cap with a remaining wall thickness of 199 mils on 250-mil nominal plate. The remaining two were found at Bent 10 on the shore side of Box Girder B and the piling cap. The lowest remaining wall thickness in these areas was 339 mils in 438-mil nominal plate. The areas each measured less than 2ft x 2ft and were covered with a thick, tightly adhered corrosion scale. All three areas were included in the detailed Level 3 non-destructive evaluation of selected bents. The remainder of the corrosion and coating failures evaluated fall into the minor damage (MN) category, having no more than 15% wall loss. These areas covered roughly 28% of the total surface area (800 ft² of 2880 ft²) for the seven bents selected for Level 3 evaluation. The total estimated area containing coating damage and/or corrosion for Berths 1 and 2 is 8,600 ft², based on the preliminary estimate in *Appendix E*.

5. The worst case corrosion rate found during the course of the evaluations is located at Bent 10 on the middle box girder in an area of 438-mil nominal plate. The corrosion rate for this area is up to 9.9 mils per year (mpy) based on the lowest remaining wall thickness (339 mils), and the assumption that this corrosion started after the 2006 refurbishment was completed. At a corrosion rate of 9.9 mpy, this location would fall into the Major (MD) damage rating in 3.2 years if not repaired.
6. No evidence was found to indicate that internal corrosion may be occurring on the box girders. A visual evaluation of the welds for the girders and pile caps found that they generally match the welding details in the 1993 construction package. The original construction package required that box girders, pile caps and sub caps be seal welded. Ultrasonic thickness data were collected for the exposed bottom plate at the north end of box girders 1 and 2. Readings found full plate thickness of 1.5-inches with no evidence of internal wall loss. Data collected for the bottom plate of the box girders in other areas of Level 3 evaluation also found full 1.5-inch plate thicknesses, with only minor external pitting (up to 20 mil depth).
7. In accordance with the original design drawings, the box girders are not seal welded to the pile caps. This configuration leaves an opening at the box girder bolting flanges that allows water to collect between the bottom of the box girders and top of the pile caps at high tides exceeding approximately 16 feet.
8. Coating failures have continued on the box girders and pile caps, primarily occurring at the 2006 coating repair areas. Coating failures observed include blistered and disbonded coatings surrounding previous repairs, surface corrosion on the horizontal surfaces of pile caps where water can collect, disbondment at plate edges and disbondment between the top of the Seashield jacket and the bottom of the piling cap. The majority of the failures observed are located on the lower surfaces of the box girders.
9. Damage to the existing Seashield system was noted at 18 piles on Berths 1 and 2 (see drawing markup in *Appendix D*). Damage ranged from slippage of the Seashield jacket system, which exposed the petrolatum tape, to complete loss of the jacket and petrolatum tape wrap system. No corrosion damage was noted in any of the areas where the Seashield system was missing. It is unknown how long areas of missing jacketing and petrolatum tape wrap have been exposed.
10. Seashield jackets were opened so evaluations could be completed on piling surfaces at the Bents selected for Level 3 evaluation. No evidence of active corrosion or external wall loss were noted. Petrolatum tape was repaired per manufacturer’s instructions and the jacketing closed with new

stainless steel hardware.

Berth 3

1. The structure-to-electrolyte potential data collected shows that the 10 piles selected at Berth 3 do not meet the requirements for adequate cathodic protection per NACE SP0176 criteria. Given the uniformity in readings, it can be assumed that the remaining piles for Berth 3 are also not receiving adequate cathodic protection.
2. The visual assessment of the pipe piles for Berth 3 found that the coating is in fair condition. The only corrosion damage observed included uniform surface corrosion starting in the tidal zone and some blistering due to corrosion in the areas of pile cap attachment welds. Marine growth is present but not as fully developed as that found on Berth 1 and 2. No pitting was found in the areas accessible for evaluation.

3.0 RECOMMENDATIONS

Berths 1 and 2

1. Install new aluminum pier anodes at all piles that have CP levels below the minimum required for adequate protection. Alternatively, an impressed current system could be designed which would allow for the adjustment of CP levels based on changing current requirements due to future berth upgrades or modifications.
2. Install electrical bonding straps between Bents 7 and 8, as well as between the berth structure and all adjacent fender and bollard piles. This will promote more even current distribution for all berth piles and allow for continued protection from adjacent anodes in the event that a local anode is damaged or depleted.
3. Consider sealing the gap between piling caps and box girders with a flexible polyurethane compound formulated for saltwater exposure to prevent water intrusion and corrosion.
4. Begin planning activities for a coating repair project to address the coating failures present on the Berth 1 and 2 structural members. Measured metal loss due to corrosion is currently classified as “Minor to Moderate Damage”. The corrosion will continue if the coatings are not repaired, with the worst location found becoming “Major Damage” in around 3.2 years. The city should consider completing a detailed pre-solicitation survey focused on obtaining a more exact estimate of needed repairs. Given Taku’s level of familiarity with the structure and coating condition, it is expected that this would be a 2-3 day effort.
5. Repair or replace all damaged or missing Seashield piling wrap systems for the berth piles. Install piling wraps in the tidal zone of all fender, bollard and mooring dolphin piles. Include a petrolatum-based wrap to improve protection in the tidal zone where CP is not as effective due to water level fluctuations.

Berth 3

1. Design and install a sacrificial or impressed current system to provide cathodic protection for the Berth 3 piles.
2. Install additional piling wraps in the tidal zone for all Berth 3 piles. The use of a petrolatum based wrap will improve protection in the tidal zone where CP is not as effective due to water

level fluctuations.

4.0 TECHNICAL APPROACH

Examination of the City of Ketchikan Berths 1, 2 and 3 included the following items:

- ASCE Level 1 inspection, including visual evaluation of the under-pier structural elements at Berths 1 and 2 (access by boat)
- ASCE Level 3 inspection, including non-destructive examination (NDE) for seven bents selected on Berths 1 and 2. NDE included visual examination, ultrasonic thickness testing, coating thickness measurement and pit depth measurement.
- Visual examination of pile surfaces beneath Seashield protective jacketing and Denso tape wrap at one pile per bent selected for Level 3 examination. Pile jackets and tape wrap were repaired per manufacturer's instructions and closed with new stainless steel hardware after examination.
- Cathodic protection survey at all piles at Berths 1 and 2, including fender, bollard and the mooring dolphin piles (Bents 1-24)
- Cathodic protection survey at ten selected piles at Berth 3

ASCE Level 1 Inspection

Visual examinations of support structure coating and surfaces were completed to evaluate the condition and effectiveness of the coatings and cathodic protection. These examinations were performed in accordance with NACE SP0176-2007 and the ASCE Waterfront Facilities Inspection and Assessment Manual. Each bent was examined for the presence of active corrosion, including visual assessment of corrosion and weld conditions. These examinations were used to determine which bents would receive a more detailed Level 3 evaluation.

ASCE Level 3 Inspection

Non-destructive examination was performed at seven bents and two box girders selected during the initial Level 1 evaluation. These evaluations were performed in accordance with NACE SP0176-2007 and Section 3 of the ASCE Waterfront Facilities Inspection and Assessment Manual. The evaluations included the removal of failed coating and corrosion product at selected locations using a grinder with a wire wheel. Collection of remaining wall thicknesses at corroded locations and adjacent actual wall thickness readings was completed using an Olympus 45 MG digital thickness gauge, calibrated for the material thickness. Any pitting located in the assessment area was evaluated with a dial-type pit gauge and then subtracted from the remaining wall thickness reading to give a conservative evaluation of wall loss. Coating thicknesses were measured for various bent elements (piles, piling caps, etc.) and cathodic protection readings were obtained at 3 locations in the water column for each pile at the bent. It was visually confirmed that the beams were seal welded as shown in the dock construction drawings. Based on the fact that the beams were seal welded, did not show significant external corrosion, and did not show internal thinning by UT testing, no holes were drilled in the beams for visual bore scope testing. These holes, even if plugged, would present a potential path for seawater into the beams when submerged by tides exceeding roughly 16 feet.

Cathodic Protection Evaluation

Cathodic protection potentials were collected at each of the piles for Berth 1 and 2, three piles on the Berth 1 and 2 mooring dolphin and ten randomly selected piles for Berth 3. These structure-to-electrolyte potentials were collected at 5 feet below water line, 20-30 feet below water line and seafloor for each of the bents selected for Level 3 evaluation, and at 25 feet below waterline for all other piles on Berth 1 and 2. The areas with failing potentials are noted on Berth 1, 2 and 3 plan drawings in *Appendix D.*

All structure to electrolyte potential measurements were collected using a weighted MC Miller silver/silver chloride (Ag/AgCl) reference electrode (P/N #13100) positioned immediately adjacent to the target pile. The collected piling potential data can be found in *Appendix A.*

All potential readings for the piles, batters, and mooring dolphins were collected using a calibrated Fluke 27 Multimeter.

The criterion used to determine the adequacy of cathodic protection has been established in NACE Standard Practice SP0176-2007. With respect to metallic structures in marine environments, the following criterion applies:

> Structure-to-Electrolyte Criteria: A minimum "On" (i.e. CP sources active) structure-to-electrolyte potential of at least -800 millivolts (mV) with respect to an Ag/AgCl reference electrode (with consideration for IR drop). IR drop can be removed from consideration in marine structure readings if the reference cell is placed sufficiently close to the structure being measured.

Unprotected carbon steel structures in seawater typically read -600 to -660 mV with respect to a solid-junction silver/silver chloride (Ag/AgCl) reference cell.

Coating Thickness Evaluation

The coating thicknesses of selected bents and beams were measure using a PosiTector Model #6000 FNTS. The coating mil thickness was measure at a minimum of three separate locations on various sections of the structure to provide a range and average for the coating thickness.

Ultrasonic Thickness Evaluation

The material thicknesses of selected bents and beams were measured using an Olympus ultrasonic thickness gauge Model 45 MG and 7.5 MHz, dual-element transducer. The thickness gauge was calibrated based on expected plate thicknesses, per manufacturer instructions using a NIST traceable calibration block.

Mechanical Pit Depth Evaluation

Areas of external pitting and wall loss that could not be evaluated ultrasonically were measured with the use of a calibrated Starrett model 52714 dial-depth gauge with a measurement range from 0.0-inches to 0.125-inch. The pit depth measurements were then subtracted from actual wall thickness measurements, gathered ultrasonically adjacent to the pitting, to provide the remaining wall thicknesses in areas where corrosion was present.

5.0 RESULTS AND DISCUSSION

5.1 Level 1 Assessment for Berth 1 and 2 Structures

Visual examinations of the Berth 1 and 2 support structure were completed from a skiff at varying tidal levels to allow for access to piles, pile caps and box girders. Multiple passes were made through the structure to estimate the amount of coating damage per structural element (beams, piles, piling caps, etc.) and evaluate the general condition of each type of element. These examinations, performed in accordance with NACE SP0176-2007 and the ASCE Waterfront Facilities Inspection and Assessment Manual, assessed each element to determine which would receive a detailed Level 3 evaluation.

This assessment included estimating approximate square footage of damaged coating on the Berth 1 and 2 bents and girders, and noting locations of slipped or missing pile jackets. See *Appendix D* for locations of missing pile jackets, and *Appendix E* for estimated square footage of damage coatings.

5.2 Level 3 Assessment for Selected Berth 1 and 2 Elements

Non-destructive evaluations were performed at seven bents (1, 3, 7, 10, 16, 21 and 24) selected during the initial Level 1 evaluation. These evaluations were performed in accordance with NACE SP0176-2007 and section 3 of the ASCE Waterfront Facilities Inspection and Assessment Manual. As many as 8 areas per bent were cleaned, prepared and examined to determine the extent and severity of corrosion. The data collected from these evaluations and pictures of specific damage areas can be found in the Bent Evaluation forms in *Appendix B.*

The Berth 1 and 2 structure was found to be in overall Fair to Satisfactory condition (rating of 4-5 on a 1 to 6 scale) per Table 2-14 of the ASCE Practice No. 130. This rating reflects the minor to moderate coating defects present on the structure, as well as the CP upgrades needed to bring protection to adequate levels.

The worst case corrosion rate calculated for the Berth 1 and 2 structure is 9.9 mils per year (mpy) for an area located on the shore side of box beam B at Bent 10. This area had a remaining wall thickness of 338 mils on plate steel with a nominal thickness of 438 mils. This area of uncoated plate is adjacent to an area that appears to have been recoated during the 2006 berth refurbishment project.

Detailed findings from the Level 3 assessments can be found in *Appendix B.*

5.3 CP Assessment for Berth Structures

Data collected during the field testing and examination in October 2016 indicates that 87 of 155 piles (56%) evaluated for Berth 1 and 2 are not receiving adequate levels of protection from the sacrificial CP systems. Field testing indicates that the Berth 3 piles do not meet the minimum potentials required for adequate cathodic protection. Three potential readings were collected at each piling for bents that received a detailed Level 3 evaluation and a single reading was collected for each of the remaining piles. These potential data are compiled in separate tables for each Berth and can be found in *Appendix A.* Mark-ups of the berth plan drawings showing the locations where data was collected and which piling fail to meet NACE criteria can be found in *Appendix D.*

Structure-to-electrolyte potential (versus an Ag/AgCl solid junction reference electrode) ranges for the berth structures are listed below.

- Berth 1 and 2 Bents 1-7: -918 mV to -966 mV
- Berth 1 and 2 Bents 8-24: -733 mV to -900 mV
- Berth 1 and 2 Fender and Bollard Piling: -618 mV to -830 mV
- Berth 1 and 2 Mooring Dolphin and Fenders: -648 mV to -672 mV

- Berth 3 Piling (10 selected at random): -630 mV to -668 mV

Readings more negative than -800 mV indicate adequate cathodic protection levels, per NACE SP0176-2007. Readings in the -600 to -700 mV range suggest that the piles have depleted anodes or no anodes installed.

Bents 1 to 7 are listed separately, as data indicates that they are not electrically continuous with the remainder of the berth structure. The box girders between bents 7 and 8 are not a continuous girder and there are no bonding straps or cables tying the structures together.

-- End of Report –

APPENDIX A

Piling Potential Survey Data

City of Ketchikan Berth 1 & 2

Cathodic Protection Assessment

All readings in milivolts DC vs Ag/AgCl reference cell

Bent Number	Reading Depth	Piling								
		North Fender	South Fender	South Bollard	Box Girder A		Box Girder B		Box Girder C	
					Seaside or North	Shoreside or South	Seaside or North	Shoreside or South	Seaside or North	Shoreside or South
1	waterline	NA	NA	NA	-963	-966	-962	NA	NA	NA
	mid	-635	-642	-649	-961	-964	-957	NA	NA	NA
	Bottom (40')	NA	NA	NA	-956	-957	-955	NA	NA	NA
2	mid	-636	-636	-641	-948	-951	-952	NA	NA	NA
3	waterline	NA	NA	NA	-963	-965	-959	NA	NA	NA
	mid	-645	-640	-662	-961	-962	-957	NA	NA	NA
	Bottom (35')	NA	NA	NA	-951	-953	-952	NA	NA	NA
4	mid	-657	-653	-661	-936	-936	-935	NA	NA	NA
5	mid	-631	-636	-647	-918	-931	-930	NA	NA	NA
6	mid	-629	-629	-634	-928	-933	-943	NA	NA	NA
7	waterline	NA	NA	NA	-936	-933	-954	-964	NA	NA
	mid	NA	NA	NA	-945	-940	-950	-957	NA	NA
	Bottom (55')	NA	NA	NA	-944	-945	-948	-952	NA	NA
8	mid	-776	-777	-660	-760	NA	-762	-781	NA	-791
9	mid	-776	-777	-651	-763	NA	-769	-779	NA	-778
10	waterline	NA	NA	NA	-769	NA	-733	-788	NA	-782
	mid	-776	-773	-660	-761	NA	-771	-777	NA	-779
	Bottom (65')	NA	NA	NA	-774	NA	-770	-773	NA	-778
11	mid	-782	-776	-652	-757	NA	-764	-768	NA	-769
12	mid	-788	-788	-663	-769	NA	-773	-773	NA	-781
13	mid	-798	-799	-662	-784	NA	-793	-801	NA	-803
14	mid	-643	-651	-652	-829	NA	-827	-845	NA	-840
15	mid	-830	-830	-660	-838	NA	-836	-842	NA	-840
16	waterline	NA	NA	NA	-858	NA	-876	-875	NA	-867
	mid	-645	-653	-664	-860	NA	-864	-864	NA	-870
	Bottom (50')	NA	NA	NA	-849	NA	-853	-856	NA	-864
17	mid	-651	-658	-662	-885	-881	-880	-884	-890	-888
18	mid	-624	-627	-649	-892	-894	-890	-892	-900	-897
19	mid	-636	-632	-887	-888	-888	-890	-890	-894	-894
20	mid	-626	-618	-646	-875	NA	-883	-883	NA	-888
21	waterline	NA	NA	NA	-885	-887	-885	NA	NA	NA
	mid	-626	-631	-646	-880	-883	-887	NA	NA	NA
	Bottom (40')	NA	NA	NA	-864	-859	-871	NA	NA	NA
22	mid	-640	-646	-642	-890	-890	-892	NA	NA	NA
23	mid	-619	-621	-633	-877	-882	-884	NA	NA	NA
24	waterline	NA	NA	NA	-870	-876	-877	NA	NA	NA
	mid	-628	-628	NA	-858	-866	-870	NA	NA	NA
	Bottom (40')	NA	NA	NA	-864	-863	-865	NA	NA	NA
Mooring Dolphin	mid	-670								
Bollard Piles	mid	-648	-672							

Total Piling Count: 155

Failing NACE Criteria: 87

Meter Information:

Model: Fluke 27

ID: TA0036

Calibration Due: 4/13/2017

Structure Potential Range:

-800 mV (or more negative)	Passing per NACE SP0176
-799 mV (or more positive)	Failing per NACE SP0176
-600 mV to -660 mV	Typical potential for carbon steel with no CP in seawater

City of Ketchikan Berth 3

Cathodic Protection Assessment

All readings in milivolts DC vs Ag/AgCl reference cell

Piling Number	Reading Depth			Comments
	5'	25'	50'	
1A	-668	-655	-641	Minor coating failures and rust blooms noted at pile cap welds and in the splash zone for all piling evaluated.
3A	-638	-636	-630	
5A	-642	-636	-634	
6C	-648	-640	-635	
7E	-640	-636	-634	
8A	-642	-640	-638	
8E	-643	-638	-638	
9E	-639	-642	-639	
11E	-642	-641	-640	
12J	-638	-638	-640	

Meter Information:

Model	Fluke 27
ID	TA0036
Calibration Due	4/13/2017

APPENDIX B

Bent Evaluations

Ketchikan Berth 1 Corrosion Examination

Date: 10-11-16
Start Time: 08:29
Bent No: 1
Exam. By: EGW, MCA

Summary:
Areas cleared for corrosion examination on the beams and piling caps were found to be in fair to good condition. Only light surface corrosion and some moderate pitting (up to 65 mils) were present. The piling surface exposed beneath the jacket was in good condition, with no visible corrosion. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	Corrosion Notes	UT Location	Min. Thickness (mils) UT Loc.	AWT	Comments:
Piling cap, north side, beneath Beam 1	Light surface corrosion and light pitting present beneath failed coating repair area. Max pitting depth 0.010" (10 mils).	1. In area cleared for examination; adjacent to top edge of north surface.	1.	273	Appears to be an area of previously repaired coating. Nominal thickness: 250 mils Lowest RWT: 263 mils
Piling cap top surface, between Beams 1 and 2	Coating is disbonded and loosely adhered. Very light surface corrosion present beneath failed coating. No pitting observed.	2. At area cleared of failed coating for examination. ~1" from south edge of piling cap.	2	485	Thickness increases slightly approaching middle of piling cap due to I-beam construction. Nominal thickness: 505 mils
Beam 1, shore side, immediately above south edge of piling cap	Lightly adhered failed coating removed. Surface exposed shows moderate pitting to max depth 65 mils. Coating DFT: 19.5-35 mils	3. At area cleared for examination; ~3" above bottom edge of beam	3	446	Appears to be a coating repair area. Nominal thickness: 438 mils Lowest RWT: 381 mils
Piling cap, north surface, shore side end (beneath Beam 2)	Lightly adhered failed coating removed. Surface exposed shows light to moderate pitting. Max pitting depth: 20 mils	4. At area cleared for examination.	4	219	Rough dimensions of exam area 40" x 13" Nominal thickness: 250 mils Lowest RWT: 199 mils

Ketchikan Berth 1 Corrosion Examination

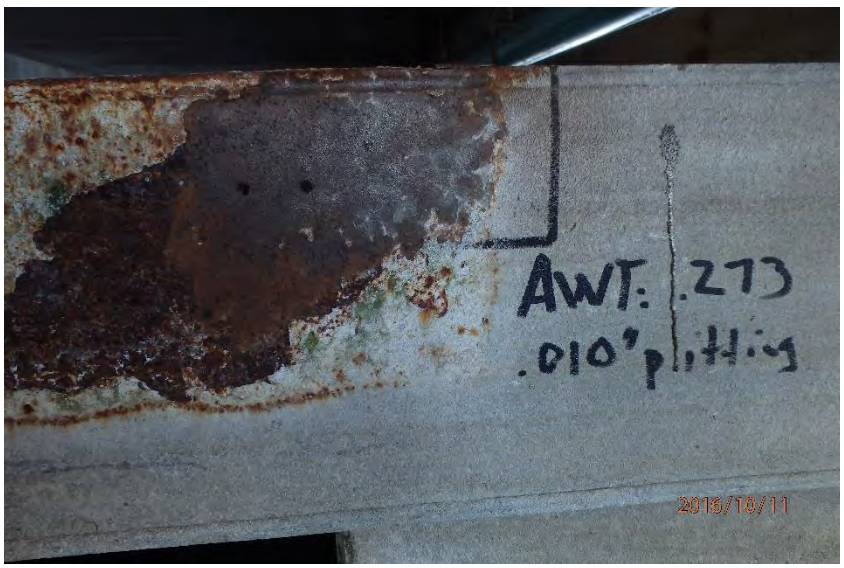
Component	Corrosion Notes	UT Location	Min. Thickness (mils)		Comments:
			UT Loc.	AWT	
Piling cap, north side, between Beams 1 and 2	Long area of lightly adhered/loose coating. Area cleared for visual examination shows light pitting to 10 mils. Coating DFT: 25.5-48.5 mils	5. In area cleared for visual examination.	5	273	Rough dimensions of exam area are 68" x 12" Nominal thickness: 250 mils Lowest RWT: 263 mils
Beam 1 north end, bottom surface (~1" from north edge)	No visible corrosion.	6. On bottom surface of beam, ~1" from the north edge.	6	1530	Checking thickness of lowest point of beam, where any water present would likely collect. No visual signs or thinning indicating water intrusion into sealed beam.
Beam 2 north side, bottom surface (~1" from north end)	No visible corrosion.	7. On bottom surface of beam, ~1" from the north edge.	7	1490	Checking thickness of lowest point of beam, where any water present would likely collect. No visual signs or thinning indicating water intrusion into sealed beam.
Piling 1	Piling steel surface is in good condition. No corrosion found on piling surface. Coating DFT: 2-27.5 mils	Near piling caps	8	515	Tape inside jacketing was found to be in good condition. Steel surface was covered with Denso paste and tape repair installed prior to re-closing pile jacket.

Additional Notes:
Beams are numbered west to east for reporting (e.g. Beam 1 is westernmost beam running north/south).

Ketchikan Berth 1 Corrosion Examination

Bent 1 Overview (looking north)


Bent 1 Overview (looking south)



Piling cap, north side, beneath Beam 1 (UT Location 1)


Close-up of UT Location 1

Ketchikan Berth 1 Corrosion Examination

Piling cap top surface (UT Location 2)

Close-up of UT Location 2

Beam 1, shore side, above S. edge of piling cap (UT Location 3)

Close-up of UT Location 3

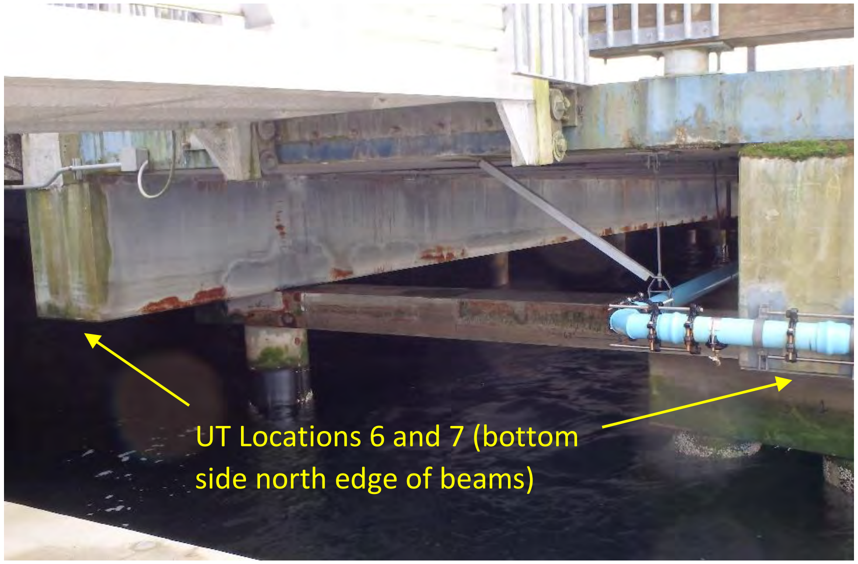
Ketchikan Berth 1 Corrosion Examination

Piling cap, north surface, under Beam 2 (UT Location 4)

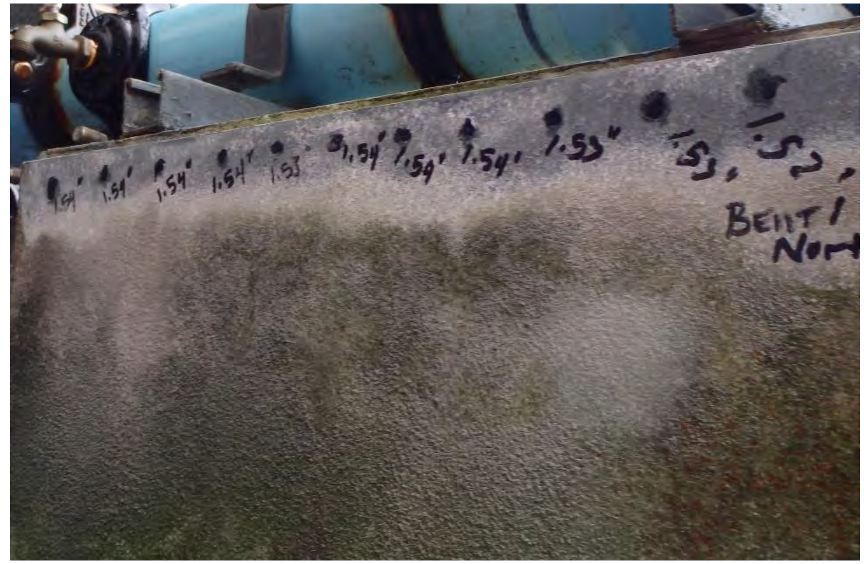
Close-up of UT Location 4

Piling cap, north side, between Beams 1 and 2 (UT Location 5)

Close-up of UT Location 5



Overview of Beams 1 and 2 North End (UT Locations 6 and 7)



Beam 1 bottom surface, north edge (UT Location 6)

Beam 2 bottom surface, north edge (UT Location 7)

Bent 1 Piling 1

Ketchikan Berth 1 and 2 Corrosion Examination

Date: 10/14/2016
Start Time: 09:04
Bent No: 2 to 3
Exam. By: EGW, MCA

Summary:
The Beam 1 bottom surface is in fair condition, with coating failures on approximately 75% of the overall surface. Surface corrosion is present at areas of failed coating. The area cleared of surface corrosion for examination contained minor pitting. No significant thinning observed or detected using UT.

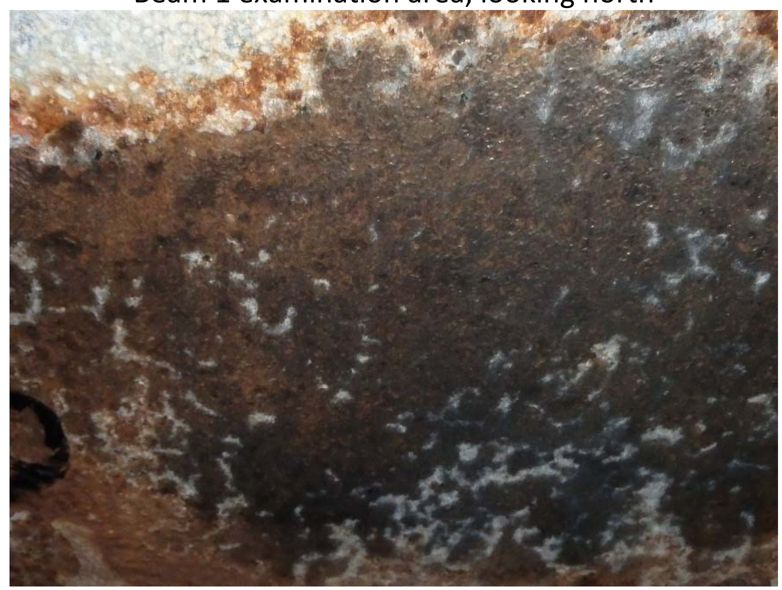
Component	**Corrosion Notes**	**UT Location**	**UT Readings (mils)**		**Comments**
			UT Loc.	AWT	
Beam 1, bottom side, between Bents 2 and 3	Coating failure present with uniform surface corrosion and light pitting (max depth 20 mils).	1. Area of failed coating, cleared for examination	1.	1522	Beam 1 is west side beam (box girder). Area cleared for examination & UT is 6" x 6". Nominal thickness: 1,540 mils Lowest RWT: 1502 mils
			UT Loc.	AWT	
			2		
			UT Loc.	AWT	
			3		
			UT Loc.	AWT	
			4		

Ketchikan Berth 1 and 2 Corrosion Examination

Overview of Beams 1 & 2 between Bents 2 & 3, looking south

Beam 1 examination area, looking north

Beam 1 exam area marked with UT and pitting notes



Beam 1 exam area corrosion close-up

Ketchikan Berth 1 Corrosion Examination

Date: 10-11-16
Start Time: 10:33 am
Bent No: 3
Exam. By: EGW, MCA

Summary:
Areas cleared for corrosion examination on the beams were found to be in fair to good condition. Only light surface corrosion and light pitting (up to 20 mils) were present. The piling surface exposed beneath the jacket was in good condition, with no visible corrosion. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	Corrosion Notes	UT Location	Min. Thickness (mils)	Comments:
Beam 1 shore side, south end	Minor external corrosion present beneath removed failed coating. 10-20 mil max pitting depth. No significant thinning detected. Coating DFT: 28-45 mils	1. In area cleared for examination. Immediately south of piling cap, 1-3” above bottom of beam.	UT Loc. AWT 1 440	None. Nominal thickness: 438 mils Lowest RWT: 420mils
Beam 1 shore side, north end	Light pitting present, approximately 10 mils max depth. No significant thinning found.	2. In area cleared for examination. ~1’ north of piling cap, 2-6” above bottom edge of beam.	UT Loc. AWT 2 431	Appears to be an area of previously repaired coating. Nominal thickness: 438 mils Lowest RWT: 421mils
Beam 2 sea side, north end	Light pitting present, approximately 10 mils max depth. No significant thinning found. Stripes of coating failure and light corrosion are adjacent to examination area.	3. In area cleared for examination. Immediately above north end of piling cap, ~4” above bottom of beam.	UT Loc. AWT 3 448	Appears to be an area of previously repaired coating. Nominal thickness: 438 mils Lowest RWT: 438mils
Piling 3	Piling steel surface is in good condition. No corrosion found on piling surface. Coating DFT:10-34 mils	N/A	UT Loc. AWT 4 506	Tape inside jacketing was found to be wet but in good condition. Steel surface was covered with Denso paste and tape repair installed prior to re-closing pile jacket.

Additional Notes:
Beams are numbered west to east for reporting (e.g. Beam 1 is westernmost beam running north/south). Thickness testing on the piling cap between Beams 1 and 2 provided a minimum thickness of 515 mils.

Ketchikan Berth 1 Corrosion Examination

Bent 3 Overview (looking north)

Bent 3 Overview (looking south)

Beam 1 shore side, south end (UT Location 1)

Close-up of UT Location 1

Ketchikan Berth 1 Corrosion Examination

Beam 1 shore side, north end (UT Location 2)

Close-up of UT Location 2

Beam 2 sea side, north end (UT Location 3)

Close-up of UT Location 3

Ketchikan Berth 1 Corrosion Examination

Bent 3 Pile 3 jacket, before opening for examination

As-found condition of piling tape

As-found condition of piling steel surface (no visible corrosion)

Bent 3 piling cap ultrasonic thickness testing (515 mils min)

Ketchikan Berth 1 Corrosion Examination

Date: 10-11-16
Start Time: 09:49
Bent No: 7
Exam. By: EGW, MCA

Summary:
Steel surfaces cleared for corrosion examination on the beams, piling caps and sub-cap were in fair to good condition. Only light surface corrosion and light pitting (up to 40 mils deep) were present. The piling surface exposed beneath the piling jacket was in good condition, with no visible corrosion. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	Corrosion Notes	UT Location	Min. Thickness (mils) UT Loc.	AWT	Comments:
Piling cap, south side, between Beams 1 and 2	Light pitting is present beneath the area of failed coating. Max pitting depth measured at 30 mils (0.030"). Corrosion visible through failed coating. Coating DFT: 46 to 78 mils	1. In area cleared for examination on south face of piling cap	1.	257	Failed coating at examination location appears to have been previously repaired. Nominal thickness:250 mils Lowest RWT: 227 mils
Beam 1, shore side, north of piling cap	Light pitting (max depth 40 mils) is present beneath failed coating.	2. In area cleared for examination on shore side face of Beam 1	2	445	Approximate dimensions of examination area are 40"x6". Nominal thickness:438 mils Lowest RWT: 405 mils
Piling sub-cap beneath Beam 2	Uniform surface corrosion is present at area of failed coating. No significant pitting observed. Coating DFT: 23 to 29 mils	3. In area cleared for examination, top surface of sub-cap	3	1002	None. Nominal thickness:1000 mils Lowest RWT: 997 mils
Batter pile, south, beneath Beam 1	Piling steel surface is in good condition. No corrosion found on piling surface. Coating DFT: 38 to 57 mils	4.	N/A	522	Tape inside jacketing was found to be in good condition. Steel surface was covered with Denso paste and tape repair installed prior to re-closing pile jacket.

Bent 7 overview (looking south)

Bent 7 shore side overview (under Beam 2)

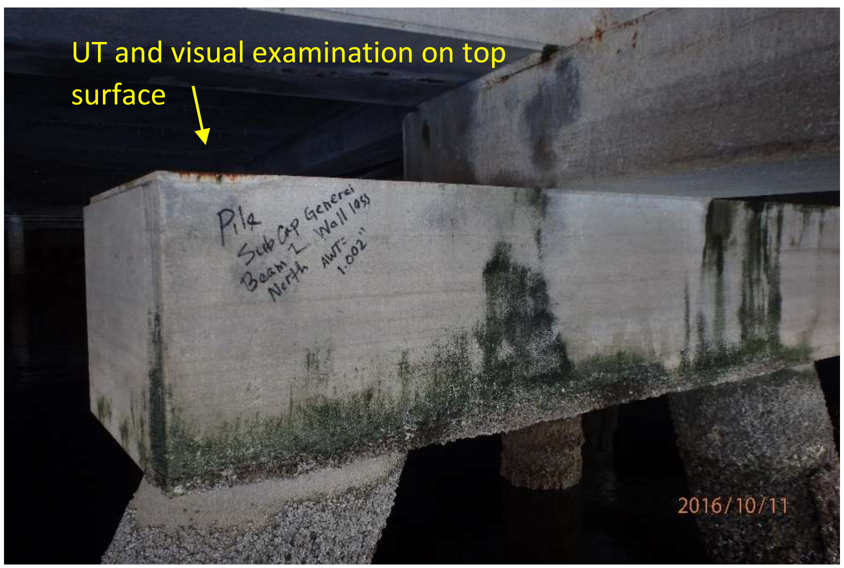
Piling cap, south side (UT Location 1)


Close-up of UT Location 1

Ketchikan Berth 1 Corrosion Examination

Beam 1, shore side, north of piling cap (UT Location 2)

Close-up of UT Location 2



Piling sub-cap beneath Beam 2 (UT Location 3)

Close-up of UT Location 3

Ketchikan Berth 1 Corrosion Examination

As-found batter pile, south, beneath Beam 1

Tape wrap found in good condition

Piling surface beneath tape found in good condition

Close-up of piling surface with no visible corrosion

Ketchikan Berth 1 Corrosion Examination

Date: 10-12-16
Start Time: 09:48
Bent No: 10
Exam. By: EGW, MCA

Summary:
Areas cleared for corrosion examination or found uncoated were in fair condition. Moderate surface corrosion and moderate pitting (up to 70 mils) were present at examination areas. The Piling 1 upper jacket was missing or had slipped down, leaving the upper surface exposed. Exposed steel was in good condition, with no visible corrosion. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	Corrosion Notes	UT Location	UT Readings (mils)		Comments:
			UT Loc.	AWT	
Beam 2 shore side, north end	Area is missing coating. Uniform surface corrosion and moderate pitting to 70 mils max depth. Adjacent Coating DFT: 13-28 mils	1. Uncoated area	1.	409	Approximate dimensions of examination area are 15”x13” Nominal Thickness: 438 mils Lowest RWT: 339 mils ***Highest corrosion rate found at 9.9 mils per year. Assumes this corrosion has occurred since the 2006 refurbishment***
			UT Loc.	AWT	
Piling cap sea side end plate	Moderate pitting to 70 mils max depth present. Adjacent Coating DFT: 15-25 mils	2. In area cleared for visual examination on end plate	2	491	Approximate dimensions of examination area are 29”x13” Nominal Thickness: 500 mils Lowest RWT: 421 mils
			UT Loc.	AWT	
Piling 1	Exposed piling steel surface is in good condition. No corrosion visible on piling.	3. N/A	--	--	Jacket is missing from piling or has slipped down. Some exposed piling surface is covered by remaining tape wrap.


Bent 10 overview (looking north)

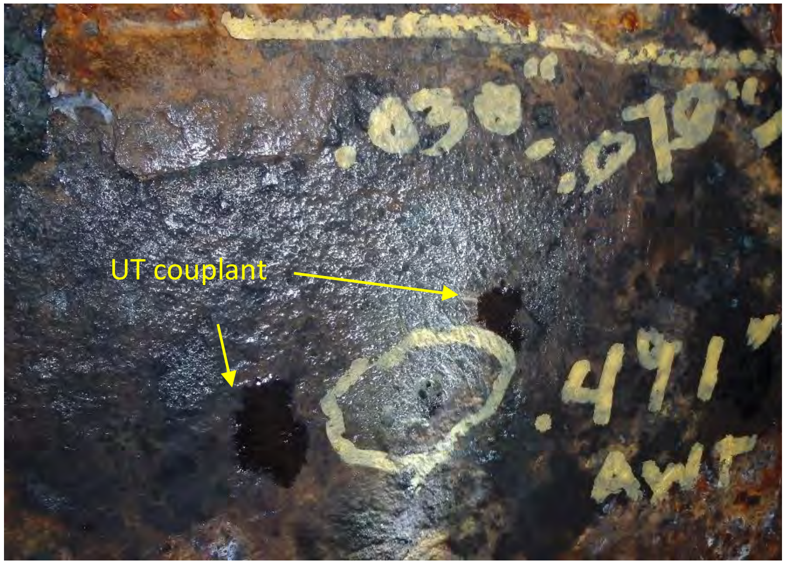

Bent 10 overview (looking south)

Beam 2 shore side, north end (UT Location 1)


Close-up of UT Location 1

Ketchikan Berth 1 Corrosion Examination

Piling cap sea side end plate (UT Location 2)



Close-up of UT Location 2

Piling with missing or slipped upper jacket

Close-up of piling exposed steel surface

Ketchikan Berth 1 Corrosion Examination

Date: 10-12-16
Start Time: 10:40
Bent No: 16
Exam. By: EGW, MCA

Summary:
Areas cleared for corrosion examination or found uncoated were in fair to good condition. Moderate surface corrosion and moderate pitting (up to 55 mils) were present at examination areas. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	**Corrosion Notes**	**UT Location**	**UT Readings (mils)**		**Comments:**
			UT Loc.	AWT	
Beam 1, shore side, north of piling cap	Coating repair area with failed coating. Minor pitting (max depth 20 mils) and uniform surface corrosion present. Coating DFT:12.5-21.5mils	1. In area cleared for corrosion examination, near bottom of beam	1	441	Rough dimensions of examination area are 24” x 5” Nominal Thickness:438 mils Lowest RWT: 421 mils
Beam 2, sea side, north of flange	Coating failure area with moderate pitting present to max depth of 55 mils. Coating DFT:15-22 mils	2. In area cleared for visual examination, near flange and bottom of beam	2	440	Rough dimensions of examination area are 6”x9” Nominal Thickness:438 mils Lowest RWT: 383 mils
Beam 3 Pile, north side	Coating failure with minor pitting to max depth 15 mils	3. In area cleared for corrosion examination	3	477	Rough dimensions of examination area are 12x15” Nominal Thickness:500 mils Lowest RWT: 462 mils
Pile cap weld, south side, under Beam 2	No coating at weld. Pitting present adjacent to weld in HAZ (right side) to max depth of 15 mils.	4. Immediately outside weld HAZ (both sides)	4	249	None. Nominal Thickness:250 mils Lowest RWT: 234 mils

Ketchikan Berth 1 Corrosion Examination

Component	Corrosion Notes	UT Location	UT Readings (mils)		Comments:
			UT Loc.	AWT	
Beam 3 piling, south side	Failed coating with uniform surface corrosion and minor pitting to max depth 20 mils.	5. In area cleared for corrosion examination	5	477	Rough dimensions of examination area are 5"x12" Nominal Thickness:500 mils Lowest RWT: 457 mils
Pile 1	Small area of piling exposed due to jacket slippage. Steel surface not exposed. Tape wrap found intact and not removed. No corrosion staining visible on tape exterior.	N/A			

Additional Notes:
Beams are numbered west to east for reporting (e.g. Beam 1 is westernmost beam running north/south).

Bent 16 Overview (looking north)

Pile 1, with jacketing gap. Tape wrap intact and not removed.

Beam 1, shore side, north of piling cap (UT Location 1)

Close-up of UT Location 1

Ketchikan Berth 1 Corrosion Examination

Beam 2, sea side, north of flange (UT Location 2)

Close-up of UT Location 2

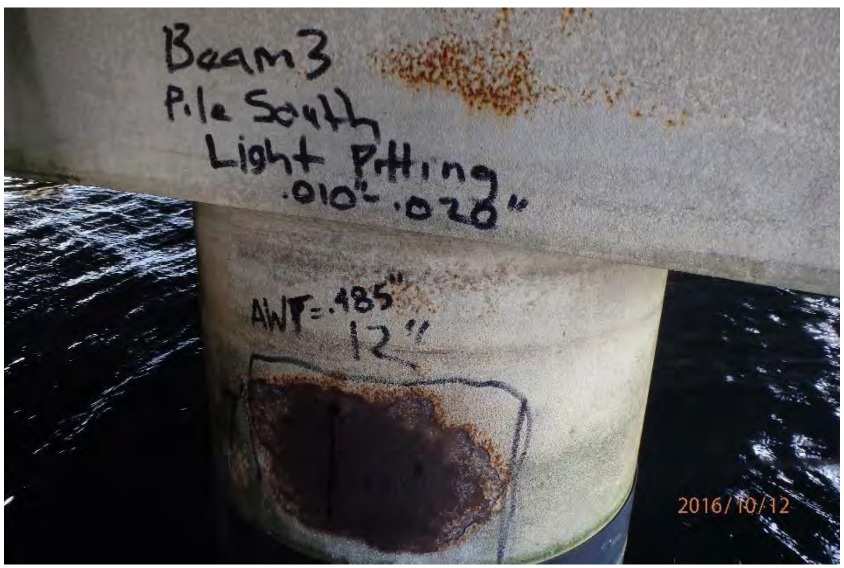
Beam 3 Pile, north side (UT Location 3)

Close-up of UT Location 3

Ketchikan Berth 1 Corrosion Examination

Pile cap weld, south side, under Beam 2 (UT Location 4)

Close-up of UT Location 4



Beam 3 piling, south side (UT Location 5)

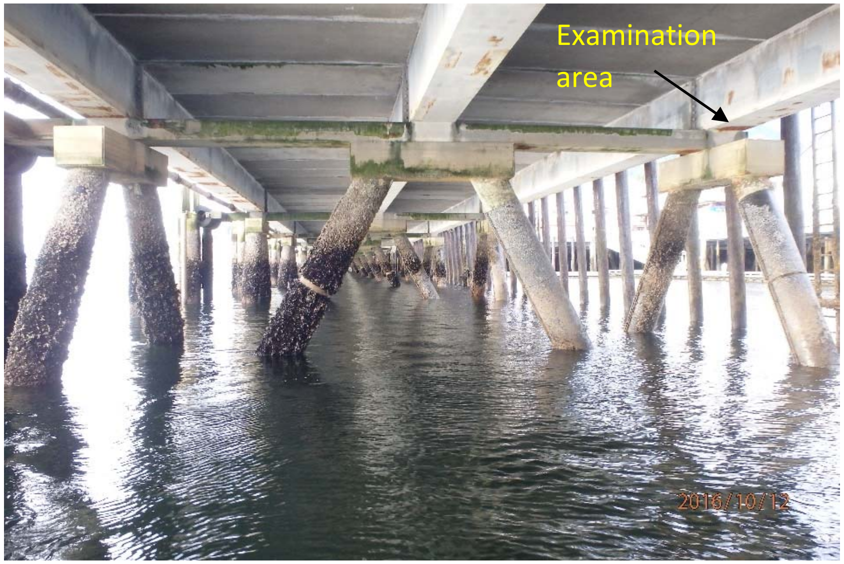
Close-up of UT Location 5

Ketchikan Berth 1 and 2 Corrosion Examination

Date: 10/14/2016
Start Time: 14:14
Bent No: South of 19
Exam. By: EGW, MCA

Summary:
The Beam 19 bottom surface is generally in fair to satisfactory condition, with coating failures on approximately 10 sq.ft. of the surface. Uniform corrosion is present within areas of failed coating. The area cleared of surface corrosion for examination contained moderate pitting. No significant thinning was observed or detected using UT.

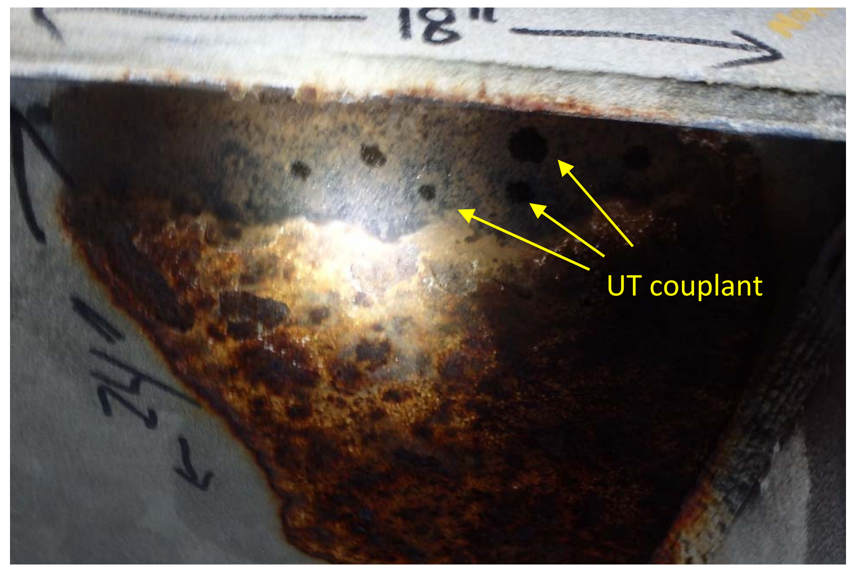
Component	Corrosion Notes	UT Location	UT Readings (mils)		Comments
			UT Loc.	AWT	
Beam 3, bottom side, south side of Bent 19 (between Bents 19 and 20)	Coating failure present with uniform surface corrosion and moderate pitting (max depth 60 mils or 0.060").	1. Area of failed coating, cleared for examination	1.	1505	Beam 3 is east side beam (box girder). Area of examination and UT dimensions 24" x 18". Nominal thickness: 1,540 mils Lowest RWT: 1,445 mils
			UT Loc.	AWT	
			2		
			UT Loc.	AWT	
			3		
			UT Loc.	AWT	
			4		



Overview of Bent 19 Beam 3, exam area, looking north

Beam 3 examination area, looking northwest

Beam 3 exam area marked with UT and pitting notes



Beam 3 exam area corrosion close-up

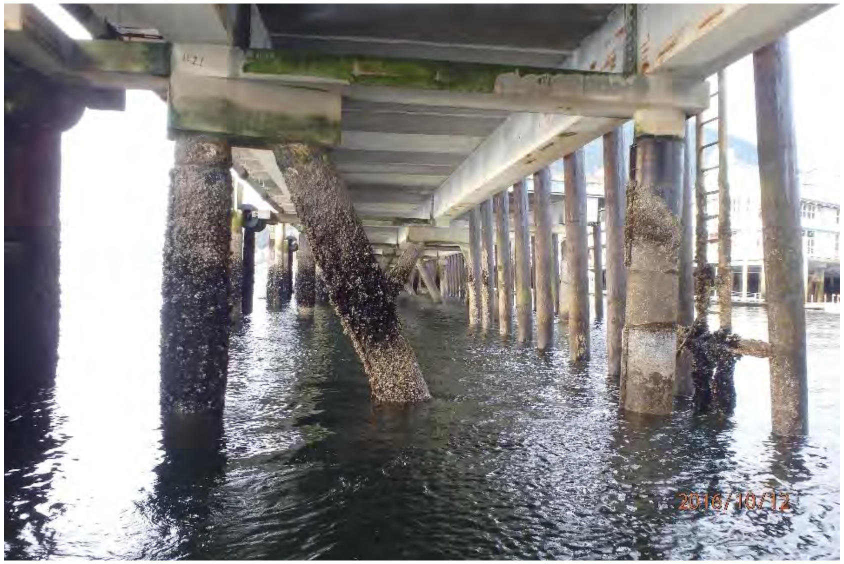
Ketchikan Berth 1 Corrosion Examination

Date: 10-13-16
Start Time: 9:30
Bent No: 21
Exam. By: EGW, MCA

Summary:
Areas cleared for corrosion examination were in fair to good condition. Light surface corrosion and Light pitting (up to 5 mils) were present at examination areas. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	Corrosion Notes	UT Location	UT Readings (mils)		Comments:
			UT Loc.	AWT	
Beam 1, piling 1	Coating failure area on piling near pile cap. Minor pitting (max depth 25 mils) and uniform surface corrosion present.	1. In area cleared for corrosion examination, near top of piling	1	473	Rough dimensions of examination area are 6” x 15” Nominal Thickness: 500 mils Lowest RWT: 448 mils
			UT Loc.	AWT	
Beam 1, piling 2	Coating failure area on piling near pile cap. Minor pitting (max depth 20 mils) and uniform surface corrosion present.	2. In area cleared for visual examination, near flange and bottom of beam	2	483	Rough dimensions of examination area are 8”x8” Nominal Thickness: 500 mils Lowest RWT:463 mils
			UT Loc.	AWT	
Beam 2, south side, seaward face	Coating failure with minor pitting to max depth 20 mils Coating DFT: 18-31 mils	3. In area cleared for corrosion examination	3	447	Rough dimensions of examination area are 12x5” Nominal Thickness: 438 mils Lowest RWT: 427 mils

Ketchikan Berth 1 Corrosion Examination



Bent 21 Overview (looking north)

Pile 1, corrosion above pile jacket. (UT Location 1)

Pile 2, corrosion above pile jacket (UT Location 2)

Beam 2 south, seaward side (UT Location 3)

Ketchikan Berth 1 Corrosion Examination

Pile 1 pile sleeve.

Piling condition at pile sleeve.

Ketchikan Berth 1 Corrosion Examination

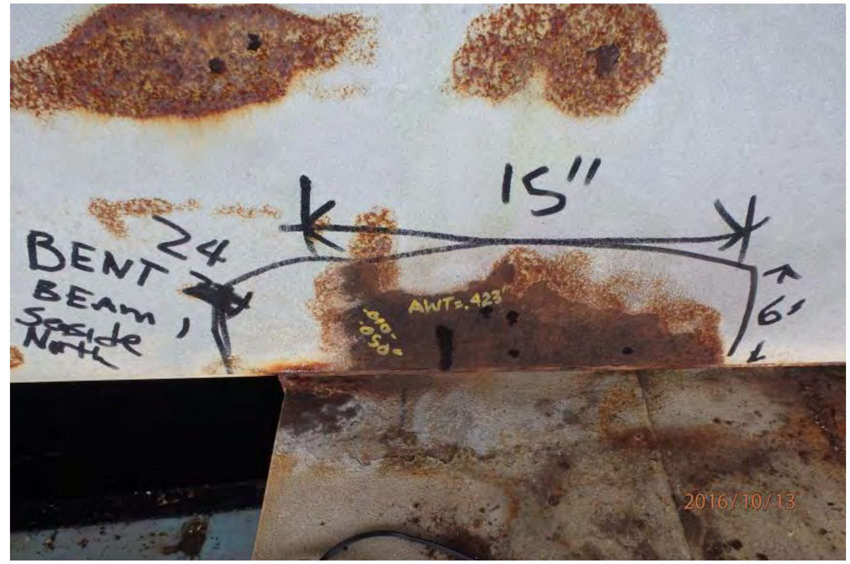
Date: 10-13-16
Start Time: 11:30
Bent No: 24
Exam. By: EGW, MCA

Summary:
Areas cleared for corrosion examination or found uncoated were in fair to good condition. Moderate surface corrosion and moderate pitting (up to 50 mils) were present at examination areas. Ultrasonic thickness testing did not indicate significant thinning at any location.

Component	**Corrosion Notes**	**UT Location**	**UT Readings (mils)**		**Comments:**
			UT Loc.	AWT	
Beam 1, sea side, north of piling cap	Coating repair area with failed coating. Moderate pitting (max depth 50 mils) and uniform surface corrosion present. Coating DFT:14-19 mils	1. In area cleared for corrosion examination, near bottom of beam	1	423	Rough dimensions of examination area are 24" x 15" Nominal Thickness: 438 mils Lowest RWT: 373 mils
			UT Loc.	AWT	
Pile cap, sea side of beam 1.	Coating failure area with moderate pitting present to max depth of 45 mils. Coating DFT:17-22 mils	2. In area cleared for visual examination, near edge of pile cap	2	503	Rough dimensions of examination area are 4"x8" Nominal Thickness: 505 mils Lowest RWT: 458 mils

Ketchikan Berth 1 Corrosion Examination

Bent 24 Overview (looking south)



Beam 1 corrosion at pile cap.(Location 1)

piling cap (UT Location 2)

Pile sleeve, no corrosion

APPENDIX C

Site Photos

Figure 1: Gangway and small boat dock to the east (shore side) of Berths 1 & 2

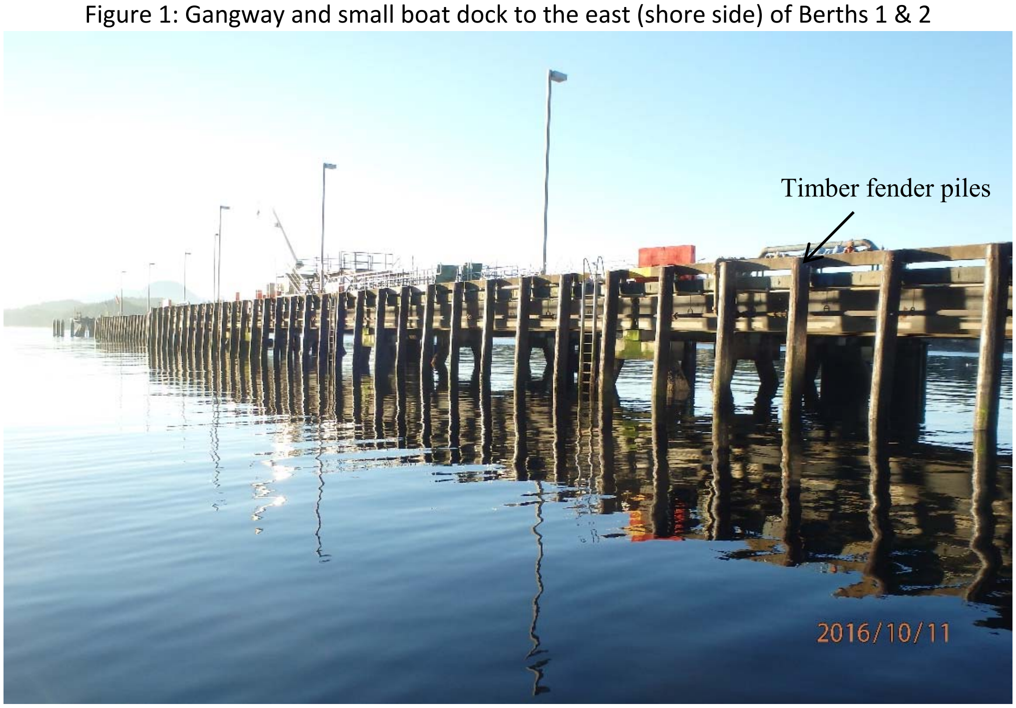


Figure 2: Overview of east side of Berths 1 & 2

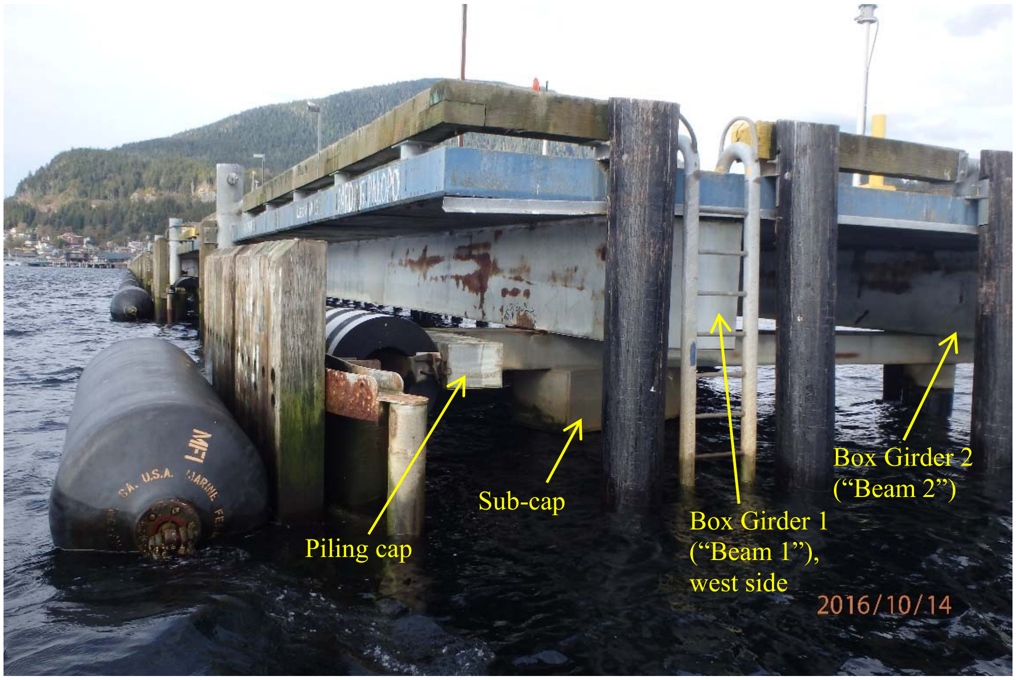


Figure 3: South end of Berths 1 & 2 (Bent 24)

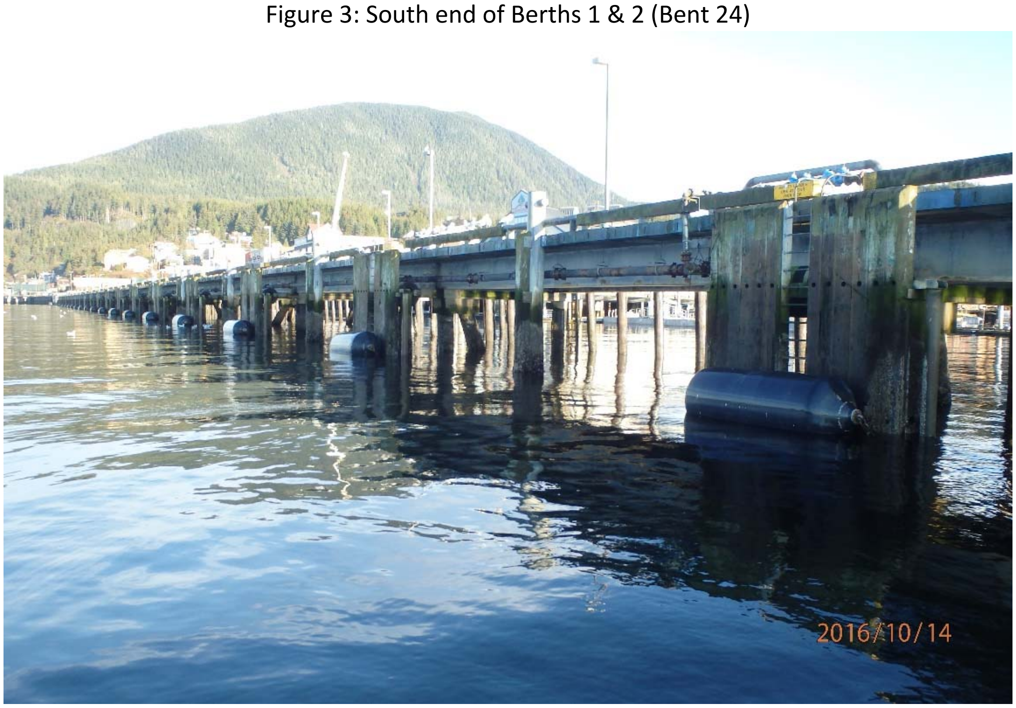


Figure 4: Overview of west side of Berths 1 & 2

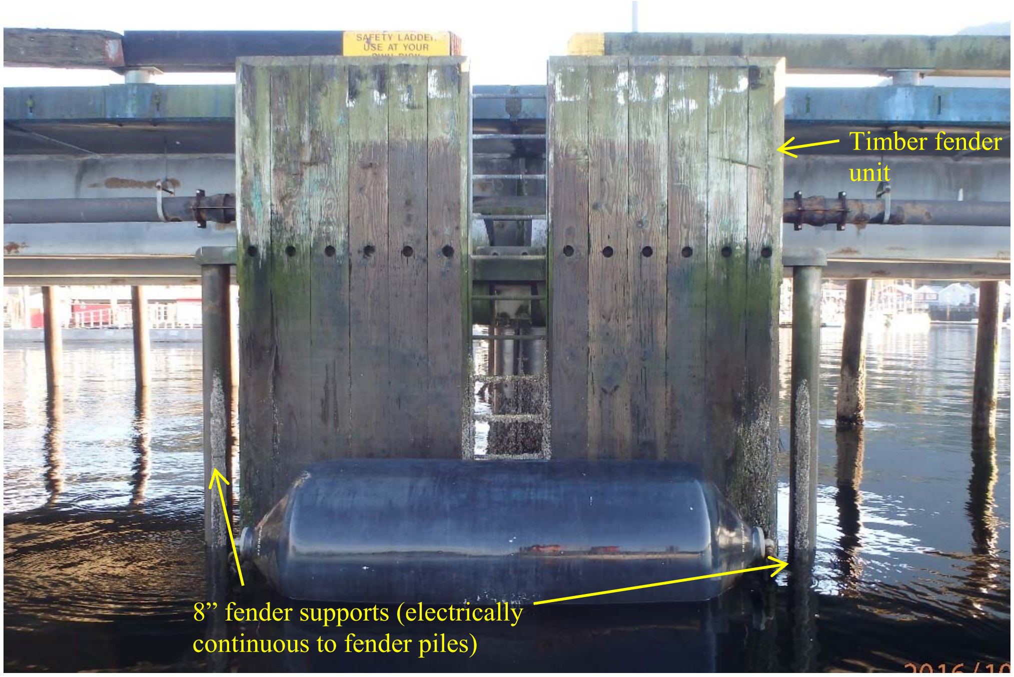


Figure 5: Typical fender arrangement, west side of dock

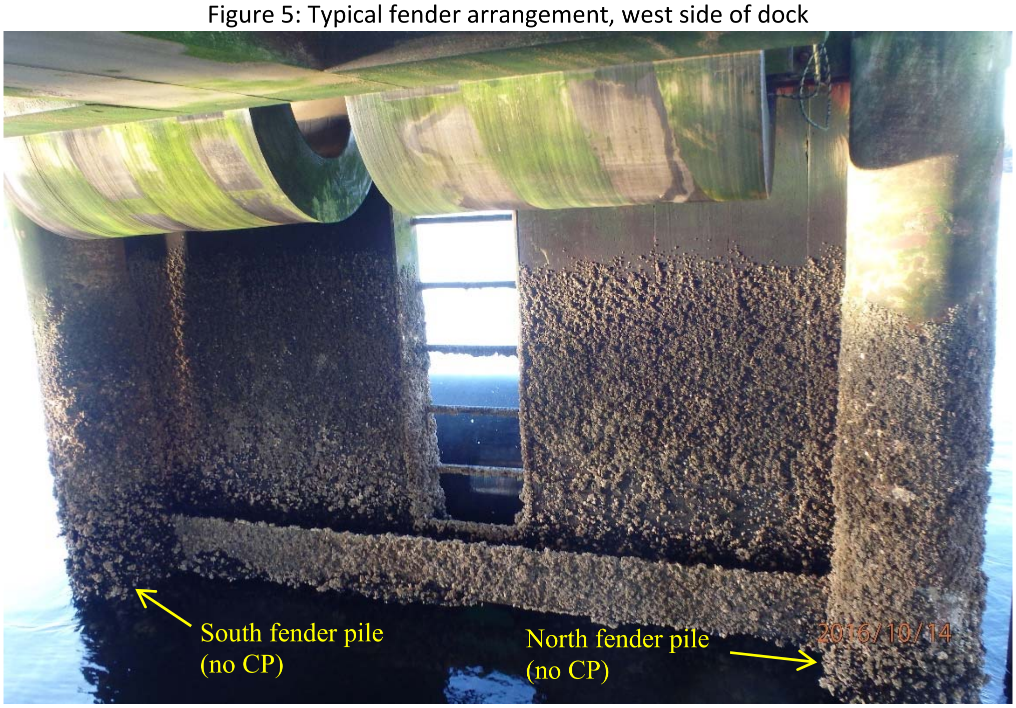


Figure 6: Back side of fender arrangement

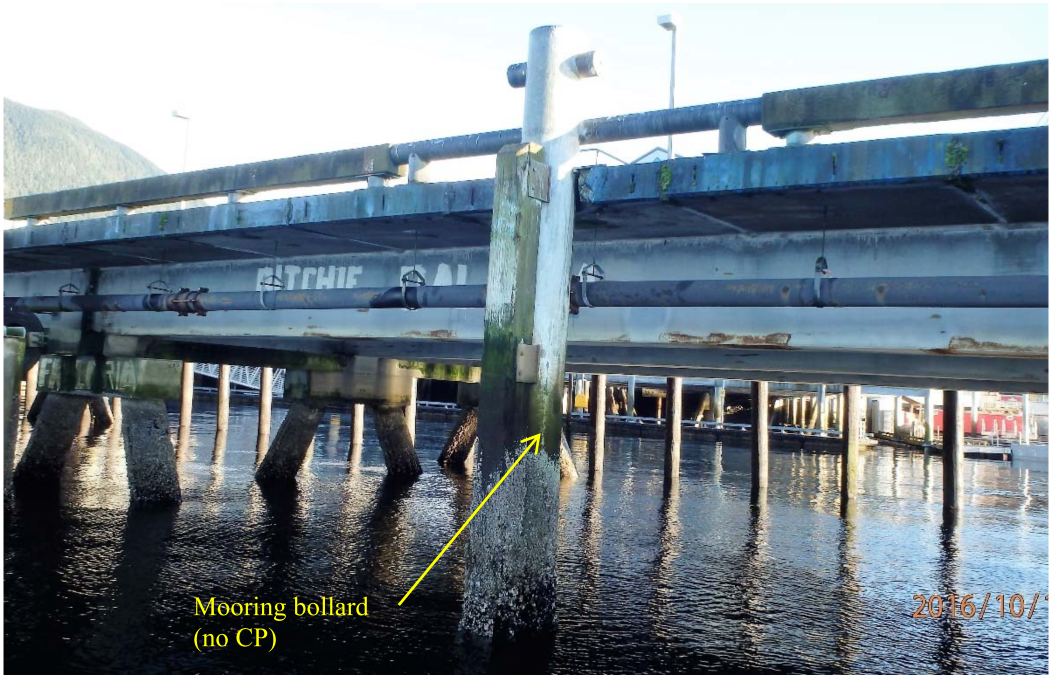


Figure 7: Typical mooring bollard (22 total)

Figure 8: Water line (6”) and hanger supports beneath berth

Figure 9: Water line hanger running east/west between Bents 13 and 14

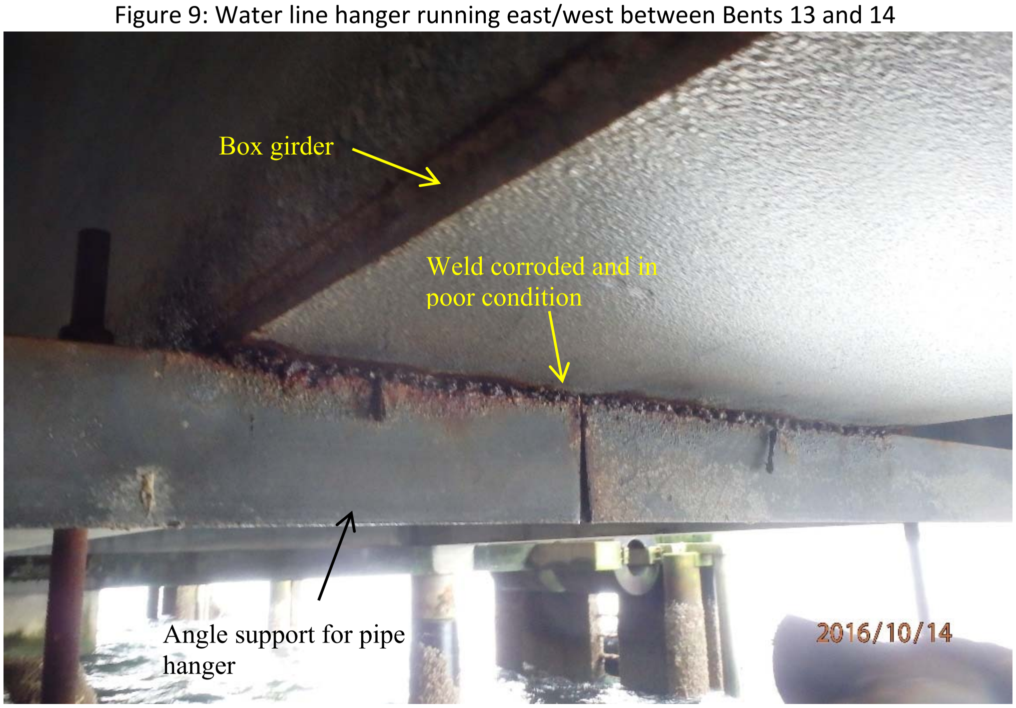


Figure 10: Pipe hanger angle structure, north side weld to box girder

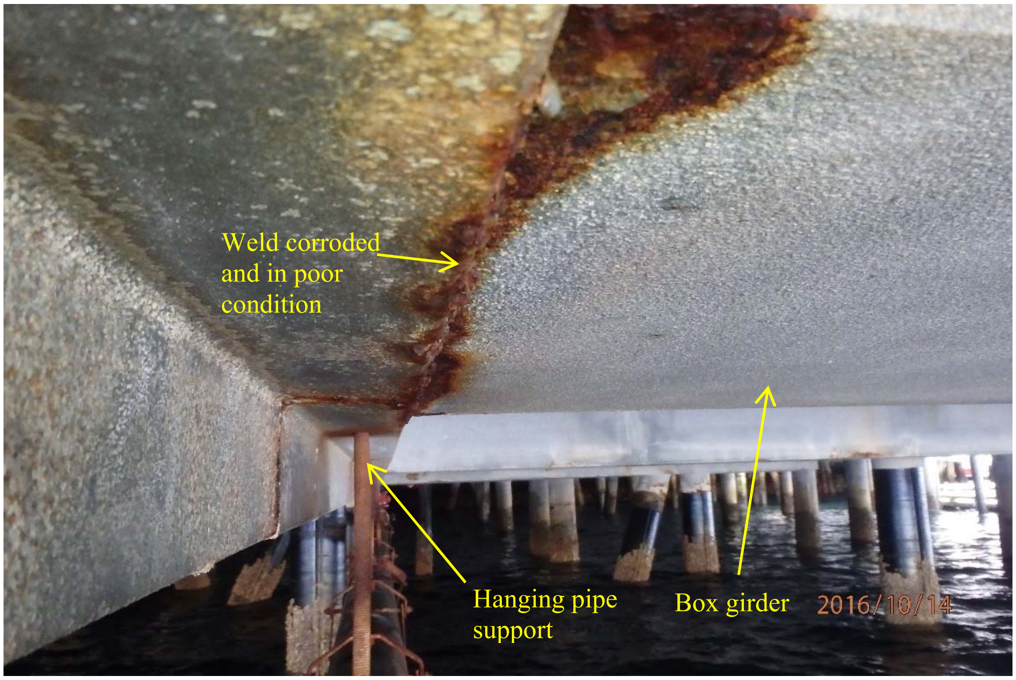


Figure 11: South side of angle support at pipe hanger

Figure 12: High water mark on box girder (Taken 12:18 on 10/14/16, high tide 16.7 ft)

Figure 13: Box girder gap between Bents 7 and 8 (gap present on both box girders)

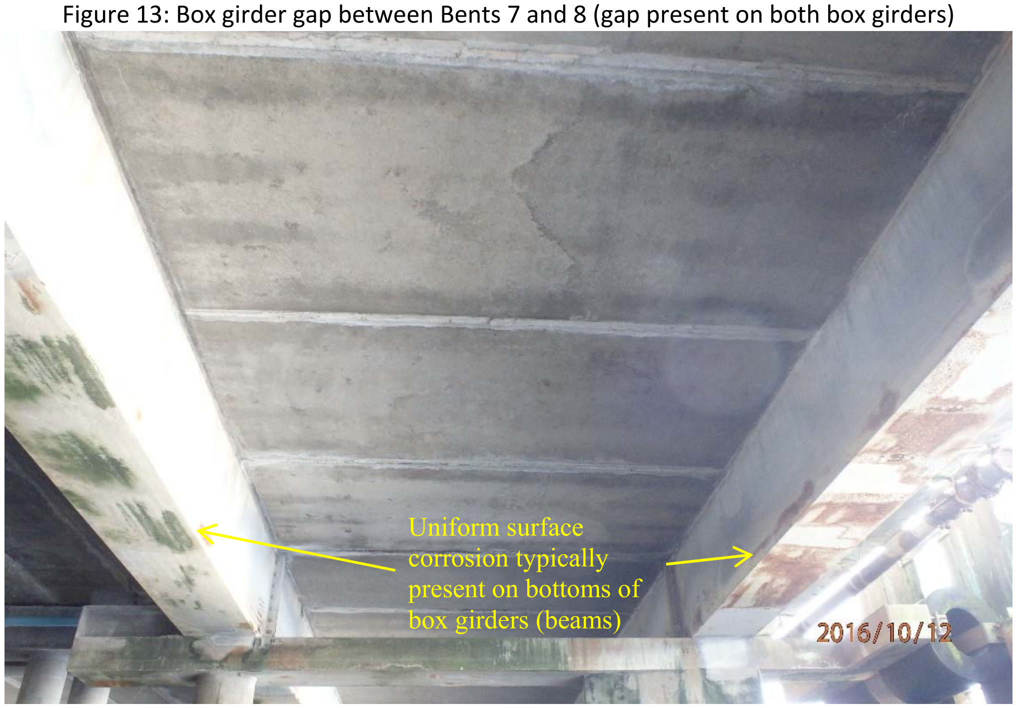


Figure 14: Typical underside of concrete deck panel and girder bottom sides with surface corrosion

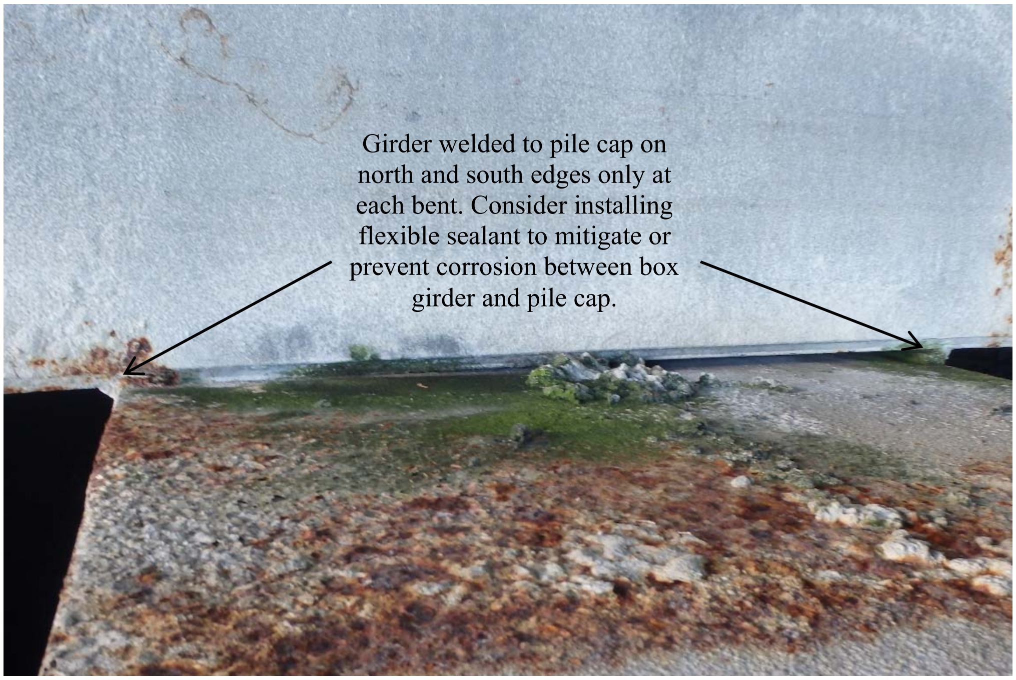


Figure 15: Typical box girder/pile cap interface with gap

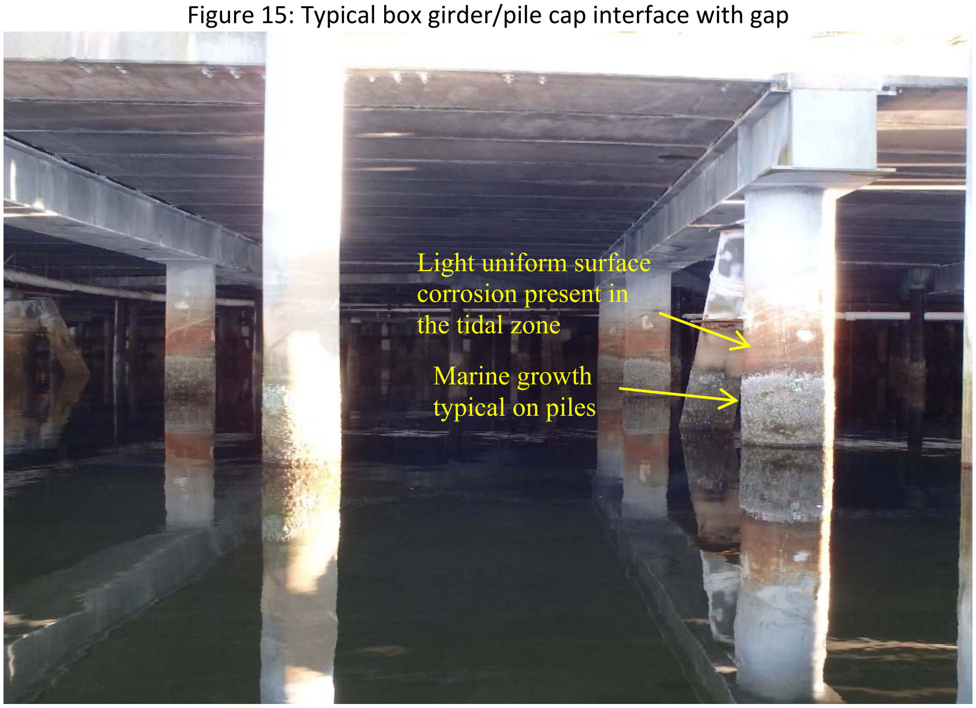


Figure 16: Berth 3 piles overview

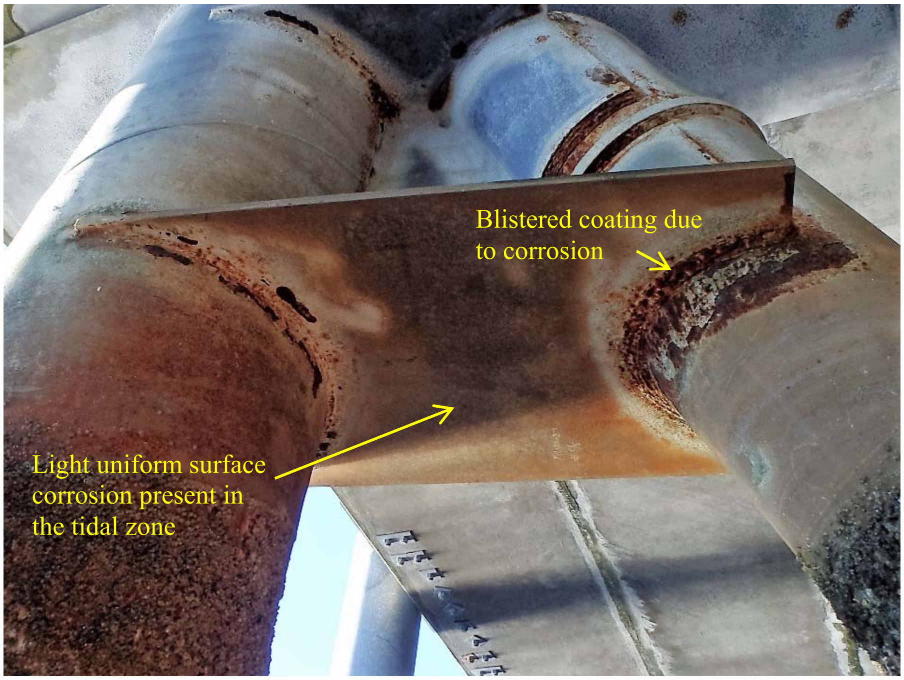


Figure 17: Berth 3 typical pile surfaces with uniform surface corrosion and coating blistering

Figure 18: Close-up of typical light surface corrosion on Berth 3 pile

APPENDIX D

Drawings

Berth 3 Piling Cathodic Protection Reading Locations

Notes:

Piling CP potential data collected at these locations.

NOTES:
1. BATTER PILES MAY VARY, AS SHOWN, ± 10' TO MISS ADJACENT VERTICAL PILES, TYP. UNLESS NOTED OTHERWISE.
2. SEE PILE SCHEDULE FOR PILE SIZES AND DETAILS.

LEGEND

SLEEVE THRU CAP (COORDINATE WITH RESTROOM, ARCHITECTURAL AND MECHANICAL FOR LOCATIONS)

PLAN

0 5 10 20 30 FT.

3/28/06
Drawings\2005\054048.01 Ketchikan berth Expansion\Design Drawings\100% Submittal\054048.01-S4.02.dwg

City of Ketchikan

P N D Incorporated CONSULTING ENGINEERS

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STATE OF ALASKA 49TH Todd Nottingham CE-7958 REGISTERED PROFESSIONAL ENGINEER

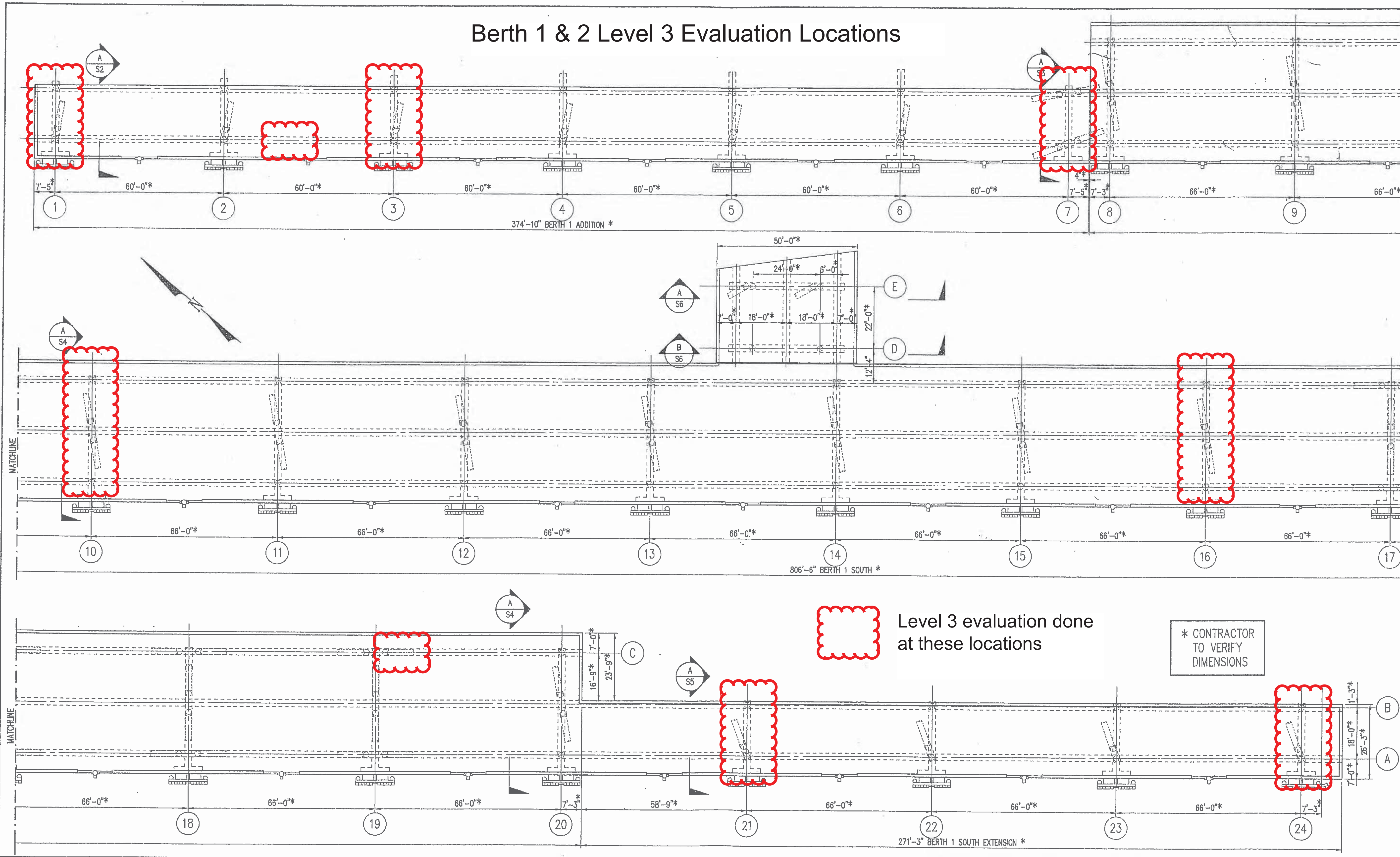
REVISIONS

REV	DATE	DESCRIPTION

PROJECT: CITY OF KETCHIKAN PORT BERTH RECONFIGURATION

TITLE: BERTH III PLATFORM PILE AND CAP PLAN

DESIGNED BY:	BKP	PROJECT NO:	054048.01	SHEET NO:
DRAWN BY:	GRD	DATE:	APRIL 3, 2006	S4.02
CHECKED BY:	TN	SCALE:	NOTED	



kpff Consulting Engineers 1601 Fifth Avenue, Suite 1600 Seattle, Washington 98101 (206) 622-5822 Fax (206) 622-8130		
NO.	DATE	BY

REVISION

City of Ketchikan

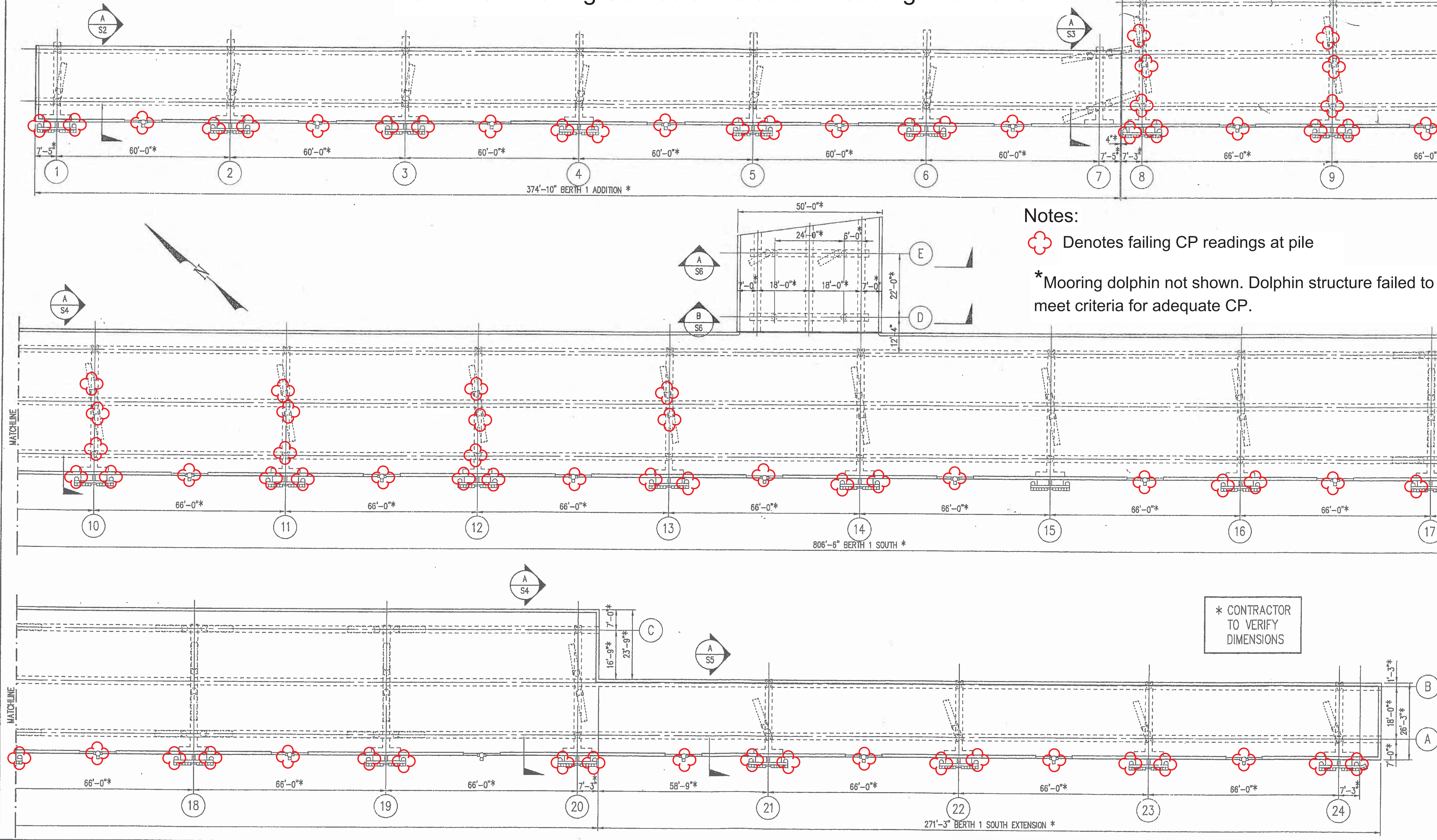
BERTH 1 REHABILITATION & UPGRADE
KETCHIKAN, ALASKA

BERTH 1 REHABILITATION
OVERALL PLAN

DRAWN: RRT	PROJECT NO.: 104561
DESIGN: DKM	SCALE: 1/16"=1'-0"
CHECKED: DKM	DATE: NOV. 14, 2005
DRAWING NO.	S1
SHEET NO.	8 OF 18

V:\104561.20 (Ketchikan Berth 1)\Design\SHB1-S01.dwg KPFF Plot Layout Nov 08, 2005 11:19am RickT

Berth 1 & 2 Failing Cathodic Protection Reading Locations



Notes:

Denotes failing CP readings at pile

*Mooring dolphin not shown. Dolphin structure failed to meet criteria for adequate CP.

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

NO.	DATE	BY	REVISION

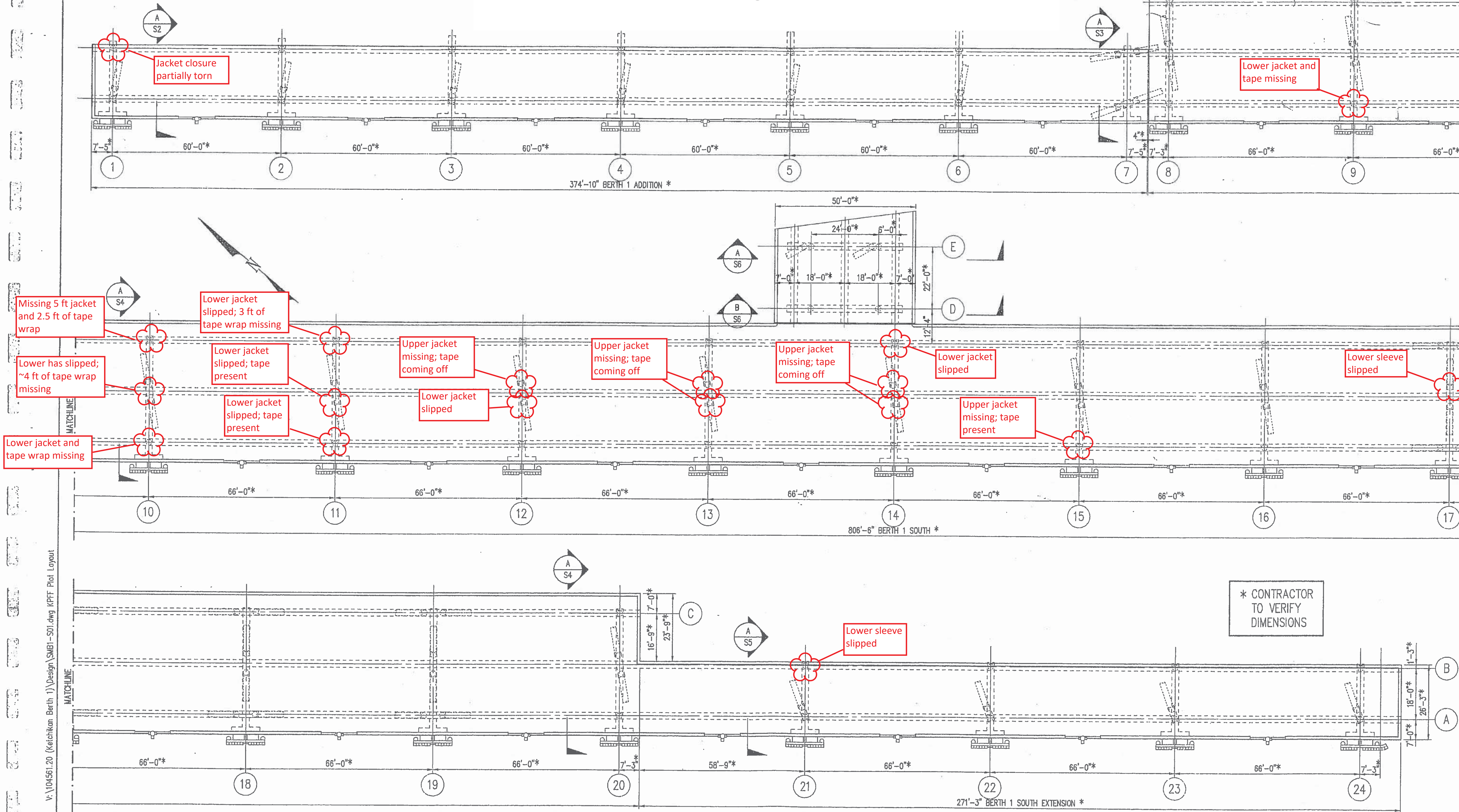
City of Ketchikan

BERTH 1 REHABILITATION & UPGRADE
KETCHIKAN, ALASKA

BERTH 1 REHABILITATION
OVERALL PLAN

DRAWN: RRT	PROJECT NO.: 104561
DESIGN: DKM	SCALE: 1/16"=1'-0"
CHECKED: DKM	DATE: NOV. 14, 2005
DRAWING NO.	S1
SHEET NO.	8 OF 18

Berth 1 & 2 Pile Jacket Damage Locations and Notes



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Nov 08, 2005 11:19am RickT

kpff Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, Washington 98101
(206) 622-5822 Fax (206) 622-8130

State of Alaska, 49th, Izzat H. Hasayen, No. CE9040, Registered Professional Engineer

NO.	DATE	BY	REVISION

City of Ketchikan

BERTH 1 REHABILITATION & UPGRADE
KETCHIKAN, ALASKA

BERTH 1 REHABILITATION
OVERALL PLAN

DRAWN: RRT	PROJECT NO.: 104561
DESIGN: DKM	SCALE: 1/16"=1'-0"
CHECKED: DKM	DATE: NOV. 14, 2005
DRAWING NO.	S1
SHEET NO.	8 OF 18

APPENDIX E

Berth 1 & 2 Damage Area Preliminary Estimate

Berth 1 and 2 Damage and Corrosion Area Preliminary Estimate

Area of Bents Selected for Level 3 Evaluation

Bent	Pilings (ft^2)	Subcap (ft^2)	Pile cap, incl "T" end (ft^2)	SA of Bent (ft^2)	
1	37.70	56.25	245.32	339.27	
3	37.70	56.25	263.22	357.17	
7	50.27	171.00	291.86	513.13	
10	50.27	85.50	367.04	502.81	
16	50.27	85.50	367.04	502.81	
21	37.70	56.25	238.16	332.11	
24	37.70	56.25	238.16	332.11	
				2,879	ft^2

Basis and Assumptions:

- Two feet of exposed pile surface above jacketing.
- Box girder (beam) areas estimated on separate sheet but included in totals
- Fender and bollard piles not included
- Based on dimensions from KPFF drawings.
- Assumes bents not selected have same average corroded or damaged as those selected for L3 eval.
- Includes bent structural components and box girders (beams).
- Includes minor corrosion and any other areas of visible surface corrosion

Visual Corrosion/Coating Damage Area Estimate for Bents Selected for Level 3 Examination

Bent	Pilings (ft^2)	Subcap (ft^2)	Pile cap, incl "T" end (ft^2)	:orroded Area (ft^2)	
1	15.08	2.81	24.53	42.42	
3	3.77	39.38	78.97	122.11	
7	2.51	17.10	29.19	48.80	
10	20.11	34.20	146.82	201.12	
16	20.11	25.65	183.52	229.28	
21	7.54	22.50	95.26	125.30	
24	3.77	11.25	23.82	38.84	
				808	ft^2
				28%	Percent corroded or damaged on Level 3 examined bents

Area of Bents NOT Selected for Level 3 Evaluation

Bent	Pilings (ft^2)	Subcap (ft^2)	Pile cap, incl "T" end (ft^2)	SA of Bent (ft^2)	
2	37.70	56.25	254.27	348.22	
4	50.27	85.50	270.38	406.15	
5	50.27	85.50	277.54	413.31	
6	37.70	56.25	284.70	378.65	
8	37.70	56.25	367.04	460.99	
9	37.70	56.25	367.04	460.99	
11	37.70	56.25	367.04	460.99	
12	37.70	56.25	367.04	460.99	
13	37.70	56.25	367.04	460.99	
14	37.70	56.25	367.04	460.99	
15	37.70	56.25	367.04	460.99	
17	37.70	56.25	367.04	460.99	
18	37.70	56.25	367.04	460.99	
19	37.70	56.25	367.04	460.99	
20	37.70	56.25	367.04	460.99	
22	37.70	56.25	238.16	332.11	
23	37.70	56.25	238.16	332.11	
				7,281	ft^2

Corrosion/Coating Damage Area Estimate for Bents Not Selected for Level 3 Examination

= surface area * percent corroded (L3 eval bents)

2,043 ft^2 corroded/damaged area

Assumes same % corroded area as Level 3 examined bents

Area of Fender Piles and Mooring Bollards

Component	Qty	Diameter, in	Exposed Length, ft.	Total Area, ft^2	
Fender Pile	48	16	10	2011	
Fndr. Support Pile	48	8	10	1005	
Mooring Bollard	22	20	1	115	
				3,131	ft^2

Corrosion/Coating Damage Area Estimate for Fender Piles and Mooring Bollards

= surface area * percent corroded (L3 eval bents)

878 ft^2 corroded/damaged area

Assumes same % corroded area as Level 3 examined bents

Estimated Total Area of Corrosion/Damaged Coating for Berth 1 & 2:	8,576	ft^2
Estimated Total Area of Structure:	46,824	ft^2
Estimated Overall Percent Corroded or Damaged:	18%	

Berth 1 and 2 Damage and Corrosion Area Preliminary Estimate -- Box Girders

Visual Corrosion/Coating Damage Area Estimate for Box Girders

Bent	Beam	Est. Percent Damaged	Length (ft)	Beam SA (ft^2)	Corroded SA (ft^2)	
1-2	1	25	60	540.00	135	
	2	30	60	570.00	171	
2-3	1	75	60	540.00	405	
	2		60	570.00	20	
3-4	1		60	540.00	30	
	2		60	570.00	20	
4-5	1		60	540.00	5	
	2		60	570.00	5	
5-6	1		60	540.00	5	
	2		60	570.00	5	
6-7	1	25	60	540.00	135	
	2		60	570.00	10	
7-8	1		7.5	67.50	2	
	2		7.5	71.25	2	
8-9	1		66	594.00	10	
	2	20	66	627.00	125.4	
	3	40	66	594.00	237.6	
9-10	1		66	594.00	10	
	2		66	627.00	10	
	3	50	66	594.00	297	
10-11	1	25	66	594.00	148.5	
	2		66	627.00	20	
	3	40	66	594.00	237.6	
11-12	1	50	66	594.00	297	
	2		66	627.00	10	
	3	50	66	594.00	297	
12-13	1		66	594.00	30	
	2		66	627.00	10	
	3		66	594.00	10	
13-14	1		66	594.00	50	
	2		66	627.00	10	
	3		66	594.00	10	
14-15	1		66	594.00	30	
	2	50	66	627.00	313.5	
	3	30	66	594.00	178.2	
15-16	1		66	594.00	15	
	2		66	627.00	30	
	3		66	594.00	5	
16-17	1		66	594.00	6	
	2	60	66	627.00	376.2	
	3		66	594.00	10	
17-18	1		66	594.00	4	
	2		66	627.00	30	
	3		66	594.00	6	
18-19	1		66	594.00	10	
	2		66	627.00	5	
	3		66	594.00	20	
19-20	1	50	66	594.00	297	
	2	30	66	627.00	188.1	
	3		66	594.00	10	
20-21	1		58.75	528.75	10	
	2		66	627.00	20	
21-22	1		66	594.00	2	
	2		66	627.00	30	
22-23	1		66	594.00	10	
	2		66	627.00	10	
23-24	1		73.25	659.25	10	
	2		73.25	695.88	10	
			Surface Area	33,532	4,406	(ft^2)
			10% for Girder Sides		441	(ft^2)
			Total SA Corroded or Damaged		4,847	(ft^2)
			Box Girders Percent Corroded		14%	

Basis and Assumptions:

- Damage area is based on field estimate for each beam (box girder).
- The large majority of damage was found on the beam bottom surfaces and not on sides of beams.
- Includes minor corrosion and any other areas of visible surface corrosion on beams.
- Damage percent estimate from field includes bottom of girders only. Very little corrosion or damage on sides of girders (primarily at bottom welds). 10% added for corrosion or damage on sides of beams.

Appendix C

Opinion of Probable Project Costs

Berth 1, 2, and 3 Corrosion and Cathodic Protection

Rock Pinnacle Removal

Berths 1 and 2 Option A

Berths 1 and 2 Option B

Berth 3 Option A

Berth 3 Option B

Berth 4 Option A

Berth 4 Option B

Berth 4 Option C

Berths 1, 2 and 3 Corrossion and Cathodic Protection Class 4 Opinion of Probable Project Cost (OPPC)								
				Base Estimate		Contingency		
Item No.	Description	Approx. Quantity	Unit	Unit Cost ($)	Estimated Cost (Rounded)	Low Estimate (-15%)	High Estimate (+30%)	Notes
1	**Mobilization and Demobilization**	1	LS	$215,200	$216,000	$183,600	$280,800	
2	**Blast and Spray-Metalize Failed Coating Areas (25%) Berths 1 and 2**	1	LS	$1,505,625	$1,506,000	$1,280,100	$1,957,800	See notes below for comparison of items 2 and 2a
2a	**Blast and Spray-Metalize Entire Dock Superstructure**	1	LS	$4,015,000	---	---	---	Item 2a not included in project summary costs; see notes below
3	**Furnish and Install Anodes on Support Piling Berths 1 and 2**	155	EA	$2,000	$310,000	$263,500	$403,000	
4	**Furnish and Install Anodes on Bollard/Fender Piling Berths 1 and 2**	68	EA	$1,500	$102,000	$86,700	$132,600	
5	**Furnish and Install Anodes Berth 3 Platform**	45	EA	$200	$9,000	$7,650	$11,700	
6	**Replace Damaged and Missing Pile Wrap Berths 1 and 2**	10	EA	$5,000	$50,000	$42,500	$65,000	
7	**Furnish and Install Pile Wrap Berth 3**	35	EA	$5,000	$175,000	$148,750	$227,500	
					BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
				Project Construction Subtotal	**$2,368,000**	**$2,013,000**	**$3,078,000**	
				Survey, Planning, Permitting, Design and Bid Documents (10%)	$272,000	$201,000	$308,000	
				Contract Administration, Inspection & Other Indirects (20%)	$491,000	$447,000	$684,000	
				Total Project Cost (Rounded)	**$3,131,000**	**$2,661,000**	**$4,070,000**	(Rounded)

Notes:

1. All costs shown are in 2016 USD and are rounded to the nearest thousand dollars.
2. Class 4 Estimate as defined by AACE international Recommended Practice.
3. Item 2a, cost of blasting and spray-metalizing entire superstructure shown for comparison, only; not included in project totals.
4. Estimated costs for Items 2 and 2a are not directly proportional due to economy of scale. 25% failed coating, includes an allowance for continual coating failure prior to construciton.
5. Includes only periodic site inspection during construction.

Pinnacle Removal Class 5 Opinion of Probable Project Cost (OPPC)

Item No.	Description	Approx. Quantity	Unit	Base Estimate		Contingency		Notes
				Unit Cost ($)	Estimated Cost (Rounded)	Low Estimate (-30%)	High Estimate (+50%)	
1	**MOBILIZATION, DEMOBILIZATION**	1	LS	$500,000	$500,000	$350,000	$750,000	
2	**COMPLIANCE WITH REGULATORY REQUIREMENTS**	1	LS	$500,000	$500,000	$350,000	$750,000	Wildlife observers, monitoring, etc.
3	**CONSTRUCTION BATHYMETRIC SURVEY**	1	LS	$500,000	$500,000	$350,000	$750,000	
4	**PINNACLE REMOVAL AND DISPOSAL**	1	LS	$2,000,000	$2,000,000	$1,400,000	$3,000,000	Highly dependent on Bathymetric and Geotechnical Conditions
					BASE ESTIMATE	**LOW ESTIMATE**	**HIGH ESTIMATE**	
	Project Construction Subtotal				**$3,500,000**	**$2,450,000**	**$5,250,000**	
	Survey, Planning, Permitting, Design and Bid Documents (25%)				$875,000	$613,000	$1,313,000	Assumes moderate level of geotechnical investigation and permitting
	Contract Administration, Inspection & Other Indirects (10%)				$350,000	$245,000	$525,000	
	Total Project Cost (Rounded)				**$4,725,000**	**$3,308,000**	**$7,088,000**	(Rounded)

Notes:
1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollars.
2. Class 5 Estimate as defined by AACE international Recommended Practice.

Ketchikan Berths 1 and 2 Option A Class 4 Opinion of Probable Project Cost (OPPC)

Item No.	Description	Approx. Quantity	Unit	BASE ESTIMATE		CONTINGENCY ESTIMATE		Notes
				Unit Cost ($)	Estimated Cost (ROUNDED)	LOW ESTIMATE (-15%)	HIGH ESTIMATE (+30%)	
1	MOBILIZATION AND DEMOBILIZATION	1	LS	$5,000,000	$5,000,000	$4,250,000	$6,500,000	
2	CONSTRUCTION SURVEY	1	LS	$300,000	$300,000	$260,000	$390,000	
3	SELECTIVE DEMOLITION AT BERTH 1 DOCK FACE	1	LS	$125,000	$130,000	$110,000	$170,000	Bullrail, fenders, bollards, etc.
4	SELECTIVE DEMOLITION AT BERTH 2 DOCK FACE	1	LS	$150,000	$150,000	$130,000	$200,000	Bullrail, fenders, bollards, etc.
5	DOCK FACE MODIFICATIONS AT BERTH 1	1	LS	$100,000	$100,000	$90,000	$130,000	
6	DOCK FACE MODIFICATIONS AT BERTH 2	1	LS	$250,000	$250,000	$210,000	$330,000	
7	ACCESS PLATFORM AT BERTH 1	1	EA	$250,000	$250,000	$210,000	$330,000	
8	ACCESS PLATFORMS AT BERTH 2	2	EA	$250,000	$500,000	$430,000	$650,000	
9	GANGWAY AT BERTH 1	1	EA	$200,000	$200,000	$170,000	$260,000	
10	GANGWAYS AT BERTH 2	2	EA	$200,000	$400,000	$340,000	$520,000	
11	50'x400' FLOATING DOCK AT BERTH 1	20,000	SF	$350	$7,000,000	$5,950,000	$9,100,000	
12	50'x400' FLOATING DOCK AT BERTH 2	20,000	SF	$350	$7,000,000	$5,950,000	$9,100,000	
13	FURNISH STEEL PIPE PILES BERTH 1	27	EA	$61,250	$1,660,000	$1,410,000	$2,160,000	Includes platform and dolphin piling
14	FURNISH STEEL PIPE PILES BERTH 2	20	EA	$61,250	$1,230,000	$1,050,000	$1,600,000	Includes platform and guide piling
15	INSTALL STEEL PIPE PILES AT BERTH 1	27	EA	$30,000	$810,000	$690,000	$1,050,000	Includes Splicing
16	INSTALL STEEL PIPE PILES AT BERTH 2	19	EA	$30,000	$570,000	$480,000	$740,000	Includes Splicing
17	ANCHOR AND SOCKET PILES AT BERTH 1	15	EA	$150,000	$2,250,000	$1,910,000	$2,930,000	Assumes some piles will req anchoring
18	ANCHOR AND SOCKET PILES AT BERTH 2	10	EA	$150,000	$1,500,000	$1,280,000	$1,950,000	Assumes some piles will req anchoring
19	NEW MOORING/BREASTING/REACTION DOLPHIN CAPS AT BERTH 1	5	EA	$300,000	$1,500,000	$1,280,000	$1,950,000	Includes cap and appurtenances
20	NEW BREASTING DOLPHIN CAPS AT BERTH 2	2	EA	$300,000	$600,000	$510,000	$780,000	Includes cap and appurtenances
21	POWER AND LIGHTING AT BERTH 1	1	LS	$175,000	$180,000	$150,000	$230,000	
22	POWER AND LIGHTING AT BERTH 2	1	LS	$100,000	$100,000	$90,000	$130,000	
23	POWER AND LIGHTING TO BERTH 1 MOORING DOLPHIN	1	LS	$250,000	$250,000	$210,000	$330,000	
24	POTABLE WATER SYSTEM AT BERTH 1	1	LS	$100,000	$100,000	$90,000	$130,000	
25	POTABLE WATER SYSTEM AT BERTH 2	1	LS	$100,000	$100,000	$90,000	$130,000	
26	SAFETY EQUIPMENT AND APPURTENENCES AT BERTH 1	1	LS	$25,000	$30,000	$30,000	$40,000	
27	SAFETY EQUIPMENT AND APPURTENENCES AT BERTH 2	1	LS	$25,000	$30,000	$30,000	$40,000	
28	PNEUMATIC FENDER SYSTEM AT BERTH 1	20	EA	$30,000	$600,000	$510,000	$780,000	
29	PNEUMATIC FENDER SYSTEM AT BERTH 2	20	EA	$30,000	$600,000	$510,000	$780,000	
30	NEW CAPSTANS AT BERTH 1	3	EA	$20,000	$60,000	$50,000	$80,000	
31	NEW CAPSTANS AT BERTH 2	2	EA	$20,000	$40,000	$30,000	$50,000	
32	NEW CATWALKS AT BERTH 1	2	EA	$75,000	$150,000	$130,000	$200,000	
33	NEW CATWALKS AT BERTH 2	2	EA	$75,000	$150,000	$130,000	$200,000	
34	CATHODIC PROTECTION	1	LS	$600,000	$600,000	$510,000	$780,000	

	BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
Project Construction Subtotal	**$34,390,000**	**$29,270,000**	**$44,740,000**	
Survey, Planning, Permitting, Design and Bid Documents (10%)	$3,439,000	$2,927,000	$4,474,000	
Contract Administration, Inspection & Other Indirects (5%)	$1,720,000	$1,464,000	$2,237,000	
Total Project Cost (Rounded)	**$39,549,000**	**$33,661,000**	**$51,451,000**	(Rounded)

<u>Notes:</u>

1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice

Ketchikan Berths 1 and 2 Option B Class 4 Opinion of Probable Project Cost (OPPC)

Item No.	Description	Approx. Quantity	Unit	Base Estimate Unit Cost ($)	Estimated Cost (Rounded)	Contingency Low Estimate (-15%)	High Estimate (+30%)	Notes
1	MOBILIZATION AND DEMOBILIZATION	1	LS	$5,000,000	$5,000,000	$4,250,000	$6,500,000	
2	CONSTRUCTION SURVEY	1	LS	$300,000	$300,000	$260,000	$390,000	
3	SELECTIVE DEMOLITION AT BERTH 1 DOCK FACE	1	LS	$150,000	$150,000	$130,000	$200,000	Bullrail, fenders, bollards, etc.
4	SELECTIVE DEMOLITION AT BERTH 2 DOCK FACE	1	LS	$170,000	$170,000	$140,000	$220,000	Bullrail, fenders, bollards, etc.
5	DOCK FACE MODIFICATIONS AT BERTH 1	1	LS	$100,000	$100,000	$90,000	$130,000	
6	DOCK FACE MODIFICATIONS AT BERTH 2	1	LS	$250,000	$250,000	$210,000	$330,000	
7	ACCESS PLATFORM AT BERTH 1	1	EA	$250,000	$250,000	$210,000	$330,000	
8	ACCESS PLATFORMS AT BERTH 2	2	EA	$250,000	$500,000	$430,000	$650,000	
9	GANGWAY AT BERTH 1	2	EA	$200,000	$400,000	$340,000	$520,000	
10	GANGWAYS AT BERTH 2	2	EA	$200,000	$400,000	$340,000	$520,000	
11	50'x400' FLOATING DOCK AT BERTH 1	20,000	SF	$350	$7,000,000	$5,950,000	$9,100,000	
12	50'x300' FLOATING DOCK AT BERTH 2	15,000	SF	$350	$5,250,000	$4,460,000	$6,830,000	
13	FURNISH STEEL PIPE PILES BERTH 1	26	EA	$61,250	$1,592,500	$1,350,000	$2,070,000	Includes platform and dolphin piling
14	FURNISH STEEL PIPE PILES BERTH 2	18	EA	$61,250	$1,102,500	$940,000	$1,430,000	Includes platform and guide piling
15	INSTALL STEEL PIPE PILES AT BERTH 1	26	EA	$30,000	$780,000	$660,000	$1,010,000	Includes Splicing
16	INSTALL STEEL PIPE PILES AT BERTH 2	18	EA	$30,000	$540,000	$460,000	$700,000	Includes Splicing
17	ANCHOR AND SOCKET PILES AT BERTH 1	15	EA	$150,000	$2,250,000	$1,910,000	$2,930,000	Assumes some piles will req anchoring
18	ANCHOR AND SOCKET PILES AT BERTH 2	10	EA	$150,000	$1,500,000	$1,280,000	$1,950,000	Assumes some piles will req anchoring
19	NEW MOORING/BREASTING/REACTION DOLPHIN CAPS AT BERTH 1	4	EA	$300,000	$1,200,000	$1,020,000	$1,560,000	Includes cap and appurtenances
20	NEW BREASTING DOLPHIN CAPS AT BERTH 2	2	EA	$300,000	$600,000	$510,000	$780,000	Includes cap and appurtenances
21	POWER AND LIGHTING AT BERTH 1	1	LS	$175,000	$175,000	$150,000	$230,000	
22	POWER AND LIGHTING AT BERTH 2	1	LS	$100,000	$100,000	$90,000	$130,000	
23	POWER AND LIGHTING TO BERTH 1 MOORING DOLPHIN	1	LS	$250,000	$250,000	$210,000	$330,000	
24	POTABLE WATER SYSTEM AT BERTH 1	1	LS	$100,000	$100,000	$90,000	$130,000	
25	POTABLE WATER SYSTEM AT BERTH 2	1	LS	$100,000	$100,000	$90,000	$130,000	
26	SAFETY EQUIPMENT AND APPURTENENCES AT BERTH 1	1	LS	$25,000	$25,000	$20,000	$30,000	
27	SAFETY EQUIPMENT AND APPURTENENCES AT BERTH 2	1	LS	$25,000	$25,000	$20,000	$30,000	
28	PNEUMATIC FENDER SYSTEM AT BERTH 1	20	EA	$30,000	$600,000	$510,000	$780,000	
29	PNEUMATIC FENDER SYSTEM AT BERTH 2	15	EA	$30,000	$450,000	$380,000	$590,000	
30	NEW CAPSTANS AT BERTH 1	3	EA	$20,000	$60,000	$50,000	$80,000	
31	NEW CAPSTANS AT BERTH 2	2	EA	$20,000	$40,000	$30,000	$50,000	
32	NEW CATWALKS AT BERTH 1	2	EA	$75,000	$150,000	$130,000	$200,000	
33	NEW CATWALKS AT BERTH 2	2	EA	$75,000	$150,000	$130,000	$200,000	
34	CATHODIC PROTECTION	1	LS	$600,000	$600,000	$510,000	$780,000	

	BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
Project Construction Subtotal	**$32,160,000**	**$27,350,000**	**$41,840,000**	
Survey, Planning, Permitting, Design and Bid Documents (10%)	$3,216,000	$2,735,000	$4,184,000	
Contract Administration, Inspection & Other Indirects (5%)	$1,608,000	$1,368,000	$2,092,000	
Total Project Cost (Rounded)	**$36,984,000**	**$31,453,000**	**$48,116,000**	(Rounded)

Notes:
1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice

Ketchikan Berth 3 Option A Class 4 Opinion of Probable Project Cost (OPPC)								
				Base Estimate		Contingency		
Item No.	Description	Approx. Quantity	Unit	Unit Cost ($)	Estimated Cost (Rounded)	Low Estimate (-15%)	High Estimate (+30%)	Notes
1	**MOBILIZATION AND DEMOBILIZATION**	1	LS	$1,000,000	$1,000,000	$850,000	$1,300,000	
2	**CONSTRUCTION SURVEY**	1	LS	$50,000	$50,000	$40,000	$70,000	
3	**SELECTIVE DEMOLITION AT BERTH 3 PLATFORM**	1	LS	$500,000	$500,000	$430,000	$650,000	Partial Deck Demolition
4	**DOCK MODIFICATIONS AT BERTH 3 PLATFORM**	1	LS	$150,000	$150,000	$130,000	$200,000	Bullrail, access, etc.
5	**RELOCATE EXISTING TRANSFER SPAN**	1	LS	$100,000	$100,000	$90,000	$130,000	
6	**REMOVE AND REINSTALL FLOATING DOCK**	1	LS	$200,000	$200,000	$170,000	$260,000	
7	**FLOATING DOCK SCHEDULED REPAIRS AND MAINTENANCE**	1	EA	$500,000	$500,000	$430,000	$650,000	
8	**80' FLOATING DOCK EXTENSION**	4,000	SF	$450	$1,800,000	$1,530,000	$2,340,000	
9	**FURNISH STEEL PIPE PILING**	10	EA	$61,250	$612,500	$520,000	$800,000	
10	**INSTALL STEEL PIPE PILING**	10	EA	$30,000	$300,000	$260,000	$390,000	
11	**ANCHOR AND SOCKET STEEL PIPE PILING**	10	EA	$150,000	$1,500,000	$1,280,000	$1,950,000	
12	**RELOCATE DOCK FENDER PANEL**	1	LS	$100,000	$100,000	$90,000	$130,000	
13	**REACTION DOLPHIN CAP**	1	EA	$300,000	$300,000	$260,000	$390,000	
14	**SAFETY EQUIPMENT AND APPURTENENCES**	1	LS	$25,000	$25,000	$20,000	$30,000	
15	**PNEUMATIC FENDER SYSTEM**	4	EA	$30,000	$120,000	$100,000	$160,000	
					BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
				Project Construction Subtotal	**$7,257,500**	**$6,200,000**	**$9,450,000**	
				Survey, Planning, Permitting, Design and Bid Documents (10%)	$726,000	$620,000	$945,000	
				Contract Administration, Inspection & Other Indirects (5%)	$363,000	$310,000	$473,000	
				Total Project Cost (Rounded)	**$8,347,000**	**$7,130,000**	**$10,868,000**	(Rounded)

Notes:

1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice

Ketchikan Berth 3 Option B Class 4 Opinion of Probable Project Cost (OPPC)								
Item No.	Description	Approx. Quantity	Unit	Base Estimate		Contingency		Notes
				Unit Cost ($)	Estimated Cost (Rounded)	Low Estimate (-15%)	High Estimate (+30%)	
1	**MOBILIZATION AND DEMOBILIZATION**	1	LS	$500,000	$500,000	$430,000	$650,000	
2	**REMOVE AND REINSTALL FLOATING DOCK**	1	LS	$200,000	$200,000	$170,000	$260,000	
3	**FLOATING DOCK SCHEDULED REPAIRS AND MAINTENANCE**	1	LS	$500,000	$500,000	$430,000	$650,000	
					BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
	Project Construction Subtotal				**$1,200,000**	**$1,030,000**	**$1,560,000**	
	Survey, Planning, Permitting, Design and Bid Documents (10%)				$120,000	$103,000	$156,000	
	Contract Administration, Inspection & Other Indirects (5%)				$60,000	$52,000	$78,000	
	Total Project Cost (Rounded)				**$1,380,000**	**$1,185,000**	**$1,794,000**	(Rounded)

Notes:

1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice

Ketchikan Berth 4 Option A Class 4 Opinion of Probable Project Cost (OPPC)								
				Base Estimate		Contingency		
Item No.	Description	Approx. Quantity	Unit	Unit Cost ($)	Estimated Cost (Rounded)	Low Estimate (-15%)	High Estimate (+30%)	Notes
1	**MOBILIZATION AND DEMOBILIZATION**	1	LS	$1,750,000	$1,750,000	$1,490,000	$2,280,000	
2	**CONSTRUCTION SURVEY**	1	LS	$100,000	$100,000	$90,000	$130,000	
3	**SELECTIVE DEMOLITION**	1	LS	$250,000	$250,000	$210,000	$330,000	
4	**NEW 50'x300' FLOATING DOCK**	15,000	SF	$350	$5,250,000	$4,460,000	$6,830,000	
5	**NEW 50'x100' FLOATING DOCK**	5,000	SF	$350	$1,750,000	$1,490,000	$2,280,000	
6	**FURNISH STEEL PIPE PILING**	15	EA	$61,250	$920,000	$780,000	$1,200,000	
7	**INSTALL STEEL PIPE PILING**	15	EA	$30,000	$450,000	$380,000	$590,000	
8	**ANCHOR AND SOCKET STEEL PIPE PILING**	15	EA	$150,000	$2,250,000	$1,910,000	$2,930,000	
9	**DOLPHIN CAPS**	3	EA	$300,000	$900,000	$770,000	$1,170,000	
10	**MOORING / BREASTING DOLPHIN EXTENSION**	1	EA	$150,000	$150,000	$130,000	$200,000	
11	**NEW TRANSFER BRIDGE**	1	EA	$75,000	$80,000	$70,000	$100,000	
12	**SAFETY EQUIPMENT AND APPURTENENCES**	1	LS	$25,000	$30,000	$30,000	$40,000	
13	**PNEUMATIC FENDER SYSTEM**	20	EA	$30,000	$600,000	$510,000	$780,000	
14	**NEW CAPSTANS**	1	EA	$20,000	$20,000	$20,000	$30,000	
15	**POWER AND LIGHTING**	1	LS	$300,000	$300,000	$260,000	$390,000	
					BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
				Project Construction Subtotal	**$14,800,000**	**$12,600,000**	**$19,280,000**	
				Survey, Planning, Permitting, Design and Bid Documents (10%)	$1,480,000	$1,260,000	$1,928,000	
				Contract Administration, Inspection & Other Indirects (5%)	$740,000	$630,000	$964,000	
				Total Project Cost (Rounded)	**$17,020,000**	**$14,490,000**	**$22,172,000**	(Rounded)

Notes:

1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice

Ketchikan Berth 4 Option B Class 4 Opinion of Probable Project Cost (OPPC)

Item No.	Description	Approx. Quantity	Unit	Base Estimate		Contingency		Notes
				Unit Cost ($)	Estimated Cost (Rounded)	Low Estimate (-15%)	High Estimate (+30%)	
1	MOBILIZATION AND DEMOBILIZATION	1	LS	$1,500,000	$1,500,000	$1,280,000	$1,950,000	
2	CONSTRUCTION SURVEY	1	LS	$100,000	$100,000	$90,000	$130,000	
3	SELECTIVE DEMOLITION	1	LS	$100,000	$100,000	$90,000	$130,000	
4	NEW 50'x100' FLOATING DOCK	5,000	SF	$350	$1,750,000	$1,490,000	$2,280,000	
5	NEW 50'x100' FLOATING DOCK	5,000	SF	$350	$1,750,000	$1,490,000	$2,280,000	
6	TRANSFER SPANS	1	LS	$300,000	$300,000	$260,000	$390,000	
7	FURNISH STEEL PIPE PILING	5	EA	$61,250	$310,000	$260,000	$400,000	
8	INSTALL STEEL PIPE PILING	5	EA	$30,000	$150,000	$130,000	$200,000	
9	ANCHOR AND SOCKET STEEL PIPE PILING	5	EA	$150,000	$750,000	$640,000	$980,000	
10	DOLPHIN CAPS	1	EA	$300,000	$300,000	$260,000	$390,000	
11	MOORING / BREASTING DOLPHIN EXTENSION	1	EA	$150,000	$150,000	$130,000	$200,000	
12	DOLPHIN MODIFICATIONS FOR NEW FLOAT ATTATCHMENT	1	LS	$500,000	$500,000	$430,000	$650,000	
13	2 NEW TRANSFER BRIDGES	1	LS	$275,000	$280,000	$240,000	$360,000	
14	SAFETY EQUIPMENT AND APPURTENENCES	1	LS	$25,000	$30,000	$30,000	$40,000	
15	PNEUMATIC FENDER SYSTEM	10	EA	$30,000	$300,000	$260,000	$390,000	
16	NEW CAPSTANS	1	EA	$20,000	$20,000	$20,000	$30,000	
17	POWER AND LIGHTING	1	LS	$300,000	$300,000	$260,000	$390,000	
					BASE ESTIMATE	**LOW ESTIMATE**	**HIGH ESTIMATE**	
				Project Construction Subtotal	**$8,590,000**	**$7,360,000**	**$11,190,000**	
				Survey, Planning, Permitting, Design and Bid Documents (10%)	$859,000	$736,000	$1,119,000	
				Contract Administration, Inspection & Other Indirects (5%)	$430,000	$368,000	$560,000	
				Total Project Cost (Rounded)	**$9,879,000**	**$8,464,000**	**$12,869,000**	(Rounded)

Notes:

1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice

Ketchikan Berth 4 Option C Class 4 Opinion of Probable Project Cost (OPPC)

Item No.	Description	Approx. Quantity	Unit	Base Estimate Unit Cost ($)	Base Estimate Estimated Cost (Rounded)	Contingency Low Estimate (-15%)	Contingency High Estimate (+30%)	Notes
1	**MOBILIZATION AND DEMOBILIZATION**	1	LS	$1,000,000	$1,000,000	$850,000	$1,300,000	
2	**CONSTRUCTION SURVEY**	1	LS	$50,000	$50,000	$40,000	$70,000	
3	**SELECTIVE DEMOLITION REACTION DOLPHIN, GANGWAY,FLOAT**	1	LS	$100,000	$100,000	$90,000	$130,000	
4	**REMOVE AND REINSTALL FLOATING DOCK**	1	EA	$200,000	$200,000	$170,000	$260,000	
5	**APPROXIMATE 50' FLOATING DOCK EXTENSION**	1,750	SF	$450	$790,000	$670,000	$1,030,000	
6	**FURNISH STEEL PIPE PILING**	10	EA	$61,250	$610,000	$520,000	$790,000	
7	**INSTALL STEEL PIPE PILING**	10	EA	$30,000	$300,000	$260,000	$390,000	
8	**ANCHOR AND SOCKET STEEL PIPE PILING**	10	EA	$150,000	$1,500,000	$1,280,000	$1,950,000	
9	**DOLPHIN CAPS**	2	EA	$300,000	$600,000	$510,000	$780,000	
10	**CATWALK**	1	EA	$50,000	$50,000	$40,000	$70,000	
11	**SAFETY EQUIPMENT AND APPURTENENCES**	1	LS	$25,000	$30,000	$30,000	$40,000	
12	**PNEUMATIC FENDER SYSTEM**	3	EA	$30,000	$90,000	$80,000	$120,000	
13	**NEW CAPSTANS**	1	EA	$20,000	$20,000	$20,000	$30,000	
14	**POWER AND LIGHTING**	1	LS	$100,000	$100,000	$90,000	$130,000	
					BASE ESTIMATE	LOW ESTIMATE	HIGH ESTIMATE	
				Project Construction Subtotal	**$5,440,000**	**$4,650,000**	**$7,090,000**	
				Survey, Planning, Permitting, Design and Bid Documents (10%)	$544,000	$465,000	$709,000	
				Contract Administration, Inspection & Other Indirects (5%)	$272,000	$233,000	$355,000	
				Total Project Cost (Rounded)	**$6,256,000**	**$5,348,000**	**$8,154,000**	(Rounded)

Notes:
1. All costs shown are in 2016 USD and are rounded to the nearest ten thousand dollar.
2. Class 4 Estimate as defined by AACE international Recommended Practice