Town of Holden Beach Draft Summary Report

Town Pier Preliminary Reconstruction

HDR Engineering, Inc. of the Carolinas
Project No. 10426190

Holden Beach, North Carolina

July 2, 2025

PRELIMINARY – FOR REVIEW ONLY

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NCBELS Firm Registration No. F-0116

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1 Background

The Town of Holden Beach (Town) purchased the property associated with the existing timber fishing pier at 441 Ocean Boulevard West in 2022. Features within the pier property included the pier, an historic pier house, an 80-space parking lot, two public beach access points, an emergency beach access point, and a multi-site campground. Figure 1-1 illustrates the location of the pier and pier property.

The pier and pier house were each originally constructed in the late 1950’s and have experienced significant deterioration. The Town closed the pier and pier house to the general public shortly after the purchase of the property due to safety concerns; the pier house was fully demolished in April 2025.

The Town engaged HDR Engineering, Inc. (HDR) to provide preliminary design, a lifecycle analysis, and a Class 3 construction cost estimate in support of revitalizing the historic pier so it may continue to serve as an iconic landmark for the Town and its residents.

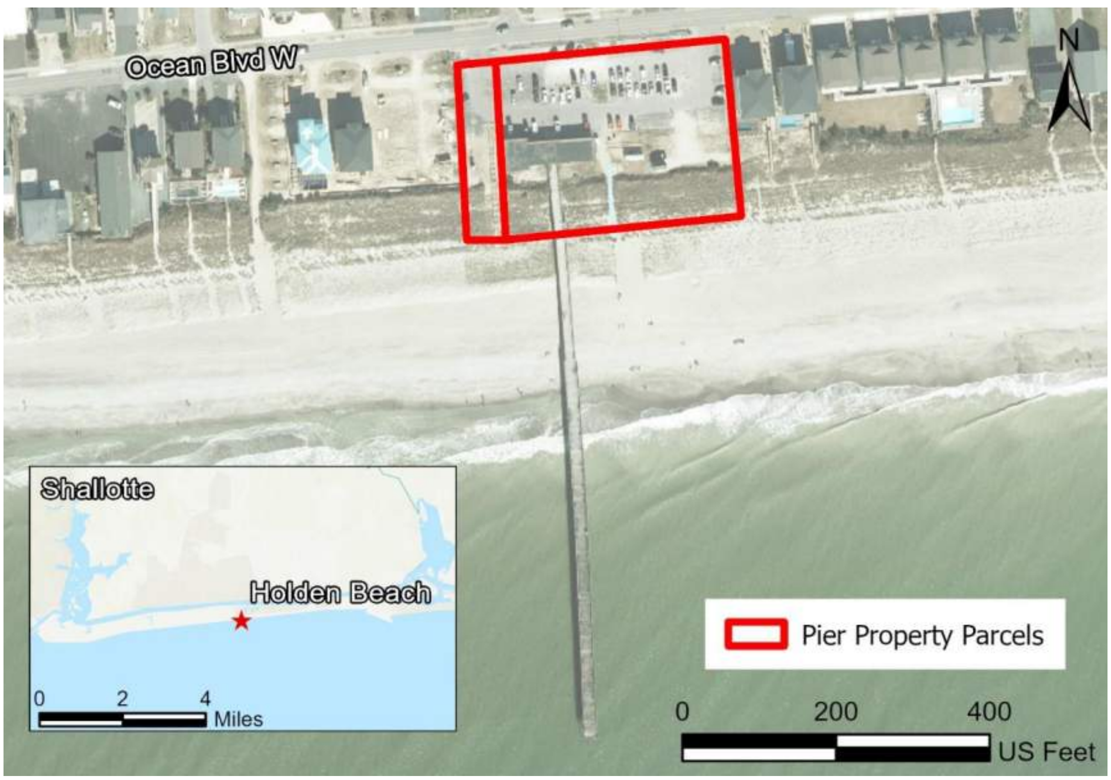

Figure 1-1. Project Site Map

2 Existing Conditions

2.1 Existing Site Features

2.1.1 Pier Structure

The existing pier has undergone significant degradation since initial construction, including losing several hundred feet of length at the end of the structure from the effects of Hurricanes Hugo (1989) and Floyd (1999). The last known major maintenance event on the pier was performed within a couple of years following Hurricane Floyd, whereby the end of the pier was repaired to its current form (i.e., approximately 750-feet-long and without any form of T-head at the pier terminus). The pier has remained closed to the public since the Town purchased the property in 2022 due to safety concerns raised by the state of the structure.

A structural investigation with both level I (i.e., visual inspection) and level II (i.e., soundness probing) considerations was performed by HDR on the subaerial portions of the pier in early March 2025. The investigation did not include any inspections on the sections of piles that were underwater or buried by sand, nor did it include any level II tests on the piles that were seaward of the tide line. The investigation was carried out following the standards defined by the American Society of Civil Engineers in the Waterfront Facilities Inspection and Assessment Manual (ASCE, 2016).

The investigation determined the overall condition of the pier to be rated as poor, with numerous specific structural components further rating as serious or critical condition. From this determination, HDR recommended to the Town that any further project scope considerations exploring potential pier repairs be curtailed due to the ineffective cost-benefit value the repairs would entail. With the Town’s acceptance of the recommendation, the scope of this project narrowed from a repair and reconstruction alternatives analysis to only a preliminary reconstruction design.

The comprehensive summary report of the structural investigation is found in Appendix A.

2.1.2 Pier House

The pier house was not part of this project scope but is mentioned due to this building previously providing the tie-in location for the water and electrical utilities servicing the pier. The pier house was in a similar state of disrepair as the pier and was likewise closed to the public shortly after the Town purchased the property. The building was demolished in April of 2025 due to safety concerns, and the Town is in the process of determining how it is to be replaced.

The removal of the pier house structure has two implications on this preliminary reconstruction design:

1) The design of the new pier structure is not constrained by the former locations of the pier access doorway or utility meters/junction boxes.

2) The design plans for the new pier structure will not include details for how the pier will ultimately tie-in to the future pier house as the pier house layout is not yet known.

2.2 Project Datum

All horizontal coordinates in this report are relative to the 2011 adjustment of North American Datum of 1983 (NAD83 2011), State Plane Coordinate System, North Carolina Zone (NC-3200) US feet. All elevations are relative to the North American Vertical Datum of 1988 (NAVD88) GEOID 18 Epoch 2001 US feet. All units are US customary.

Table 2-1 displays the tidal datums with respect to NAVD88 using data from the NOAA Station 8661070 at Springmaid Pier in Myrtle Beach, SC (NOAA, 2025b). The Myrtle Beach, SC station was selected as the Wilmington, NC station is too far inland to appropriately represent coastal conditions, and the Myrtle Beach, SC station was found to be spatially closer to the pier site while also reporting more conservative values relative to the Wrightsville Beach, NC station. The Town installed a tide gauge on the Intracoastal Waterway approximately 650 feet southwest of the Holden Beach Road causeway in 2021; the inland location of this gauge provides different tidal dynamics relative to the oceanfront location of the pier site and thus is not suitable for use for this particular project.

Table 2-1. Tidal Datums For NOAA Station 8661070 In Myrtle Beach, SC

Tidal Datum	Elevation (Feet NAVD88)
Mean Higher High Water (MHHW)	+2.4
Mean High Water (MHW)	+2.1
Mean Sea Level (MSL)	-0.5
Mean Low Water (MLW)	-3.0
Mean Lower Low Water (MLLW)	-3.2
Average Tidal Range	5.0

2.3 Beach Profile Elevation Survey

Elevation data of the beach profile were collected by McKim & Creed on March 19, 2025 (Figure 2-1). The onshore and nearshore portions of the survey were measured using an RTK GNSS rover while the offshore portions were measured using a hydrographic survey-grade single beam 200 KHz echosounder. The measurements were taken such that the offshore and nearshore measurements overlapped to compare between the collection methodologies.

Six profile transects were collected, with three transects taken on either side of the pier. For each side, a transect was first collected near the pier at a distance considered safe and logistical by the field crew, with the following two transects being spaced approximately 100 feet away from the previous. The westernmost transect (Transect 1) and easternmost transect (Transect 6) were approximately 450 feet apart. Each transect was approximately 2,100 feet in length.

In addition to the transects, multibeam data was collected covering an approximately 425-foot by 65-foot area near the end of the pier at a 10-foot by 10-foot resolution. These data had strong agreement with the overlapping single beam transects.

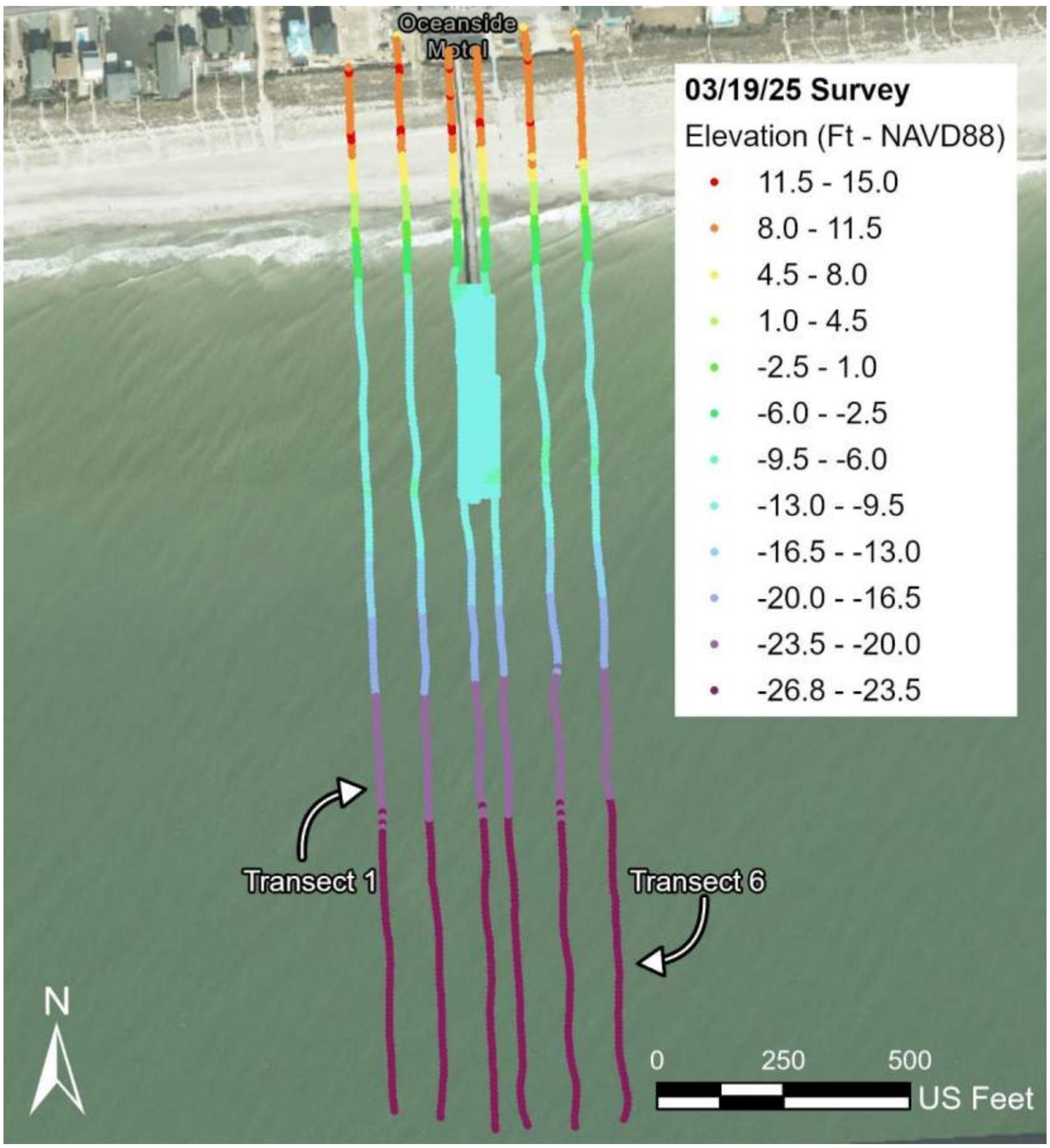

Figure 2-1. Survey Transects Under Existing Pier

Figure 2-2 shows the profiles along Transects 1, 3, 4, and 6. Transects 1 and 6 provided bed profile information approximately 200 feet from the pier while Transects 3 and 4 provided bed profile information at either side of the pier.

From Figure 2-2, the effects of the pier on local scour can be observed in the offshore bar located between Stations 4+50 and 8+00. The bed within the immediate vicinity of the pier is about three feet deeper compared to the bed located approximately 200 feet away. The deeper elevation was used in the scour analysis to account for impacts on pile stability from bedform variability.

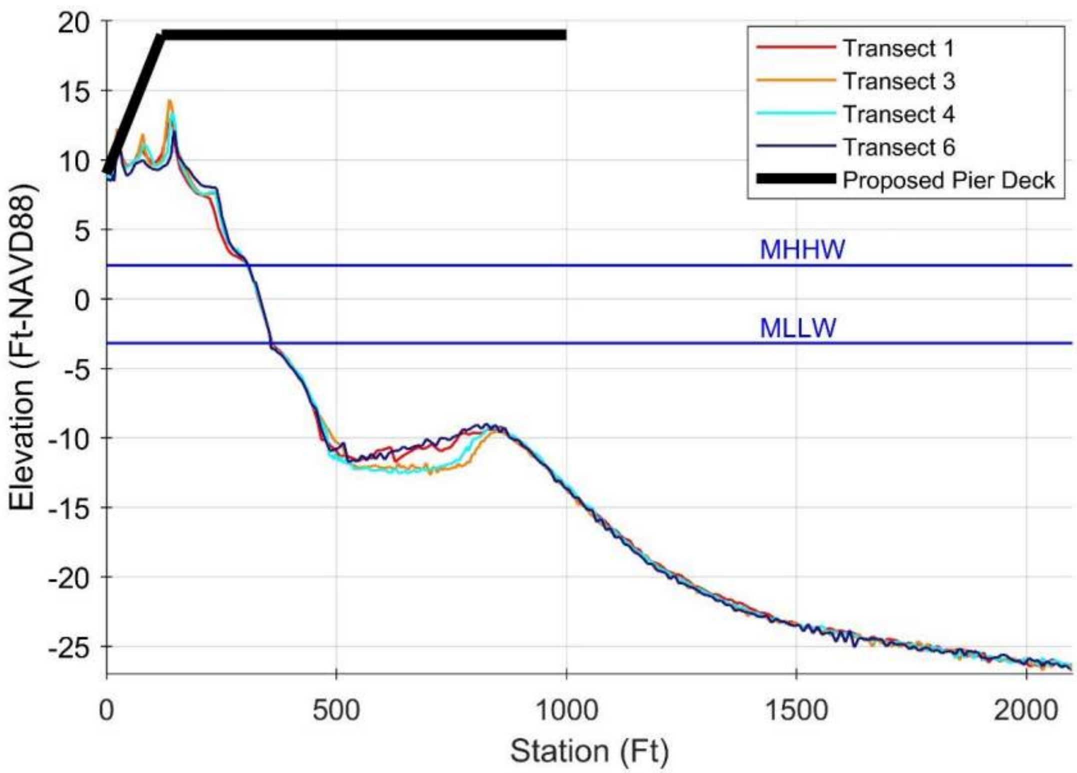

Figure 2-2. Beach Profiles Including the Proposed Pier Deck Elevation

2.4 Geotechnical Investigations

At the direction of the Town, a 2023 geotechnical investigation report for the project site prepared by S&ME, Inc. (SM&E) was used to provide the geotechnical data referenced within this preliminary design. The report, titled “Report of Geotechnical Exploration – Holden Beach Pier and Pier House” (S&ME Job No. 23060076), is dated July 24, 2023, and is included in Appendix E of this document (S&ME, 2023). The geotechnical boring data from the S&ME report provides the basis for existing site conditions, while the results from HDR’s geotechnical evaluation will provide the design parameters for the replacement pier structure.

The two borings collected by S&ME in 2023 were located near the dune and tide lines, and although deemed sufficient for this preliminary design, at least one additional offshore boring located at the end of the proposed pier is necessary during future design phases with additional borings being strongly recommended. See Appendix E for further geotechnical details and information.

2.5 Meteorological and Oceanographic Conditions

A meteorological and oceanographic (metocean) analysis was performed and is documented in a metocean report included in Appendix D. The report includes a summary of the datum, water level (i.e., measured data, extreme event record, sea level rise, and FEMA flood hazard information), wind (i.e., measured data, ASCE effective speeds, and extreme storm history), wave, and shoreline change characteristics of the pier site. See Appendix D for the full data review and related discussion.

The locations of the metocean data sources are shown in Figure 2-3 and include the National Oceanic and Atmospheric Administration (NOAA) Station 8661070 in Myrtle Beach, South Carolina (NOAA, 2025b), and the US Army Corps of Engineers (USACE) Wave Information Study (WIS) Station 63310 (USACE, 2025) that is 17 miles offshore of the pier. The NOAA National Data Buoy Center (NDBC) Buoy 41013 (NOAA, 2025c) was used for verification of the WIS dataset.

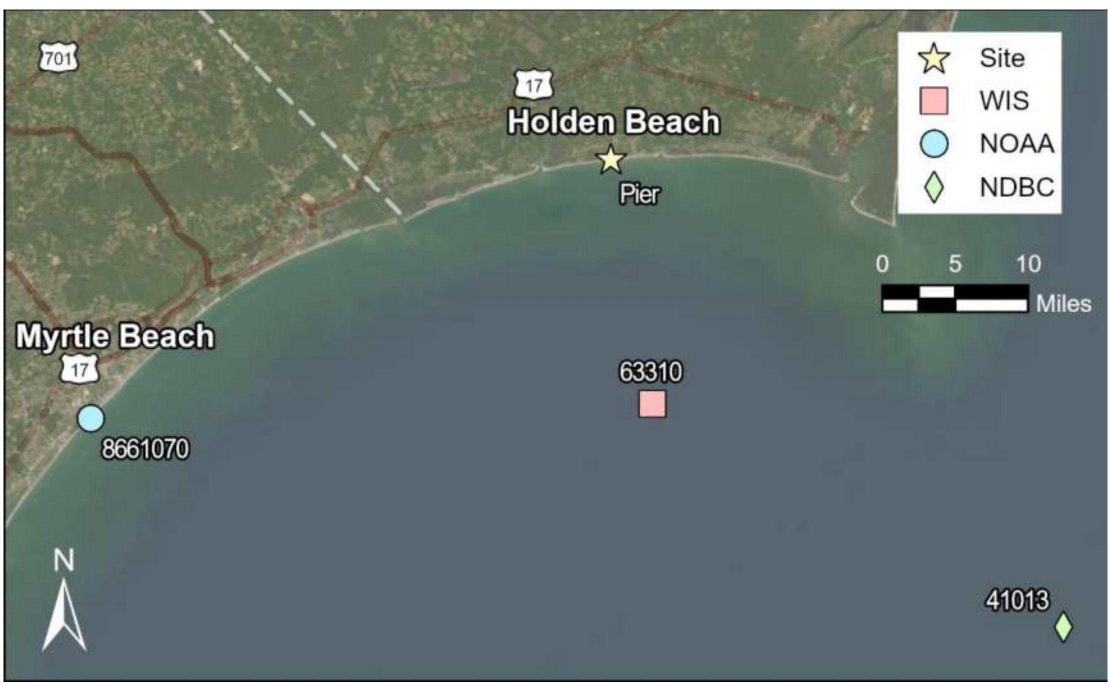

Figure 2-3. Metocean Data Source Locations

The primary findings from the metocean report are summarized below in Table 2-2. The bold rows indicate values that were directly applied during design.

Table 2-2. Summary Of Metocean Report Design Values (HDR, 2025)

	Description	Value
Water Level	**Projected Sea Level Rise between 1992 and 2055**	**+1.7 feet**
	Projected 50-year Event WSEL in 2055 incl SLR (NAVD88)	**+8.9 feet**
	Max Observed Surge (NAVD88), Hurricane Hazel (NWS, 1954)	+14.6 feet
	FEMA 100-Yr Flood Elevation (NAVD88)	+16 feet
	Mean Higher High Water (NAVD88)	+2.4 feet
	Mean Lower Low Water (NAVD88)	-3.2 feet
Wind	Dominant Wind Direction - Spring	Southwesterly
	Dominant Wind Direction - Fall	Northeasterly
	ASCE Max Design Wind Speed (Converted 20-Minute Wind Duration)	**100.3 miles per hour**
	Recorded Hurricane Landfall Count Within 60 Nautical Miles of Pier (1851-2023)	42
Wave	Dominant Offshore Wave Direction	Southeasterly
	Peak Offshore Wave Height (Before Depth-Limited Conditions Are Applied)	19.7 feet
	Peak Offshore Wave Period	15.5 seconds
	Design Wave Height at Pier (Depth-Limited Conditions)	**17.9 feet**
	Design Wave Period at Pier	**15.5 seconds**
Shoreline	Annual Average Erosion Rate in Pier Vicinity (1944-2020)	-1.7 feet per year
	Bed Elevation at Proposed End of Pier (NAVD88)	**-14 feet**

*__Bold indicates value directly used for design__

3 Preliminary Design

3.1 Structural Service Life

The proposed pier structure is designed for a 30-year service life consistent with the typical longevity of timber piles subjected to standard coastal wind and wave conditions. This 30-year life may be extended with the adoption of regular inspection and maintenance type activities, and thus the life cycle analysis (discussed in Section 5) will include a 50-year life cycle horizon. The 30-year service life does not incorporate considerations for unpredictable events such as natural disasters (extreme storm events, hurricanes, earthquakes, etc.) or acute accidents (vessel strikes, vandalism, etc.).

While the structural elements are designed for a 30-year service life, several components – including decking, benches, railings, and utilities – will require more frequent inspection and replacement. Routine maintenance will focus on ensuring pedestrian safety, maintaining appearance, and preventing deterioration from exposure to saltwater and standard coastal weather.

The pier's timber structure will require regular condition assessments to monitor signs of decay, marine borer activity, corrosion of fasteners, and scour or instability. Utility system maintenance will need to be tracked as part of the included life cycle plan, with recommended activities based on material type and corrosion risk.

3.2 Loadings

At the guidance of the Town, the proposed pier structure is only intended to support passive recreational use such as walking, fishing, and public gathering. A pedestrian load of 60 pounds per square feet and a 400-pound concentrated point load at any location along the structure will be used to size the structural members (ASCE, 2020; DoD, 2017; ICC, 2018).

The pier is in an exposed coastal environment and is sized for a design wind speed of 148 miles per hour (3-second gust) and an exposure category D per ASCE 7-16 (ASCE, 2016).

3.3 Structural Design Specifications

The pier will utilize marine grade timber pilings and structural members with treated lumber decking. Handrails will be furnished on the outboard side along the full length of the pier and will be 42-inches-high above the walking surface. The finished deck height of the piers is +19 feet NAVD88 to ensure that it is above the FEMA base flood elevation. General features include:

- an approximately 120-foot-long by 16-foot-wide ADA ramp at a 12H:1V slope that leads up to the main deck elevation
- a 12-foot-long by 6-foot-wide observation balcony that begins at the top of the ramp
- an 828-foot-long by 16-foot-wide main walkway

- a 48-foot-square T-head terminus that is centered on the main walkway and includes a simple covered structure in the center
- a top of pier walkway elevation of +19 feet (NAVD88).

See Appendix B for the comprehensive Basis of Design document.

3.3.1 Structural Design

The timber pier is designed as a two-pile bent system along the main pier and as a 4-pile bent system (5-piles longitudinally) under the T-head. The pier is designed for strength and serviceability with an allowable deflection based on L/360.

The structural design will follow a defined load path (as outlined below for operational gravity loads).

Decking – The decking spans 2 feet between the joists, while supporting the operational loads of 60 pounds per square foot or a concentrated load of 400 pounds, whichever produces a more critical load effect. The decking is designed as a one-way system and sized based on individual member stresses distributing loads to the supporting joists. The minimum decking is taken as a 2x6 timber board.

Joists – The joists will span between the bent cap beams and are designed for a max clear span of 12 feet. The joists support the decking and will be designed to transmit vertical and lateral loads from the superstructure to the bent cap beams. The minimum joist size is taken as a 3x12 timber.

Bent Cap Beams – The bent cap beams will span between the piles and support the joists. The bent cap beams are designed to have a total span equal to the walkway width of 16 feet, and a clear span equal to the nominal pile spacing of 12 feet. The bent cap beam section is based on two beams per bent, sitting on either side of the pile. The minimum bent cap beam size is taken as a 12x12 timber.

Piles – The piles will be spaced at a nominal pile spacing of 12 feet apart along the walkway (longitudinal) and 12 feet (center-to-center) apart across the walkway (transverse). The round timber piles are battered at a 3H:12V slope and sized based on axial and lateral capacity and stability. The minimum pile size is taken as a 15-inch diameter pile (butt diameter) that tapers to approximately a 10-inch diameter tip according to ASTM D25 (ASTM, 2022). The piles are 60 feet long.

Railing – The timber handrails will be 42 inches tall and be comprised of 4 rows of 2x4 timber boards. The rail posts will be 4x4 timbers spaced every 4 feet (center-to-center).

All timbers (structural and railing members) shall be new, southern yellow pine, Grade No. 2 or better. All timber shall be treated with chromated copper arsenate (CCA) to a retention of 2.5 pounds per cubic foot.

3.3.2 Water Utilities

The water service will be extended from the existing supply at the meter to the new pier. A backflow preventer assembly will be installed near the meter in accordance with local utility standards. The proposed water line will use materials that meet applicable local utility standards. The new line will be routed along the pier to service hose bibs and the two fish cleaning stations. Final pipe sizing will be determined based on the quantity and spacing of these fixtures to ensure adequate flow and pressure. A valve and discharge will be provided at the low point of the system for drainage as needed. All components shall conform to local utility standards and approved details.

3.3.3 Electrical Utilities

A new 120/240V, single phase service will be provided for the pier. An equipment rack will be installed on shore which will support the new electric utility meter, service disconnect and panelboard. The service disconnect will be an enclosed 60A breaker with a lockable NEMA 4X stainless steel enclosure. The panelboard will be 100A main lug-only type with 18 poles for branch breakers and housed in a lockable NEMA 4X stainless steel enclosure. The panelboard will be protected by an externally mounted NEMA 4X surge protection device.

Exposed conduits at the service equipment rack will be rigid aluminum conduit. Conduits installed below grade or run exposed along on the pier will be fiberglass type (reinforced thermosetting resin conduit). Outlet boxes and junction boxes will be cast aluminum. Receptacles will be GFCI type, weather and corrosion resistant, and will have a cast aluminum cover rated as weatherproof while in use. Receptacle quantity and locations will be coordinated with the Town. Pole mounted light fixtures on the pier will consist of LED fixtures with cast aluminum housing, IP68 rating, and full cutoff optics. Desired lighting levels will be coordinated with the Town and regulatory agencies. Dusk-to-dawn light operations will be provided by photocells installed on the first light pole on the pier.

3.3.4 Amenities

To help provide comfort and safety for the pier visitors, several minor amenities are included within the design:

- Benches are placed along the main deck walkway and T-head terminus; no benches are found on the ramp. The benches are staggered along the walkway every 50 feet such that adjacent benches on the same rail are 100 feet apart. Each side of the T-head terminus has two benches, with the three uninterrupted sides having a 10-foot clearance between the benches and the T-head deck corners. The benches are centered along each rail for the side of the terminus that connects with the main walkway. This design proposes 25 total benches.
- Two fish cleaning stations are situated along the main walkway, with one located approximately 250 feet from the T-head (~Sta. 6+90) and the other approximately 30 feet from the T-head (~Sta. 920).
- Light poles are placed along the entire length of the structure past the top of the ADA ramp. The pole locations are roughly 110 feet apart and are staggered similar to the benches. Additionally, two light poles are proposed to be along each side of the pier where the main walkway connects into the T-head terminus. Railing-mounted lights are placed along the ADA ramp and are staggered at 10-foot spacings.

- A simple covered structure measuring 30 feet by 30 feet is to provide protection from the elements for visitors within the center of the T-head deck. The structure provides 6 feet of unobstructed walkway from the structure edge to the back of the benches and provides 9 feet of unobstructed walkway from the structure edge to the railing. Electricity is provided to the structure for overhead lights.

4 Construction Cost Not-To-Exceed Estimate

4.1 General Clarifications

Any opinions on the probable construction cost or cost estimates provided by HDR are based on information available to HDR and based on the cost estimator's experience and qualifications and represents its judgment as an experienced and qualified professional engineer. However, HDR, has no control over the cost of labor, materials, equipment, or services furnished by others, or over the contractor(s') methods of determining prices, or over competitive bidding or market conditions. HDR does not guarantee that proposals, bids, or actual project or construction cost will not vary from opinions of probable cost or cost estimates prepared by HDR.

The pricing is based upon a competitive bidding situation with multiple responsible bidders. Any sole sourced work will have an impact on the overall cost.

The costs provided are consistent with recent experience and market conditions, but as demonstrated in the past, markets are dynamic and unpredictable. No market or commodity volatility has been considered for this estimate.

The pricing in this report should be considered primarily for screening and evaluation purposes only. Material pricing is based on industry cost publications, recent proposals, and historical project cost information.

The estimate assumes there is no shortage of qualified labor craftsmen. A labor study has not been conducted at this stage of the project.

The estimate does not include specific pricing or schedule impacts for extensive scope changes.

4.2 Classification

A construction cost estimate was developed for the pier and is considered a Class 3 estimate based on the overall 30% level of project design. Class 3 estimates are between -20% and +30% based on the maturity of the design and estimating methodology. The estimate is classified based upon AACE International, Recommended Practices 18R-97 – As Applied in Engineering, Procurement, and Construction for the Process Industries (AACE, 2020).

4.3 Not-To-Exceed Estimate

During the development of the standard Class 3 cost estimate, the Town was made aware that the cost estimate would be further used to establish the value of a potential bond that may ultimately provide funds for the pier's construction pending the results of a resident referendum. With the additional implication that the Class 3 cost estimate would be used for a bond to potentially pay for the construction in its entirety, the cost estimate was further refined into a not-to-exceed (NTE) basis such that an upper-bound cost limit would result.

4.3.1 Additional Constructability Investigation

HDR determined that the 30% cost estimate as scoped would not provide an adequate NTE construction amount due to the lack of construction methodology considerations at this stage of design. Although some engineered projects may suitably employ a standard 30% Class 3 estimate for construction estimation, a coastal pier structure in particular will present numerous construction methods that often vary significantly in cost. Methods can include the construction of a work trestle, land- and barge-based construction, top-down construction, the creation of a land bridge, or a combination thereof.

From the initial construction methodology investigation, a work trestle was found to be the method constituting the potential upper bound cost limit while still being reasonably permittable and suitable for a design not rated for loadings beyond standard pedestrian use. Conservative pricing of the trestle construction was used to keep the estimate in line with an NTE basis.

4.3.2 Contingency

Contingency is calculated on a weighted basis representing areas of risk and unknowns and is included as a single-line entry of the cost build-up. For this design, HDR recommended a contingency of 25% of total construction cost be used. The contingency is preliminary and can be further defined during subsequent design phases. No additional owner's contingency or reserve funds were included.

4.3.3 Recommended Not-To-Exceed Amount

With the inclusion of all design and construction methodology aspects and the 25% contingency, the total NTE construction cost estimate that HDR recommends be used for the bond amount is $7,300,000.

5 Life Cycle Analysis and Plan

Life cycle plans provide a structured approach to managing an asset throughout its service life. The complete life cycle plan developed for the pier is provided in Appendix C, and includes a comprehensive discussion into the details, assumptions, and results from the life cycle analysis performed for this preliminary pier design. It outlines the main four lifecycle strategies to support ongoing maintenance, protect asset conditions through preservation, address issues through periodic rehabilitation, and plan for future replacement needs. The life cycle approach enables the Town to estimate long-term costs, prioritize reinvestment, and make informed decisions that align with available resources and service expectations. Figure 5-1 provides a visual description of how successfully implementing a life cycle plan can be generally expected to extend the service life of an asset.

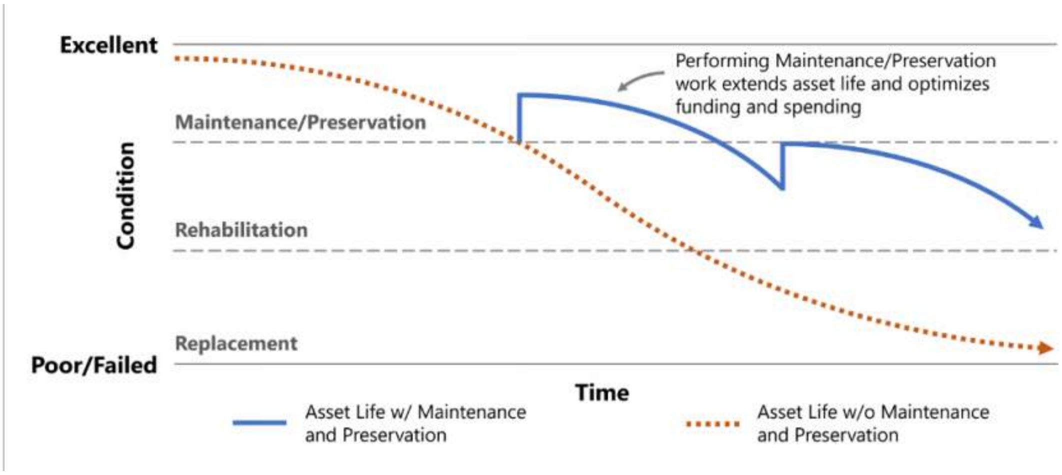

Figure 5-1. Extending Asset Life With Maintenance And Preservation

The four recommended life cycle strategies to manage and maintain Holden Beach's pier are summarized in Table 5-1 on the following page.

The activity frequency column lists the recommended or estimated time in years between applications of the given activity. The frequency values have been determined based on a compilation of other pier best practices as recommended by regulatory agencies, industry standards, and subject matter experts. Frequency ranges are presented (denoted as low and high in the table), where applicable, along with the proposed frequency for life cycle planning purposes.

The activity cost estimate and comment columns provide the basis for estimating the cost of these activities. These costs are estimated in 2025 year's dollars and align to the pier's preliminary design plans. Cost estimates include a combination of average bid prices and man-hour assessments.

By performing maintenance and preservation activities in a timely manner, the frequency of major rehabilitations and replacements is predicted to decrease.

Table 5-1. Proposed Pier Life Cycle Framework

Category	Activity		Frequency - Low	Frequency - High	Frequency	Activity Cost	Comments
Maintenance	Inspection	Above Water Inspection and Condition Assessment	3 yrs	5 yrs	4 yrs	$20,000	
		Under Water Inspection and Condition Assessment	-	-	5 yrs	$25,000	
	Preventative Maintenance	Debris Management	-	-	4x / yr	$1,200	
		Sealing and Re-Coating of Decking	5 yrs	10 yrs	7 yrs	$48,000	
Preservation	Pile Protection	Pile Wrap Installation or Reapplication	-	-	1/ life cycle (at 16 yrs)	$89,595	Only 50% of piles assumed to get wrapped
	Cleaning & Drainage Maintenance	Cleaning of Pier Superstructure	-	-	1 yr	$16,000	
		Cleaning of Pier Substructure	3 yrs	5 yrs	4 yrs	$6115	
Rehabilitation	Partial Deck Rehab	Decking Repairs	-	-	10 yrs	$3,913	Estimated 20% of boards will need to be replaced every 10 years
	Structural Strengthening	Addition of Bracing of Pile Caps	5 yrs	10 yrs	7 yrs	$5,250	Assuming 2.5% of elements are braced every occurrence
	Upgrading Benches	Upgrade and/or replace worn benches	15 yrs	20 yrs	17 yrs	$15,000	Includes all benches
Replacement	Upgrading Utilities and Fixtures	Electrical and Lighting Upgrades	-	-	1/ life cycle (at 30 yrs)	$262,000	Replacement of entire electrical system
		Plumbing Upgrades	-	-	1/ life cycle (at 30 yrs)	$19,000	Replacement of entire plumbing system
	Full Deck Replacement		-	-	1/ life cycle (at 30 yrs)	$124,000	Replacement of entire superstructure
	Pile Replacement		-	-	1/ life cycle (at 30 yrs)	$375,000	10% of piles over beach replaced, 50% of piles over water replaced
	Full Roof Replacement		-	-	1/ life cycle (at 30 yrs)	$4,600	Replacement of entire roof structure

5.1 Cost Forecast: Recurring Activities

The first three life cycle management strategies of maintenance, preservation, and rehabilitation are collectively known as recurring activities. These activities occur more than once over the lifespan of the asset and are developed into a framework that forecasts the year-by-year spending using assumed activity frequencies. The recurring activities supporting the pier are designed on an unconstrained scenario, meaning all scheduled work is performed as planned at the recommended standard time interval.

Figure 5-2 illustrates the resulting year-by-year spending, showing considerable variability due to the assumption that each activity occurs in the exact year it is due. Notable spikes include a major preservation project to wrap piles in 2041. Full pier replacement is anticipated at the end of the 50-year period and that cost is not included in this forecast.

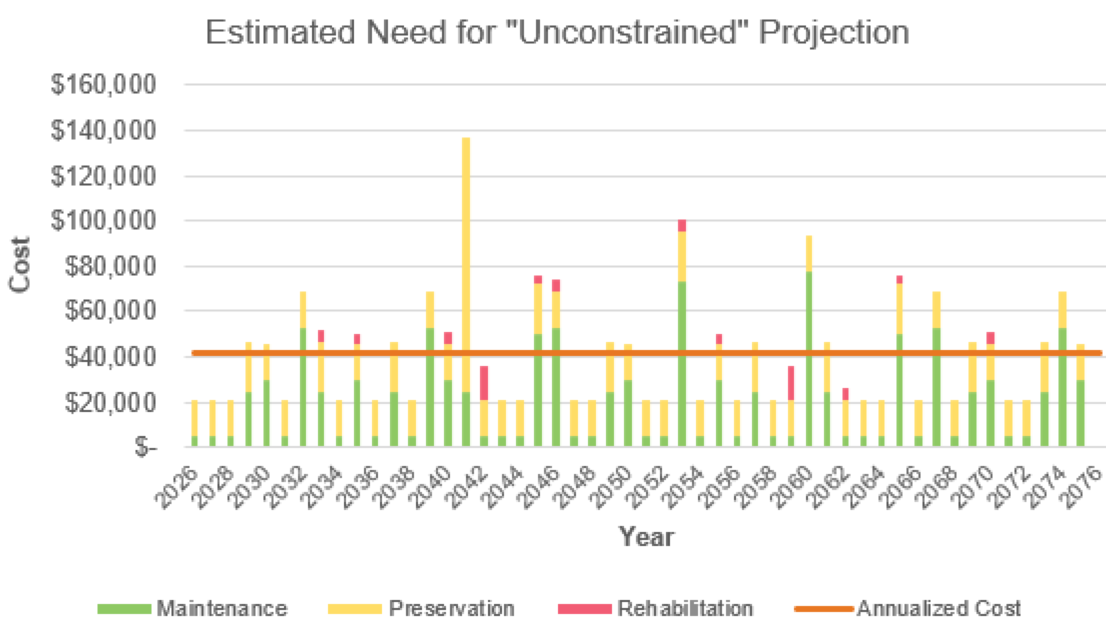

Figure 5-2. Estimated Needs For An Unconstrained Recurring Activity Forecast

Table 5-2 below shows the annualized cost for each activity type and the total cost over the 50-year period. These annualized costs represent a high-level annual estimate and are calculated based on the initial design of the pier.

Table 5-2. Future Annualized Funding Needs Projection (2025 Dollars)

Activity Type	Avg. Annual Cost	50-Year Cost
Maintenance	$20,901	$1,066,000
Preservation	$18,881	$962,975
Rehabilitation	$1,512	$77,151
Total*	$41,296	$2,106,127

***** *Replacement activities are not included*

5.2 Cost Forecast: Mid-Life Replacement

Figure 5-2 shows the calculated average annual cost that only includes planned maintenance, preservation, and rehabilitation activities. Not included in that projection is a major capital project classified as replacement work, anticipated in 2056 at the 30-year mark.

This replacement effort is expected to cost approximately $784,700 and is intended to extend the pier's service life to 50 years in a cost-effective manner, avoiding the need for full reconstruction. Table 5-3 provides a breakdown of the estimated costs for the 2056 replacement activities. The pile replacement rate is noted as deriving from the assumption that 10% of piles landward and 50% of piles seaward of the mid-tide line will be replaced.

Note that the following replacement line-item costs are not inclusive of construction methodology considerations (i.e., barge rentals, trestle construction, etc.). The line items include base labor and material costs only.

Table 5-3. Replacement Activities Cost in 2056 (2025 Dollars)

Activity	Cost	Notes
Utility Replacements	$281,000	Electrical and Plumbing systems replacement
Deck Replacement	$124,000	Complete replacement of superstructure
Roof Replacement	$4,600	Complete replacement of roof structure
Pile Replacement	$375,100	Replacement of approx. 38% of piles
Total	$784,700	

5.3 Cost Forecast: Total Life Cycle

Table 5-4 shows the annualized funding needs projection similar to the one shown in Table 5-2, however Table 5-4 includes the annualized cost of replacement activities. Adding replacement costs provides a more complete picture of the full life cycle cost and shows the resulting increase in average annual cost due to major replacement work.

Table 5-4. Total Future Annualized Funding Needs Projection (2025 Dollars)

Activity Type	Avg. Annual Cost	50-Year Cost
Maintenance	$20,901	$1,066,000
Preservation	$18,881	$962,975
Rehabilitation	$1,512	$77,151
Replacement	$15,386	$784,700
Total*	**$56,682**	**$2,890,827**

***** *Reactive activities are not included in the Total Costs*

See Appendix C for full details and discussion from the full life cycle analysis and plan.

6 References

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Appendix A

Existing Pier Structural Investigation

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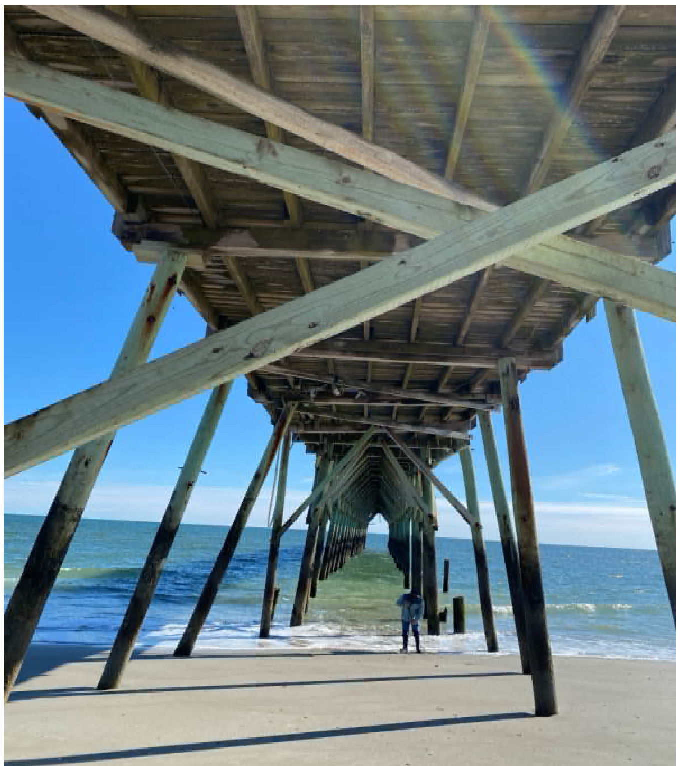

Condition Assessment and Report of Findings

Town of Holden Beach

Holden Beach Pier

Repair or Replacement Design

Holden Beach, North Carolina

May 5, 2025

NORTH CAROLINA PROFESSIONAL SEAL 055975 ENGINEER LUKE R. CRESSMAN

5/5/2025

HDR Engineering Inc.
of the Carolinas

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NCPELS Firm Registration No. F-0116

REVISION HISTORY

Rev.	Issued Date	Description	Reviewed	Approved
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1 Executive Summary

1.1 Overview

The recreational fishing pier and historic pier house in Holden Beach, North Carolina are in disrepair and have been closed off to the public. The Town of Holden Beach (Town) has asked HDR to perform a site investigation of their historic fishing pier, shown in Figure 1.

Figure 1 - Holden Beach Fishing Pier Plan View and Project Stationing

On March 3, 2025, HDR conducted a site investigation and condition assessment as defined in the “Waterfront Facilities Inspection and Assessment – Manuals and Reports on Engineering Practice No. 130” published by the American Society of Civil Engineers. The deficiencies recorded have been divided into the following condition assessment categories in line with ASCE’s published condition assessment ratings:

1. Good (No repairs required)
2. Satisfactory (No repairs required)
3. Fair (Low priority repair)
4. Poor (Moderate priority repair)
5. Serious (High to very high priority repairs)
6. Critical (High to very high priority repairs)

1.2 Findings

The field investigation of the timber pier was performed from both the pier topside and from below along the beach shoreline to collect data and photos of the pier superstructure and above waterline substructure elements. The substructure investigation from the shore was performed at low tide in order to capture as much of the pier’s timber pilings as observable. The structure was divided into four sections or areas:

- Access Ramp Section (Sta 0+00 to 0+75)
- Balcony Viewing Area (Sta 0+75 to 0+90)
- Narrow Pier Segment (Sta 0+75 to 2+50)
- Wide Pier Segment (Sta 2+50 to 7+50)

The overall assessment of the timber recreational pier is in POOR condition and displays varying degrees of individual deterioration as represented in Table 1. In general, the condition of superstructure elements exhibits a higher degree of damage or deficiencies relative to the substructure components.

Table 1 - Condition Assessment Summary

Location	Access Ramp Section	Balcony Area	Narrow Pier Segment	Wide Pier Segment
Superstructure	POOR[1]	CRITICAL	POOR	SERIOUS
Substructure	FAIR[1]	POOR	FAIR	POOR

The pier's superstructure, which includes the deck boards, support joist, handrails, etc., is heavily deteriorated, warped and/or damaged with deficiencies consisting of checks, splits, gouges, and railing failures, and should be entirely replaced.

- The handrails and rail post hardware connections are in CRITICAL condition, particularly the eastern rail. The hardware and rail posts are damaged and heavily corroded and therefore insufficient in transferring or supporting the required OSHA rail load standards.
- There are numerous timber deck boards inadequately connected to the supporting joists as well as several locations where the deck boards deflect excessively under pedestrian loading.
- The spacing between the existing primary timber support joists was field measured at approximately 30-in on center at several locations. The deck boards overlaid atop of the timber joists were visually observed to consist of nominal 2x6 boards. Industry standard spacing recommendations for support joists is 24-in on center to support the serviceability requirements for typical pedestrian loading on recreational piers (assuming 2x6 deck boards).
- Timber rotting / cross-section loss of the primary timber support joists at multiple locations was also observed and in POOR or SERIOUS condition.
- The balcony or viewing pavilion located near station 0+85 was observed to be in CRITICAL condition with deficiencies including failed handrails, loose deck boards, corroded steel hardware, rotted supports, and hollowed timber piles.

The condition of the existing substructure, consisting of pressure treated timber pilings, timber bent caps and timber cross-bracing, was observed to range from FAIR to POOR overall, with individual elements being more serious. Furthermore, the condition assessment was limited to what was visually observed above the waterline at the time of the investigation. Additional deficiencies may exist below the waterline.

- The general condition of pilings that could be visually observed from shore or the pier topsides is FAIR. However, multiple pilings were noted to be in POOR to SERIOUS condition, including a cluster of pilings near the shoreline at low tide. The pier structure

[1] Ramp Section needs to be completely replaced due to ADA non-compliance

consists of approximately 64 total bent systems. Piling and pile bents beyond Station 4+00 were not able to be completely assessed due to the water inaccessibility. Considering the pile bents that were visually observable from both topsides and underneath (approximately 40 of the 64 bents), over 30% of these assessed bent systems were noted to have some piling damage, deterioration or degree of deficiencies requiring repair. It can be reasonably assumed the degree of damage of the bent systems / pilings not assessed have similar if not further degree of deterioration.

- The overall condition of the timber pile caps is FAIR; however, timber rot of the pile caps supporting the timber joists was recorded at several locations. The nominal size of the timber pile caps at each bent system varied between 8x10 to 10x10. Considering the pile bents that were observable (as noted in the previous bullet), over 25% of these timber bents were noted to have some structural deficiencies.
- Several existing cross-bracings were observed to be in POOR or SERIOUS condition. There are multiple locations where cross bracing has either split or separated at its connection to the piles, rendering the member ineffective. Some bracings are broken, snapped, or missing and need to be replaced. When only considering the pile bents that were observable, over 40% of these pile bents were observed to have some cross-bracing deficiencies.
- The majority of the existing bolted hardware connections have experienced heavy corrosion, section loss, or failure and are classified in POOR to SERIOUS condition.
- There are numerous locations of deteriorated, missing and/or failed hardware connections between the existing timber piles and the timber pile cap.

Additional factors and considerations affecting the condition of the structure includes:

- Limited remaining useful service life of the existing timbers. Timber substructure elements are understood to be a minimum of 25 years old.
- Insufficient or minimal information is available regarding the design loadings for the existing timber pier structure.
- Insufficient or minimal official information is available regarding the as-built condition of the foundation pilings. Strike tests would be recommended to understand the in-situ capacity of the existing piles.
- The substructure and superstructure for the Ramp Section will be required to be entirely replaced in order to meet federal ADA requirements for pedestrian access.
- The anticipated construction means and methods that would be required to perform a large quantity of the localized repairs would be similar to those needed for new construction (i.e. construction from a work barge in the water OR building out a working jetty (sand or gravel deposit) parallel to the pier. It is HDR recommendation that machinery and/or construction equipment shall NOT be utilized atop of the existing pier deck for operations in the structures present deteriorated state.

1.3 Recommendations

In summary, the overall condition of the existing fishing pier was assessed to be in POOR condition and HDR recommends replacing the timber superstructure in its entirety. The pier approach (superstructure and substructure) will also be required to be rebuilt and reconfigured to satisfy federal ADA requirements. The existing substructure has many structural deficiencies which would require extensive repairs and is currently at the end of its useful service life. This coupled with the fact the recommended construction methods would be similar for both repair and replacement options supports the conclusion that repairing the existing pier would not be structurally cost effective, nor would it provide the longevity or service life that results from replacing the timber fishing pier. Therefore, it is HDR's recommendation that the Town of Holden Beach consider a pier replacement option only.

2 Introduction

2.1 Authorization / Background

The work outlined in this study was authorized by the Town of Holden Beach, North Carolina (Town). The Town is a municipal corporation located in Brunswick County, North Carolina serving a community of nearly 1,000 year-round residents and a higher seasonal population. The work performed herein is in accordance with HDR's proposal dated January 27, 2025, and agreed to on February 11, 2025.

2.2 Purpose and Scope

The recreational fishing pier and historic pier house in Holden Beach are in disrepair and have been closed off to the public. The pier is over 65 years old. The Town has retained HDR to provide preliminary design and cost estimating services related to revitalizing the historic fishing pier. As part of the repair design, the Town has asked HDR to perform a site investigation and condition assessment of their historic fishing pier, shown in Figure 2.

Figure 2 - Holden Beach Fishing Pier Plan View and Project Stationing

The 750-ft long recreational fishing pier consists of a timber superstructure (i.e. deck boards, joists, handrails, benches, appurtenances, utility poles, etc.) supported by a timber substructure comprised of a series of pile bent systems (i.e. piles, bracing, pile cap, etc.). There are 64 substructure bents are generally spaced 12-ft apart. For the purpose of this field investigation, project stationing started at the pier house and ended at the end of the existing pier, as seen in Figure 2. Evidence of previous repairs to structure were noted during the field investigation.

2.3 Report Terminology and Rating System

Throughout this document, references are made to the American Society of Civil Engineers' (ASCE) Waterfront Facilities Inspection and Assessment, Standard Practice Manual, ASCE Manuals and Reports on Engineering Practice No. 130, herein referred to as ASCE, or ASCE guidelines. This document was used as the basis for the condition rating system to rate the individual components as well as the structure's overall condition on a scale from GOOD to CRITICAL. Refer to Appendix D for a detailed description of the condition assessment ratings.

The field investigation performed is classified by ASCE as a special purpose inspection. Special purpose inspections are conducted to collect more detailed information than normally collected during a routine or structural repair or upgrade design inspection. Such information may be necessary to understand the nature and/or extent of deterioration prior to determining the need for any type of repairs. Special purpose inspections may also be utilized to generally estimate the approximate remaining useful life of the structure.

The field observations consisted of both a Level I and Level II inspection according to the ASCE guidelines. A Level I inspection generally consists of a non-destructive visual inspection of the system which is detailed enough to identify major or large areas of damage or deterioration. It also confirms the structural continuity of members. A Level II inspection is more detailed and intended to detect and identify damaged and deteriorated areas that may be hidden on the surface. For this investigation, this included occasional probing of various components to determine their soundness.

3 Summary of Findings

3.1 Field Investigation / Methodology

General conditions of the timber pier as shown in Figure 2 along with the typical deficiencies encountered are described in the following sections. The deficiencies are divided into following condition assessment categories in line with ASCE's condition assessment ratings:

1. Good (No repairs required)
2. Satisfactory (No repairs required)
3. Fair (Low priority repair)
4. Poor (Moderate priority repair)
5. Serious (High to very high priority repairs)
6. Critical (High to very high priority repairs)

Localized and general deficiencies have been captured in the Photo Log in Appendix C. Photo numbers referenced in this report refer to the numbering identifier in the Photo Log of Appendix C.

The field investigation of the timber pier was performed from both the pier topside and from the beach shoreline to collect data and photos of the pier superstructure and accessible substructure elements. The substructure investigation from the shore was performed at low tide in order to capture as much of the pier's structural pilings as observable.

3.2 Superstructure

The superstructure generally consists of nominal 2" x 6" or 2" x 8" timber decking supported by a series of 3" x 10" joists. The overall width of the timber fishing pier is approximately 12'-0" wide from station 0+00 to 2+50 and then widens to approximately 16'-0" wide from station 2+50 to the end of the pier structure (approximately station 7+50). See Figure 3 and Figure 4 below for typical superstructure details. The fishing pier has side rails that extend approximately 45-inches above the top pedestrian walking surface with 2" x 4" midrails and 2" x 6" toe boards. The top rail is an angled 2" x 10" board. The rail posts alternate between 4"x4" and 4"x6" posts spaced approximately 4-feet on center. Public features atop of the fishing pier structure begin at approximately station 3+25 and consist of various timber benches (spaced about 12-feet on center), a fish cleaning station as well as water and electric utility tie-ins located at station 4+85.

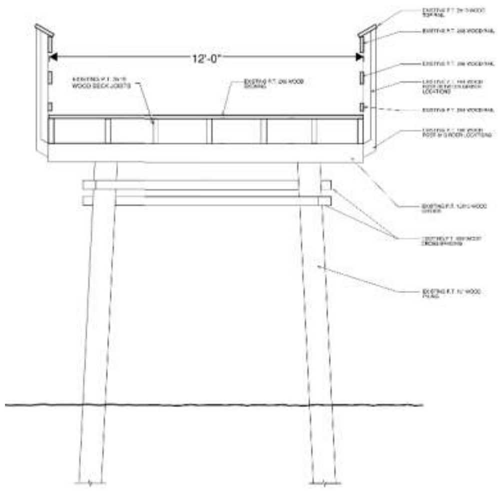


Figure 3 - Narrow Pier Segment

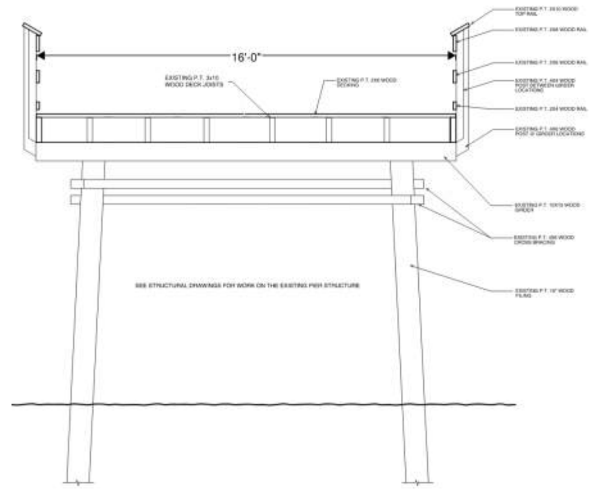


Figure 4 – Wide Pier Segment

3.2.1 Access Ramp Section (Sta 0+00 to Sta 0+75)

The access ramp section from the pier house to the top of pier walking elevation is approximately 75-ft long. For security purposes, the side railing has a continuous chain link fence to prevent unwanted access to the recreational pier. Deficiencies observed include

- Missing or broken railing elements (Photo 1)
- Cut or disconnected chain link fence (Photo 1)
- Checks and flaking in edge joist (Photo 2)

As shown in Photo 1 of Appendix C, the typical side rails, toe boards, and chain link fencing are in POOR condition. There are over 12 locations where the toe boards, midrails, rail posts, and top rails are disconnected and/or split. The chain link fence has also been cut or disconnected in at least 3 locations. Structurally, the railings are POOR, and the deck boards appear SATISFACTORY. However, it was noted that the ramp does NOT meet federal ADA requirements for pedestrian access and would require to be reconfigured and/or replaced.

3.2.2 Balcony Viewing Area (Sta 0+75 to Sta 0+90)

At the end of the access ramp or start of the main pier, there is a balcony area that acts as an overlook for the beach (Figure 5). The balcony superstructure is in CRITICAL condition overall. Deficiencies observed include:

- Railing detachment and failure (Photo 5)
- Loose and soft deck boards
- Split rail posts (Photos 3 and 6)
- Corroded steel hardware (Photo 6 and 67)
- Hollow pile (Photos 4).

While timber piles are a substructure element, the pile top was observed from the balcony as hollowed. Individually, the railing is in CRITICAL condition while the deck boards and hollowed pile are in POOR to SERIOUS condition. The hardware is heavily corroded with sections of failed timber railing and therefore insufficient in transferring or supporting the required OSHA rail load standards.

Figure 5 - Balcony Area Between Sta 0+75 and 0+90

3.2.3 Narrow (12-ft Wide) Pier Segment (Sta 0+75 to Sta 2+50)

The main recreational pier is comprised of two segments – a narrower 12-ft wide section that extends from the top of the access ramp (STA 0+75) to approximately station 2+50 and then transitions to a wider 16-ft wide pier section to the end of the pier. The Narrow (12-ft wide) Pier Segment superstructure is in POOR condition overall. Deficiencies observed include:

- Missing rail elements (Photo 7)
- Edge joist deterioration and splitting (Photos 8 and 11)
- Corroded connection hardware (Photo 11)
- Past joist splice/replacement (Photo 12).

The eastern railing and rail posts have connection issues between Sta 1+00 to approximately 1+50 and are in SERIOUS condition overall with stretches of CRITICAL condition. These railings are insufficient in transferring or supporting the required OSHA rail load standards.

3.2.4 Wide (16-ft Wide) Pier Segment (Sta 2+50 to Sta 7+50)

The main recreational pier widens around Sta 2+50 from 12-ft wide to 16-ft wide and continues at 16-ft wide until the end of the pier. As discussed previously, this pier segment includes timber benches and a fish cleaning station (Photo 32). The Wide Pier Segment superstructure is in POOR to SERIOUS condition overall. Deficiencies observed include:

- Warping joist and top deck from Sta 3+25 to about 4+25 (Photos 17 and 18)
- Missing joists between Sta 3+80 to 4+10 (Photos 24 and 25)
- Observed 30-in joist spacing (Photo 24 and 25)
- Joist checking and splitting (Photo 15)
- Corroded connection hardware (various Photos 13-56)
- Disconnected or broken railing elements (Photos 13, 22, 42, 43, 45, 50, 53, & 54)
- Loose and soft deck boards from
    - Sta 3+55 to Sta 3+65
    - Sta 3+85 to Sta 3+95
    - Sta 5+00 to Sta 5+50
    - Sta 5+75 to Sta 6+50
    - Sta 6+75 to Sta 7+50
- Cracked PVC utility conduit (Photo 31)

Photos 13-56 of Appendix C cover the photographed deficiencies observed from the topside pier investigation of the Wide Pier Segment. Of these deficiencies noted, the most widespread issues are the deck warping and the missing and replacement joists.

The spacing between the existing primary timber support joists in these repaired locations was field measured at approximately 30-in on center. The currently installed deck boards were field measured as 2” x 6” timbers. To support the constructed 2”x6” timber deck planks for both structural and serviceability requirements, the industry recommended joist spacing for pedestrian loadings on recreational piers is typically 24-in on center. As a result, many locations where the spacing exceeds 24” exhibit large deformations under gravity pedestrian loadings. Furthermore, there are numerous timber deck boards inadequately connected to the supporting joists.

The deck warping observed is likely a result or combination of poor construction installation tolerances of uneven pile heights, joist rotting deterioration, and excessive deck board spacing. This is more of a serviceability deficiency as opposed to a structural deficiency with the exception of the joist rotting deficiency. Railing condition is rated as SERIOUS due to the safety implications from the various damage noted from missing top rails, mid rails, and toe boards.

3.3 Substructure and Foundations

The substructure generally consists of a two-pile bent with a 10x10 timber pile cap or transfer beam above the timber piles. The diameters of the timber piles were field measured at various locations and heights due to the current pier being comprised of a mix of original aged piles and newer repair timber piles. The measured diameters ranged from just over 12-in to 8.5-in each with varying conditions. It is assumed the original pile size installed consisted of a combination of 12-in and 10-in diameter piles. The pile lengths and subsequent embedded penetration below the ground surface is unknown at the time of this investigation report. The image shown in Figure 6 below was provided to HDR by a contractor who performed repair work on the pier circa year 2000/2001. The sketch indicates that the piles should have been installed with 14.5-ft below ground surface penetration.

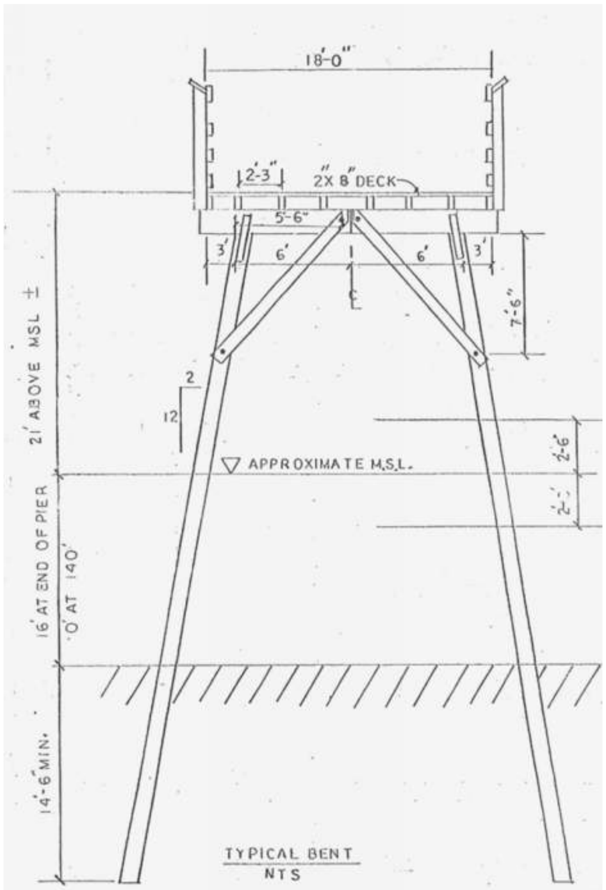


Figure 6 - Typical Bent

3.3.1 Access Ramp Section (Sta 0+00 to Sta 0+75)

The access ramp from the pier house to the top of pier walking surface elevation is approximately 75-ft long. The ramp's substructure is in FAIR condition overall, though there are individual components that range from POOR to SERIOUS. Deficiencies observed include:

- Exterior rot and interior pile hollowing (Photos 57 and 58)
- Cross bracing splits and checks (Photos 59)
- Corroded connections between piles and cross bracing (Photos 61 and 62)

Additionally, it was observed that the substructure is comprised of different structural elements. The largest pile was measured to have a diameter of 13.5-in versus the smallest pile was measured to have a diameter of 8.5-in. The pile caps also were a blend of 10x10 and 8x10 members. Structurally, the timber members are generally FAIR, but the steel connections are POOR. However, as noted previously, the geometry of the superstructure ramp and subsequent support locations for the substructure elements does NOT meet federal ADA requirements for pedestrian access and would require to be reconfigured and/or replaced.

3.3.2 Balcony Viewing Area (Sta 0+75 to Sta 0+90)

At the end of the access ramp or the start of the main pier, there is a balcony area that acts as an overlook for the beach (Figure 5). The balcony area consists of 2 substructure support bents with the substructure rated in POOR condition overall, though there are individual components that are rated as SERIOUS. Deficiencies observed include:

- Corroded connections and steel hardware
- Rotted and deteriorated members (Photos 63, 65, and 66)
- Detached railing includes a disconnection of joist from pile cap (Photo 64)
- Checking and splitting of cross-bracing and support members (Photos 67 and 68)

Pile caps were observed to be 8x10 members under the balcony viewing platform and piles were measured to be 12-in in diameter. The SERIOUS elements include the rotting support and bracing members.

3.3.3 Narrow (12-ft Wide) Pier Section (Sta 0+75 to Sta 2+50)

The main recreational pier is comprised of two segments – a narrower 12-ft wide section that extends from the top of the access ramp (STA 0+75) to approximately station 2+50 and then transitions to a wider 16-ft pier section to the end of the pier. This pier segment consists of about 15 pile bent systems. The supporting substructure condition within the Narrow Pier Section is in FAIR condition overall, though there are individual components that are rated as either POOR or SERIOUS. Deficiencies observed include:

- Disconnected and failed bracing (Photo 73)
- Rotting pile caps (Photos 71, 72, and 74)
- Rotting and split joists (Photo 70)
- Checking and splitting of cross-bracing and support members (Photos 69 and 74)
- At least 3 hollow piles
- Corroded connections and steel hardware (Photos 75 and 76)

Pile caps were observed to generally be 10x10 members and piles were typically field measured as 12-in in diameter. The SERIOUS elements include the corroded/failed pile to pile cap connections and the disconnected and split bracing members which are no longer structurally effective.

3.3.4 Wide (16-ft Wide) Pier Section (Sta 2+50 to Sta 7+50)

The main recreational pier widens around Sta 2+50 from 12-ft wide to 16-ft wide and continues at 16-ft wide until the end of the pier. This pier segment consists of about 38 pile bent systems.

The supporting substructure condition within the Wide Pier Section is in POOR condition overall, though there are individual components that are rated as SERIOUS.

- Missing pile cross bracing between at least 10 different substructure bents (Miscellaneous Photos 19-56 and 79-90)
- Split or cracked piles (Photos 46 and 47)
- Pile necking, which refers to the reduction in critical pile diameter
- Corroded connections and steel hardware (Miscellaneous Photos 19-56 and Photos 80, 88, 89, and 90)
- Misaligned or damaged pile to pile cap connections (Photos 80, 81, 82, 88, and 89)
- Rotting pile caps and joists (Photos 85, 86, and 87)
- Pile gouging and flaking (Photos 34, 35, 37, 40, 51, 55, 56 and 83)

Pile caps were generally visually observed as 10x10 members, and the largest pile was field measured with a diameter of 12-in while the smallest pile diameter encountered was field measured as 10-in. The Town shall be advised that the limits of the substructure investigations was limited to the visual observations performed the beach shoreline around station 4+00 (Photo 84). The SERIOUS elements include the broken or missing lateral cross bracing members, the cracked piles, and the misaligned or damaged pile to pile cap connections which are not fully connected.

3.4 Summary of Deficiencies

The various deficiencies recorded and mentioned in the report are summarized below. Note that these deficiencies are limited to what was observed above the waterline at the time of observation. Additional deficiencies may potentially exist below the waterline. Deficiencies include:

<u>Railing Element Damages</u>: Missing, broken, or deteriorated top rails, mid rails, and toe boards are included under this category. Railing element damage is where an individual railing element has deteriorated to the point that the railing is unable to carry the OSHA required rail loading locally, but replacing the individual element in kind would restore the OSHA compliance.

1. <u>Railing Segment Failure</u>: A railing segment failure occurs when the rail post or rail post connection has deteriorated to the point that the railing is detaching from the pier or is not structurally capable to resist or support the OSHA required rail loading as a system. Replacing an individual element would not be sufficient.
2. <u>Deck Board Deficiency</u>: Deck board deficiency covers the condition when the main timber decking is inadequately connected to or supported by the transfer joists. Additionally, this includes locations where the boards appear to be “soft” or “flexible” and where section rot may be likely.
3. <u>Joist (Checks, Splits, etc.):</u> This covers various types of observed deterioration to the main support joist members. This includes:

- Checks or splitting (where the timber section starts to develop cracks or starts separating along the grain. These occur either along the member or at the connection point.)
- Flaking (where the timber is noticeable peeling, separating, or delaminating along the outer surface)
- Rotting (where timber organic material is decaying, and the timber was observed to be soft)
- Gouging (where the timber has localized recesses, divots, or seams usually caused external abrasion or erosion)

4. Corroded Connections and Steel Hardware: Steel connection hardware such as bolts and nails are considered corroded if the thread or nut is no longer operable or if the section has experienced visually noticeable necking or loss of section.
5. Pile Cap (Splits, Checks, etc.): This covers various types of observed deterioration to the pile cap members. This includes:
    - Checks or splitting (where the timber section starts to develop cracks or starts separating along the grain. These occur either along the member or at the connection point.)
    - Flaking (where the timber is noticeable peeling, separating, or delaminating along the outer surface)
    - Rotting (where timber organic material is decaying and the timber was observed to be soft)
6. Cross Bracing (Splits, Checks, etc.): This covers various types of observed deterioration to the cross-bracing members. This includes:
    - Checks or splitting (where the timber section starts to develop cracks or starts separating along the grain. These occur either along the member or at the connection point.)
    - Flaking (where the timber is noticeable peeling, separating, or delaminating along the outer surface)
    - Rotting (where timber organic material is decaying and the timber was observed to be soft)
    - Broken / Missing / Disconnected (where the member is unable to carry load from one pile to the other)
    - Gouging (where the timber has localized recesses, divots, or seams usually caused external abrasion or erosion)
7. Pile (Splits, Checks, Cracks, Flaking, etc.): This covers various types of observed deterioration to the pile members. This includes:
    - Checks or splitting (where the timber section starts to develop cracks or starts separating along the grain. These occur either along the member or at the connection point.)

- Flaking (where the timber is noticeable peeling, separating, or delaminating along the outer surface)
- Misalignment (where the pile cap does not fully bear on the pile or where connection elements are missing such that load is not fully transferred from the pile cap to the pile as designed)
- Cracking (where the timber is splitting due to localized overstressing. This is different than checking or splitting due to the generation mechanism of the cracking)
- Gouging (where the timber has localized recesses, divots, or seams usually caused external abrasion or erosion)

Table 2 - Summary of Deficiency Quantities by Pier Section

Pier Section	Section Length (LF of Pier)	Railing Element Deficiency (LF of Pier)	Railing Segment Failure (LF of Pier)	Deck Board Deficiency (LF of Pier)	Joist Checks, Splits, Etc. (EA)	Corroded Connections and Steel Hardware (% of Connections)	Pile Cap Splits, Checks, Etc. (EA)	Cross Bracing Splits, Checks, Etc. (EA)	Pile Splits, Checks, Cracks, Flaking, Etc. (EA)
Access Ramp Section	75	60	0	0	1	>50%	1	2	2
Balcony Viewing Area	15	15	15	10	2	>50%	1	2	1
Narrow Pier Segment	175	60	50	0	4	>50%	3	10	3
Wide Pier Segment	500	200	0	220	2	>50%	2	16	16

4 Repair Option Considerations

The Town would like to consider the possibility and cost of performing isolated repairs to restore the functionality of the timber pier versus a complete replacement of the pier. In addition to the observed deficiencies from the site investigations, there are a few other considerations factors that impact the viability of a pier repair plan highlighted in the subsections below.

4.1 Existing Piles & Remaining Useful Service Life

The existing pilings are a combination of replacement and original timber piles. The replacement piles were noted as marine treated timber with 2.5 CCA (Chromated Copper Arsenate). The lifespan of marine timber treated with 2.5 CCA is on the order of 20-40 years. These replacement piles were installed circa 2000 according to the Town and are approximately 25 years old. Therefore, they are effectively near the end of their recommended service life. Existing pilings that were not a part of the pile replacement are likely significantly older. From field observations of the relative decay as well as review of the Town's provided documents, it is assumed the original piling could be over 50 years old (see Appendix B).

4.2 Design Loading and Operations for Existing Structure

Insufficient and/or minimal information is available regarding the design loadings for the existing timber pier structure. It should be noted that during the field investigation, the existing pier was observed to noticeably sway under cross current and normal wave loads. Additionally, several areas along the timber pier deck were observed to noticeably deflect under the investigation team's pedestrian walking load.

The design capacity of the existing piles is unknown. While a contractor provided a sketch of typical bent indicating 14.5 feet of penetration below ground surface (Figure 6), there are no official Town records of what was required or constructed. A pile strike testing program could be implemented and recommended to determine the in-situ geotechnical supporting capacity of the existing piles.

4.3 ADA Compliance

The access ramp section from station 0+00 to approximately 0+75 was noted as being noncompliant for ADA considerations as its slope is too steep and will need to be reconfigured or replaced prior to public access. This will require the substructure and respective superstructure between stations 0+00 and around 0+75 to be entirely reconstructed in order to meet federal ADA requirements for pedestrian access. Furthermore, this may impact the substructure interface transition at the start of the Narrow Pier Segment as the new modified ramp would need to tie into the restored pier.

4.4 Construction Methodology

The anticipated construction means and methods that would be required to perform a large quantity of the localized repairs would be similar to those needed for new construction (i.e. construction from a work barge in the water OR building out a working jetty (sand or gravel deposit) parallel to the pier. It is HDR recommendation that machinery and/or construction equipment shall NOT be utilized atop of the existing pier deck for operations in the structures present deteriorated state.

The substructure capacity would need to be verified prior to supporting construction equipment (as noted in Section 4.2), and it is HDR's opinion that modifications to the substructure (additional piles or closer pile bents) would be needed to support construction activities.

5 Summary and Recommendations

5.1 Summary

The overall assessment of the timber recreational pier is in POOR condition and exhibits varying degrees of individual deterioration as represented in Table 3. In general, the condition of the superstructure elements exhibits a higher degree of damage or deficiencies relative to the substructure components.

Table 3 - Condition Assessment Summary

Location	Access Ramp Section	Balcony Area	Narrow Pier Segment	Wide Pier Segment
Superstructure	POOR[2]	CRITICAL	POOR	SERIOUS
Substructure	FAIR[2]	POOR	FAIR	POOR

The pier's superstructure, which includes the deck boards, support joist, handrails, etc., is heavily deteriorated, warped and/or damaged with deficiencies consisting of checks, splits, gouges, and railing failures, and should be entirely replaced.

- The handrails and rail post hardware connections are in CRITICAL condition, particularly the eastern rail. The hardware and rail posts are damaged and heavily corroded and therefore insufficient in transferring or supporting the required OSHA rail load standards.
- There are numerous timber deck boards inadequately connected to the supporting joists as well as several locations where the deck boards deflect excessively under pedestrian loading.
- The spacing between the existing primary timber support joists was field measured at approximately 30-in on center at several locations. The deck boards overlaid atop of the timber joists were visually observed to consist of nominal 2x6 boards. Industry standard spacing recommendations for support joist spacing is 24-in on center to support the serviceability requirements for typical pedestrian loading on recreational piers (assuming 2x6 deck boards).
- Timber rotting / cross-section loss of the primary timber support joists at multiple locations was also observed and in POOR or SERIOUS condition.
- The balcony or viewing pavilion located near station 0+85 was observed to be in CRITICAL condition with deficiencies including failed handrails, loose deck boards, corroded steel hardware, rotted supports, and hollowed timber piles.

The condition of the existing substructure, consisting of pressure treated timber pilings, timber bent caps and timber lateral cross-bracings, was observed to range from FAIR to POOR overall, with individual elements being more serious. Furthermore, the condition assessment was limited to what was visually observed above the waterline at the time of the investigation. Additional deficiencies may exist below the waterline.

- The general condition of pilings that could be observed from shore or the pier topsides is FAIR. However, multiple pilings were noted to be in POOR to SERIOUS condition, including a cluster of pilings near the shoreline at low tide. The pier structure consists of approximately 64 total bent systems. Piling and pile bents beyond Station 4+00 were not able to be completely assessed due to the water inaccessibility. Considering the pile bents that were visually observable from both topsides and underneath (approximately 40 of the 64 bents), over 30% of these assessed bent systems were noted to have some piling damage, deterioration or degree of deficiencies requiring

[2] Ramp Section needs to be completely replaced due to ADA non-compliance

repair. It can be reasonably assumed the degree of damage of the bent systems / pilings not assessed have similar if not further degree of deterioration.

- The overall condition of the timber pile caps is FAIR; however, timber rot of the pile caps supporting the timber joists was recorded at several locations. The nominal size of the timber pile caps at each bent system varied between 8x10 and 10x10.Considering the pile bents that were observable (as noted previously), over 25% of these timber bents were noted to have some structural deficiencies.
- Several existing lateral cross-bracings were observed to be in POOR or SERIOUS condition. There are multiple locations where cross bracing has either split or separated at its connection to the piles, rendering the member ineffective. Some bracings are broken, snapped, or missing and need to be replaced. When only considering the pile bents that were observable, over 40% of these pile bents were observed to have some cross-bracing deficiencies.
- The majority of the existing bolted hardware connections have experienced heavy corrosion, section loss, or failure and are classified in POOR to SERIOUS condition.
- There are numerous locations of deteriorated, missing and/or failed hardware connections between the existing timber piles and the timber pile cap.

Additional factors and considerations affecting the condition of the structure includes:

- Limited remaining useful service life of the existing timbers. Timber substructure elements are understood to be a minimum of 25 years old.
- Insufficient or minimal information is available regarding the design loadings for the existing timber pier structure.
- Insufficient or minimal official information is available regarding the as-built condition of the foundation pilings. Strike tests would be recommended to understand the in-situ capacity of the existing piles.
- The substructure and superstructure for the Ramp Section will be required to be entirely replaced in order to meet federal ADA requirements for pedestrian access.
- The anticipated construction means and methods that would be required to perform a large quantity of the localized repairs would be similar to those needed for new construction (i.e. construction from a work barge in the water OR building out a working jetty (sand or gravel deposit) parallel to the pier. It is HDR recommendation that machinery and/or construction equipment shall NOT be utilized atop of the existing pier deck for operations in the structures present deteriorated state.

After visiting the site and performing a level I and level II condition assessment of the pier, HDR does not recommend pursuing isolated repairs or relying on the existing substructure to restore the existing timber fishing pier.

5.2 Recommendations

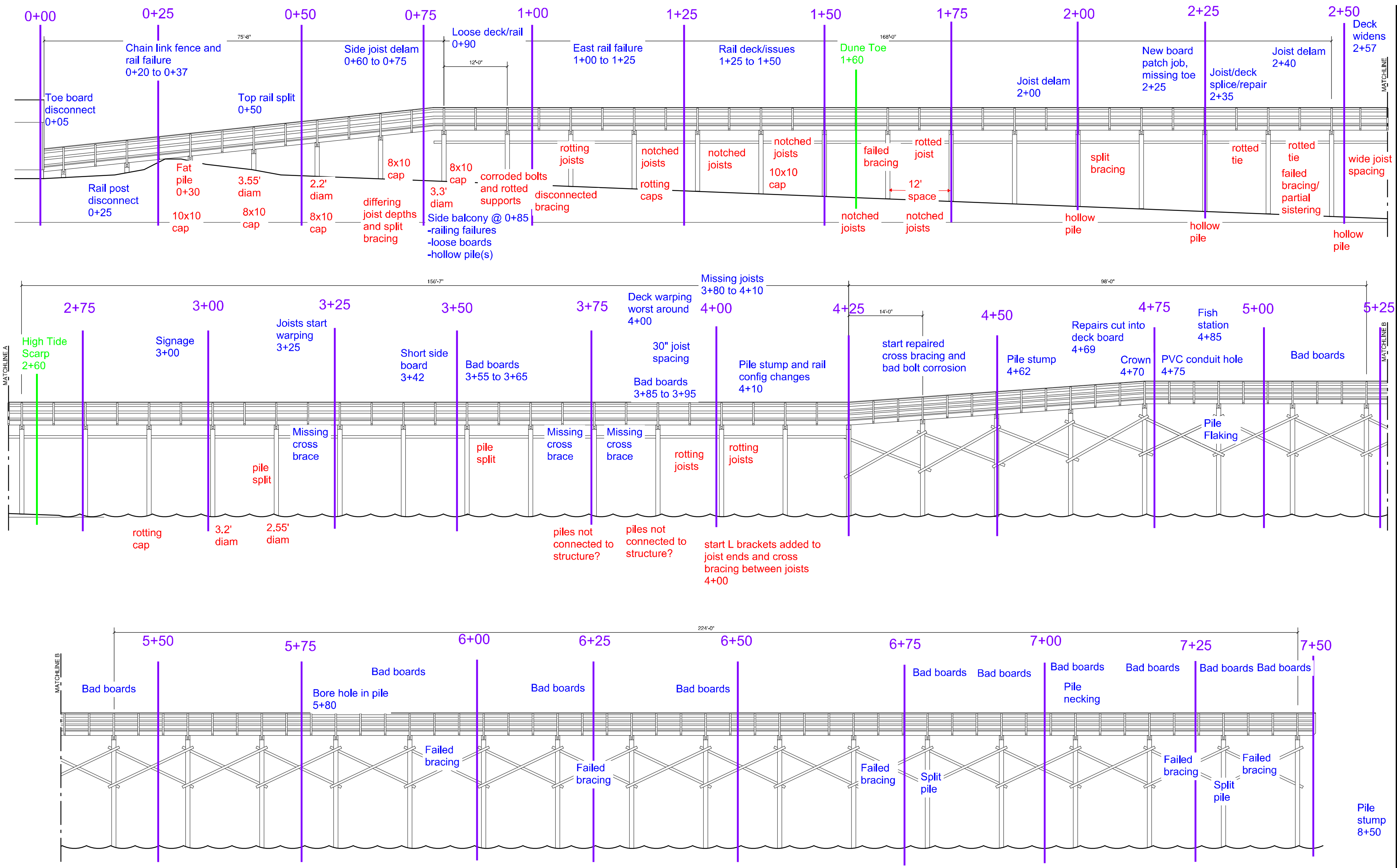
In summary, the overall condition of the existing fishing pier was assessed to be in POOR condition and HDR recommends replacing the timber superstructure in its entirety. The pier approach (superstructure and substructure) will also be required to be rebuilt or reconfigured to satisfy federal ADA requirements. The existing substructure has many structural deficiencies which would require extensive repairs and is currently at the end of its useful service life. This coupled with the fact the recommended construction methods would be similar for both repair and replacement options supports the conclusion that repairing the existing pier would not be structurally cost effective, nor would it provide the longevity or service life that results from replacing the timber fishing pier. Therefore, it is HDR's recommendation that the Town of Holden Beach consider a pier replacement option only.

6 References

Heffron, Ronald E., & Coasts, Oceans, Ports and Rivers Institute (American Society of Civil Engineers. (2015). *Waterfront Facilities Inspection and Assessment*. Reston, Va.: American Society of Civil Engineers.

Appendix A1

Field Notes



Blue are notes taken on deck

Red are notes taken beneath structure

1 A3.2 **Existing Pier Elevations**

scale: 1/8" = 1'-0"

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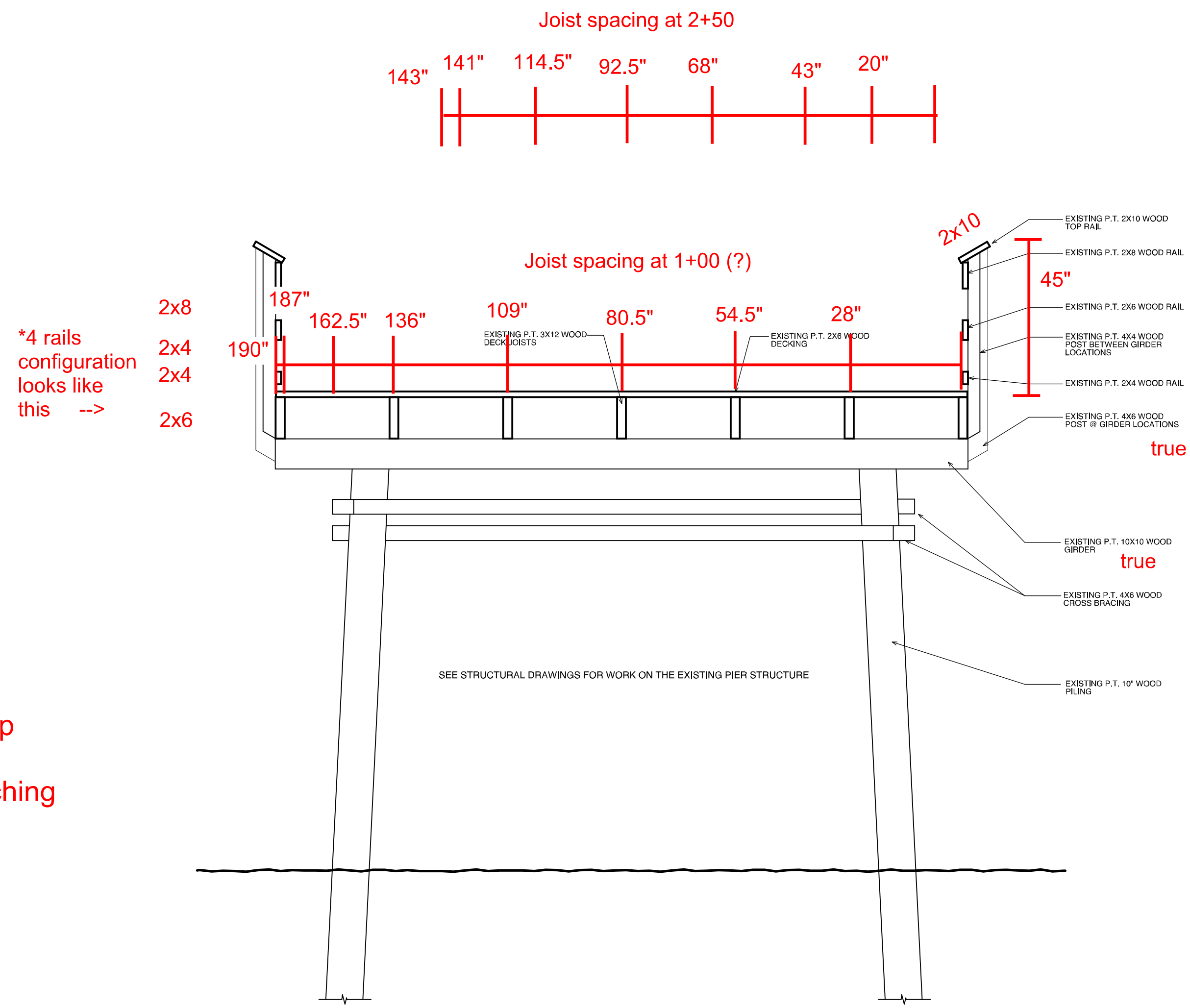
Holden Beach Pier
441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Existing Pier Elevations

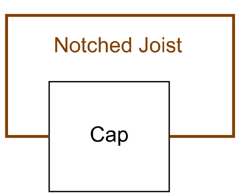
JOB NUMBER
DRAWN BY MG
CHECKED BY GCH
DATE 12/8/22
REVISIONS
SHEET NUMBER
A3.2

Note - there are mixed joist sizing throughout structure

Some 3x10 others 2x10



Joists are cut around the cap
11" to 9.5"
several bents have this notching



1 A4.0 **Existing Pier Section**
scale: 3/4" = 1'-0"

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Holden Beach Pier
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Holden Beach, North Carolina 28462

Existing Pier Section

JOB NUMBER

DRAWN BY MG

CHECKED BY GCH

DATE 12/8/22

REVISIONS

SHEET NUMBER

A4.0

Appendix A2

Town Provided Information

The Town of Holden Beach

Holden Beach Pier Renovation

441 Ocean Boulevard West
Holden Beach, North Carolina 28462

INDEX OF DRAWINGS

BOWMAN MURRAY HEMINGWAY ARCHITECTS

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www.bmharch.com

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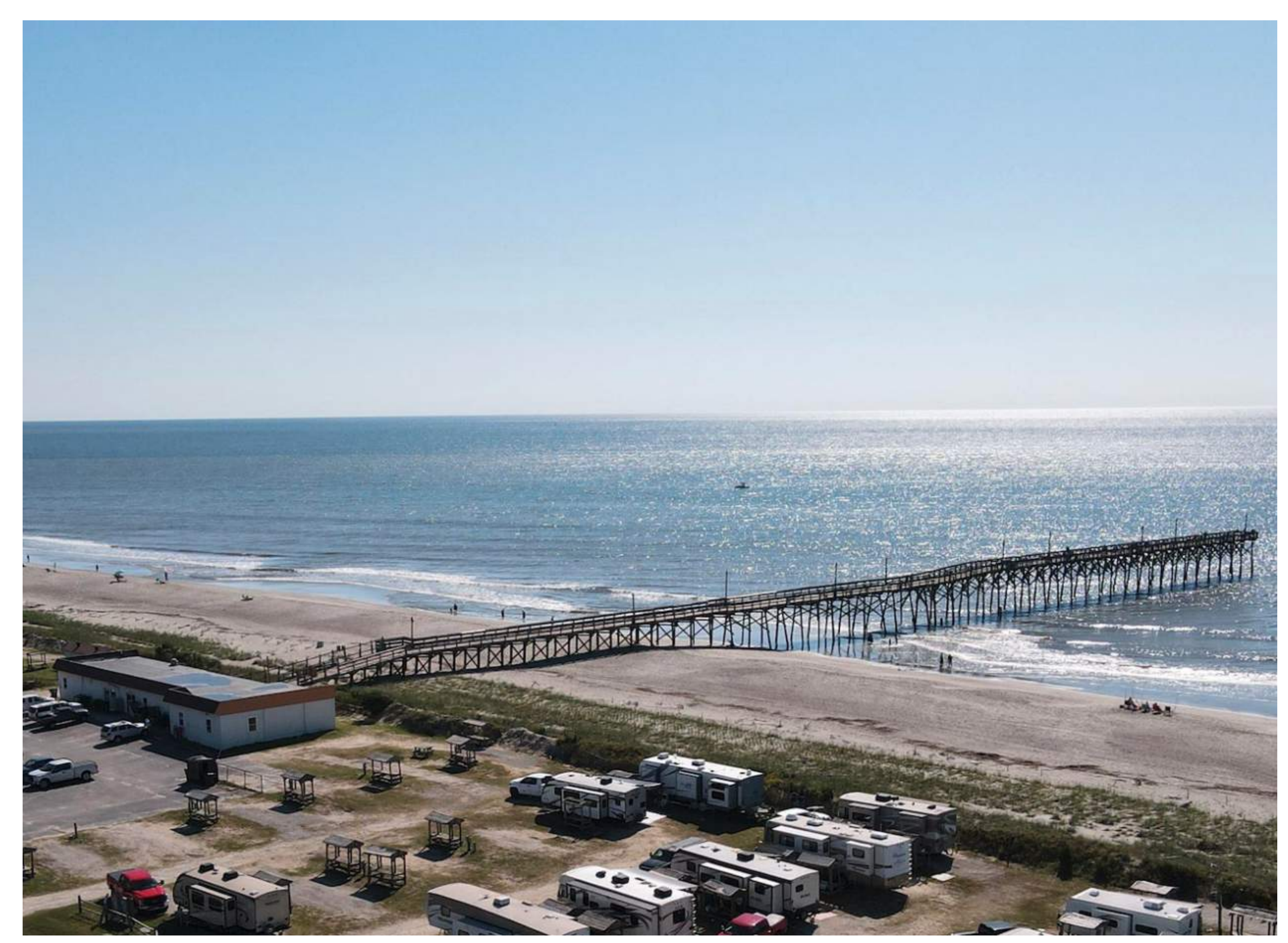
3811 Peachtree Avenue, Suite 300
Wilmington, NC 28403
(910) 202-5555

Plumbing, Mechanical & Electrical:
CBHF Engineers, PLLC
2246 Yaupon Drive
Wilmington, NC 28401
(910) 791-4000



KEY MAP

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BOWMAN MURRAY HEMINGWAY ARCHITECTS, PC · REGISTERED ARCHITECTURAL CORPORATION · CERT. NO. 50424 · NORTH CAROLINA · WILMINGTON, N.C.

Holden Beach Pier Renovation
441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Cover Sheet
Drawing Index

JOB NUMBER

DRAWN BY MG

CHECKED BY GCH

DATE 12/8/22

REVISIONS

SHEET NUMBER

G1.0

2018 APPENDIX B
EXISTING BUILDING DATA SUMMARY

Name of Project: Holden Beach Pier Renovation
Address: 441 Ocean Blvd West, Holden Beach, NC Zip Code 28462
Proposed Use: Public Fishing Pier with Tackle Shop, Concessions, Public Restrooms
Owner or Authorized Agent --
Phone #: -- E-mail --
Owned By: [X] City / County [ ] Private [ ] State
Code Enforcement Jurisdiction: [X] City: Holden Beach [ ] County: [ ] State

LEAD DESIGN PROFESSIONAL: Text

DESIGNER	FIRM	NAME	LIC#	TEL#	E-MAIL
Architectural	Bowman Murray Hemingway	George (Chip) Hemingway	7487	910.762.2621	hemingway @ bmharch.com
Civil	Andrew Consulting Engineers	Neal W. Andrew	23591	910.202.5555	--
Electrical	TBD				
Fire Alarm					
Plumbing	TBD				
Mechanical	TBD				
Sprinkler/Standpipe					
Structural	Andrew Consulting Engineers	Neal W. Andrew	23591	910.202.5555	--
Retaining Walls > 5' High					
Other					

2018 NC EXISTING BUILDING CODE: Existing: [ ] Prescriptive [X] Repair [ ] Chapter 14
Alteration: [X] Level I [X] Level II [ ] Level III
[ ] Historic Property [ ] Change of Use

CLASSIFICATION OF WORK: WORK AREA METHOD (PIER HOUSE ONLY)
Repair: Damaged exterior walls at specific locations
Alteration Level I: Exterior fenestration to be restored and painted.
Exterior walls to received new interior finish & insulation.
New floor finishes.
Alteration Level II: New restrooms for ADA compliance.
Reconfigure interior spaces.
New concrete slab-on-grade.
New Plumbing, Mechanical, and Electrical systems.
New windows and doors.
New public restrooms for Beach & Pier visitors

CONSTRUCTED: (date) 1960 (PIER) CURRENT OCCUPANCY(S) (Ch. 3): Merchantile, A-2
RENOVATED: (date) 1980 (PIER HOUSE) PROPOSED OCCUPANCY(S) (Ch. 3): Merchantile, A-2
RISK CATEGORY (Table 1604.5): Current: [ ] I [X] II [ ] III [ ] IV
Proposed: [ ] I [X] II [ ] III [ ] IV

BASIC BUILDING DATA

Construction Type: (check all that apply) [ ] I-A [ ] II-A [ ] III-A [ ] IV [ ] V-A
[ ] I-B [ ] II-B [ ] III-B [X] V-B
Sprinklers: [X] No [ ] Partial [ ] Yes [ ] NFPA 13 [ ] NFPA 13R [ ] NFPA 13D
Standpipes: [X] No [ ] Yes Class: [ ] I [ ] II [ ] III [ ] Wet [ ] Dry
Fire District: [X] No [ ] Yes Flood Hazard Area: [ ] No [X] Yes
Special Inspections Required: [X] No [ ] Yes

FLOOD DATA: Flood Zone - AE
Base Flood Elevation (BFE): 11 FT
County: Brunswick
Panel: 2015
Map Number: 3720201500K
Existing Finish Floor: 9.95 FT

GROSS BUILDING AREA TABLE (Pier House Only)

Floor	Existing (sq ft)	New (sq ft)	Sub Total (sq ft)	Upfit (sq ft)
First Floor	3,891	0		
Total	3,891	0		

OCCUPANCY
Primary Occupancy Classification(s):
Assembly [ ] A-1 [X] A-2 [ ] A-3 [ ] A-4 [ ] A-5
Mercantile [X]

Primary Occupancy Classification(s): A-2 ASSEMBLY
Mixed Occupancy: [ ] No [X] Yes Separation: 0 Hr.
[X] Non-Separated Use (508.3)

BUILDING HEIGHT
EXISTING BUILDING HEIGHT = 10'-6"+/- AVERAGE (FLAT ROOF)
TOP OF PARAPET = 13'-6" +/-

FIRE PROTECTION REQUIREMENTS
TYPE 5B NON-PROTECTED COMBUSTIBLE
FIRE SEPARATION: 30+ MIN. ALL SIDES
NON-RATED EXTERIOR WALLS
OPENING PROTECTION: NOT APPLICABLE
OPEN RESTRICTIONS: NONE

ACCESSIBLE PARKING
103 EXISTING ON-SITE PARKING SPACES (TOTAL)
6 ACCESSIBLE SPACES (INCLUDED)

[TBD] LIFE SAFETY SYSTEM REQUIREMENTS

Emergency Lighting [ ] No [X] Yes
Exit Signs [ ] No [X] Yes
Fire Alarms [ ] No [X] Yes
Smoke Detection Systems [X] No [ ] Yes [ ] Partial
Carbon Monoxide Detection [X] No [ ] Yes

[TBD] LIFE SAFETY PLAN REQUIREMENTS

Life Safety Plan Sheet #: X
- [ ] Fire and / or smoke rated wall locations (Chapter 7)
- [ ] Assumed and real property line locations (if not onthe site plan)
- [ ] Exterior wall opening area with respect to distance to assumed property lines (705.8)
- [ ] Occupancy Use for each area as it relates to occupant load calculation (Table 1004.1.2)
- [ ] Occupant loads for each area
- [ ] Occupant loads for each area
- [ ] Exit access travel distances (1017)
- [ ] Common path of travel distances (Tables 1006.2.1 & 1006.3.2(1))
- [ ] Dead end lengths (1020.4)
- [ ] Clear exit widths for each exit door
- [ ] Maximum calculated occupant load capacity each exit door can accommodate based on egress width (1005.3)
- [ ] Actual occupant load for each exit door
- [ ] A separate schematic plan indicating where fire rated floor/ceiling and/or roof structure is provided for purposes of occupancy separation
- [ ] Location of doors with panic hardware (1010.1.10)
- [ ] Location of doors with delayed egress locks and the amount of delay (1010.1.9.7)
- [ ] Location of doors with electromagnetic egress locks (1010.1.9.9)
- [ ] Location of doors equipped with hold-open devices
- [ ] Location of emergency escape windows (1030)
- [ ] The square footage of each fire area (202)
- [ ] The square footage of each smoke compartment for Occupancy Classification I-2 (407.5)
- [ ] Note any code exceptions or table notes that may have been utilized regarding the items above

PLUMBING FIXTURES

CONCESSIONS: 1,976 SF seating area = 1,976 / 15 = 132 (66 male, 66 female)
Required: [A-2] (1) WC per 75, (1) LAV per 75 each sex.
Provided: (2) Single use toilets with (1) WC & (1) LAV each.
Maximum supported occupants = 150

TACKLE SHOP: 1,160 SF space = 1,160 / 60 = 20 occupants
Required: [M] (1) WC per 500, (1) LAV per 750
Provided: (1) Single use toilet with (1) WC & (1) LAV
Maximum supported occupants = 100
D.F. not required when under 100 occupants.

RETAIL [TBD]: 400 SF space = 400 / 100 = 4 (2 male, 2 female)
Required: [TBD] (1) WC per 25, (1) LAV per 40
Provided: (1) Single use toilet with (1) WC & (1) LAV (shared with Tackle Shop)
Maximum supported occupants = 25 (for single unisex restroom)
D.F. : To be determined depending on occupancy.
(Calculation for Business shown for reference.)

PUBLIC RRs: Provided: (2) Mulit-Use restroom with (2) WC & (1) LAV each.
Assuming use similar to [A-5] with (1) WC per 100
the supported occupancy load is (4) WC x 100 = 400 people.

SPECIAL APPROVALS

Special approval: (Local Jurisdiction, Department of Insurance, SBCCI, ICC, etc., describe below.)
Local Jurisdiction

[TBD] ENERGY SUMMARY

Existing building envelope complies with code: [ ] No [ ] Yes (The remainder of this section is not applicable)
Exempt Building: [ ] No [ ] Yes (Provide code or statutory reference):
Climate Zone [X] 3A [ ] 4A [ ] 5A
Method of Compliance: Energy Code [ ] Performance [ ] Prescriptive
ASHRAE 90.1 [ ] Performance [ ] Prescriptive
(If "Other" specify source here)

THERMAL ENVELOPE (Prescriptive method only)

Roof/ceiling Assembly (each assembly)
Description of assembly
U-Value of total assembly
R-Value of insulation
Skylights in each assembly

Exterior Walls (each assembly)
Description of assembly
U-Value of total assembly
R-Value of insulation
Openings (windows or doors with glazing)
U-Value of assembly:
Solar heat gain coefficient:
projection factor:
Door R-Values:

Floor Slab on Grade
Description of assembly
U-Value of total assembly
R-Value of insulation

STRUCTURAL DESIGN
[TBD]

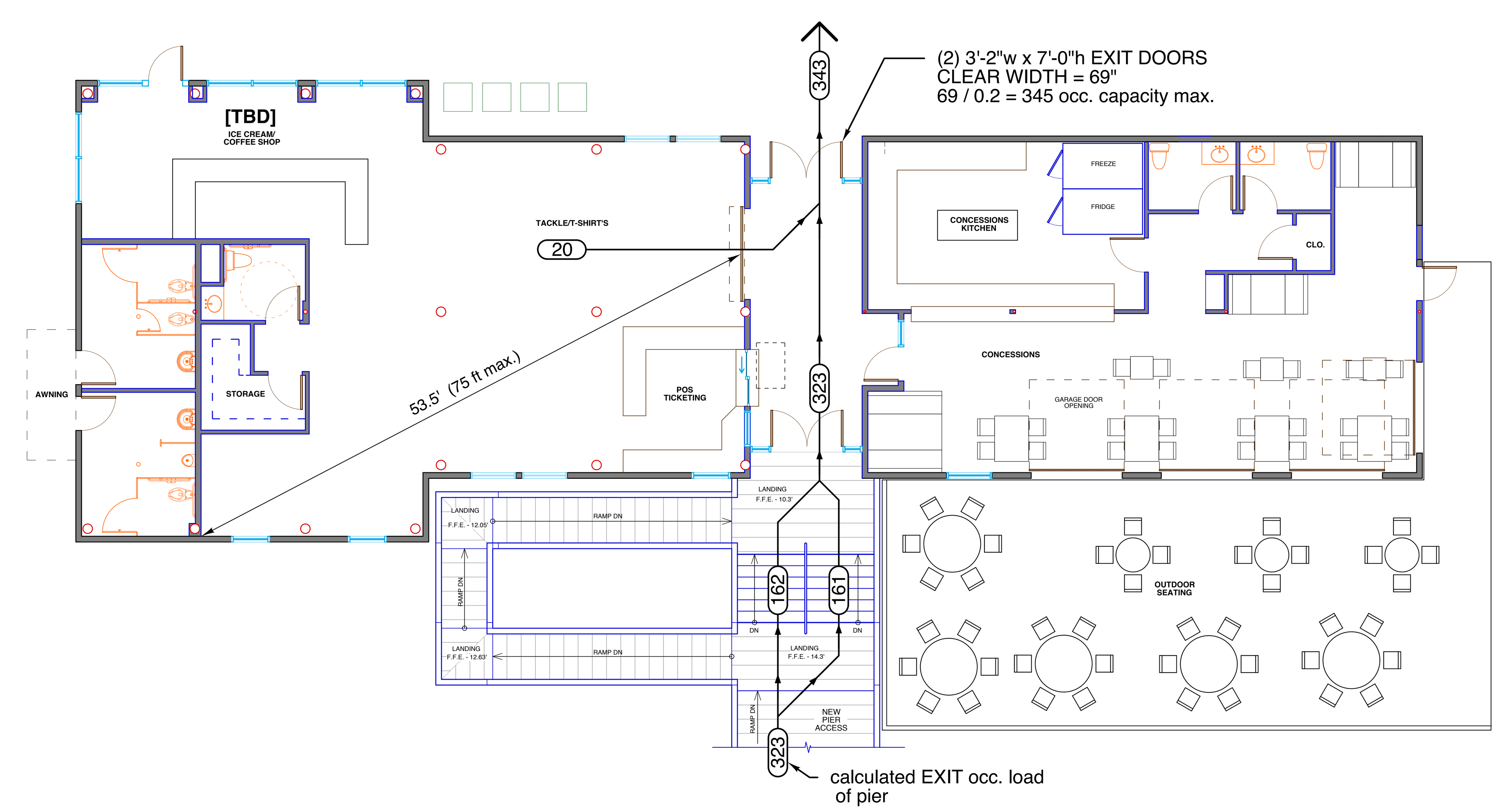
DESIGN LOADS:
Importance Factors: Snow (I_s)
Seismic (I_E)
Live Loads: Roof psf
Mezzanine psf
Floor psf
Ground Snow Loads: psf
Wind Loads: Ultimate Wind Speed mph (ASCE-7)
Exposure Category

SEISMIC DESIGN CATEGORY: [ ] A [ ] B [ ] C [ ] D
Provide the following Seismic Design Parameters:
Risk Category (Table 1604.5) [ ] I [ ] II [ ] III [ ] IV
Spectral Response Acceleration SS %g SI %g
Site Classification (ASCE 7) [ ] A [ ] B [ ] C [ ] D [ ] E [ ] F
Data Source: [ ] Field Test [ ] Presumptive [ ] Historical Data
Basic Structural System [ ] Bearing Wall [ ] Dual w/Special Moment Frame
[ ] Building Frame [ ] Dual w/Intermediate R/C or Special Steel
[ ] Moment Frame [ ] Inverted Pendulum
Analysis Procedure [ ] Simplified [ ] Equivalent Lateral Force [ ] Dynamic
Architectural, Mechanical, Components anchored? [ ] Yes [ ] No

LATERAL DESIGN CONTROL: Earthquake [ ] Wind [ ]
SOIL BEARING CAPACITIES:
Field Test (provide copy of test report) psf
Presumptive Bearing capacity psf
Pile size, type, and capacity

[TBD] MECHANICAL SUMMARY

[TBD] ELECTRICAL SUMMARY



TRUE
PROJECT NORTH

1 G1.1 **Life Safety Plan** [Preliminary]
scale: 1" = 10'-0"

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CERT. NO. 50424
NORTH CAROLINA
WILMINGTON, N.C.

Holden Beach Pier Renovation
441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Building Data
Life Safety Plan

JOB NUMBER
DRAWN BY AT
CHECKED BY GCH
DATE 12/8/22
REVISIONS

SHEET NUMBER
G1.1

1
A1.0

Existing Site Plan

scale: 1" = 30'-0"

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Holden Beach Pier
441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Existing Site Plan

JOB NUMBER

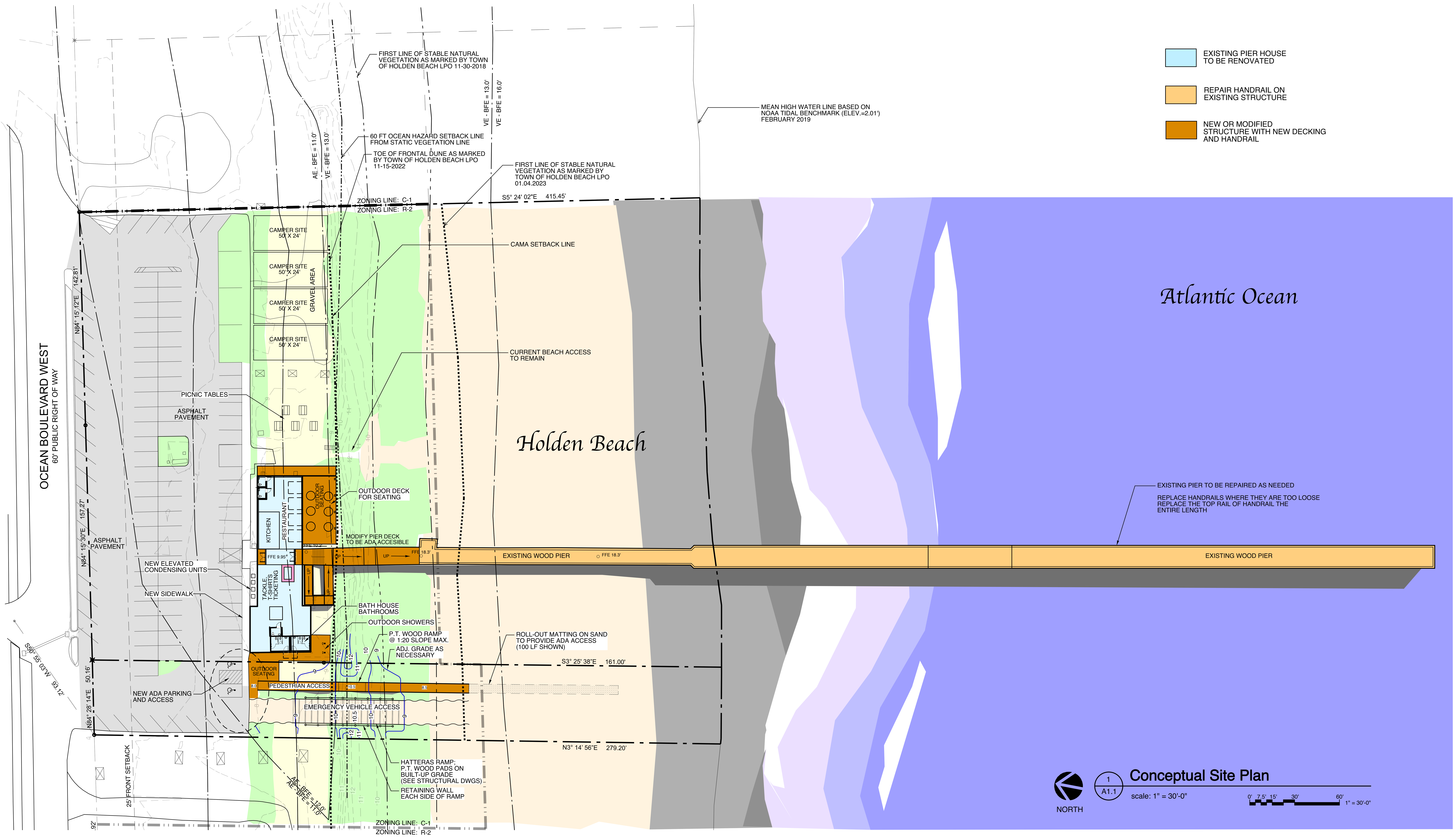
DRAWN BY
MG

CHECKED BY
GCH

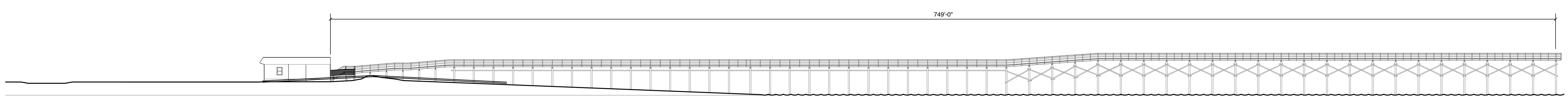
DATE
12/8/22

REVISIONS
03.31.23 ADD UPDATED SURVEY INFO.

SHEET NUMBER
A1.0



1 A1.1 **Conceptual Site Plan**
scale: 1" = 30'-0"



2 A1.1 **Conceptual Elevation**
scale: 1" = 30'-0"
0' 7.5' 15' 30' 60'
1" = 30'-0"

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Holden Beach Pier
441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Conceptual Site Plan & Elevation

JOB NUMBER

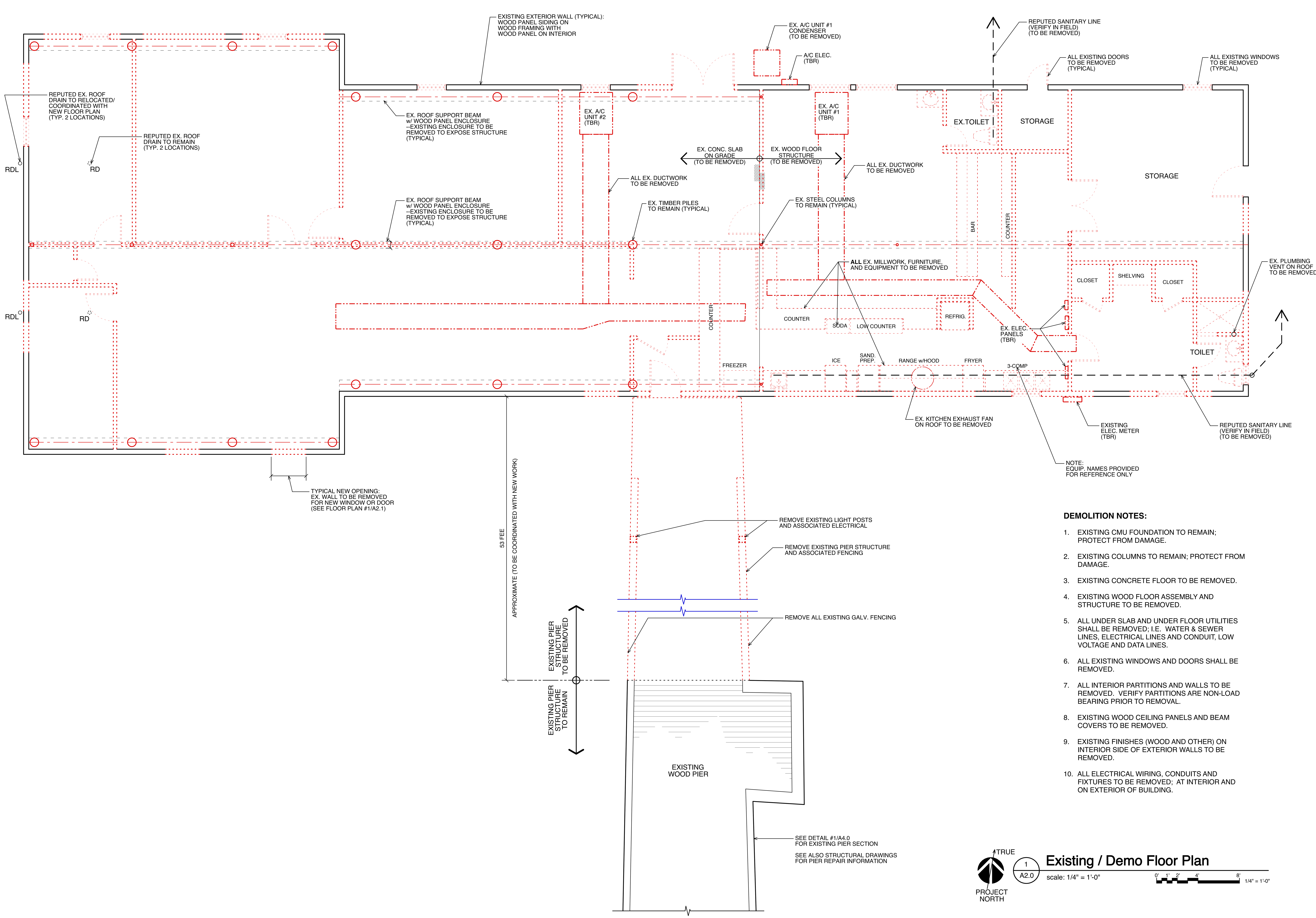
DRAWN BY
MG

CHECKED BY
GCH

DATE
12/8/22

REVISIONS
03.31.23 ADD UPDATED SURVEY INFO.

SHEET NUMBER
A1.1



DEMOLITION NOTES:

1. EXISTING CMU FOUNDATION TO REMAIN; PROTECT FROM DAMAGE.
2. EXISTING COLUMNS TO REMAIN; PROTECT FROM DAMAGE.
3. EXISTING CONCRETE FLOOR TO BE REMOVED.
4. EXISTING WOOD FLOOR ASSEMBLY AND STRUCTURE TO BE REMOVED.
5. ALL UNDER SLAB AND UNDER FLOOR UTILITIES SHALL BE REMOVED; I.E. WATER & SEWER LINES, ELECTRICAL LINES AND CONDUIT, LOW VOLTAGE AND DATA LINES.
6. ALL EXISTING WINDOWS AND DOORS SHALL BE REMOVED.
7. ALL INTERIOR PARTITIONS AND WALLS TO BE REMOVED. VERIFY PARTITIONS ARE NON-LOAD BEARING PRIOR TO REMOVAL.
8. EXISTING WOOD CEILING PANELS AND BEAM COVERS TO BE REMOVED.
9. EXISTING FINISHES (WOOD AND OTHER) ON INTERIOR SIDE OF EXTERIOR WALLS TO BE REMOVED.
10. ALL ELECTRICAL WIRING, CONDUITS AND FIXTURES TO BE REMOVED; AT INTERIOR AND ON EXTERIOR OF BUILDING.

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Holden Beach Pier
441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Existing / Demo Floor Plan

JOB NUMBER

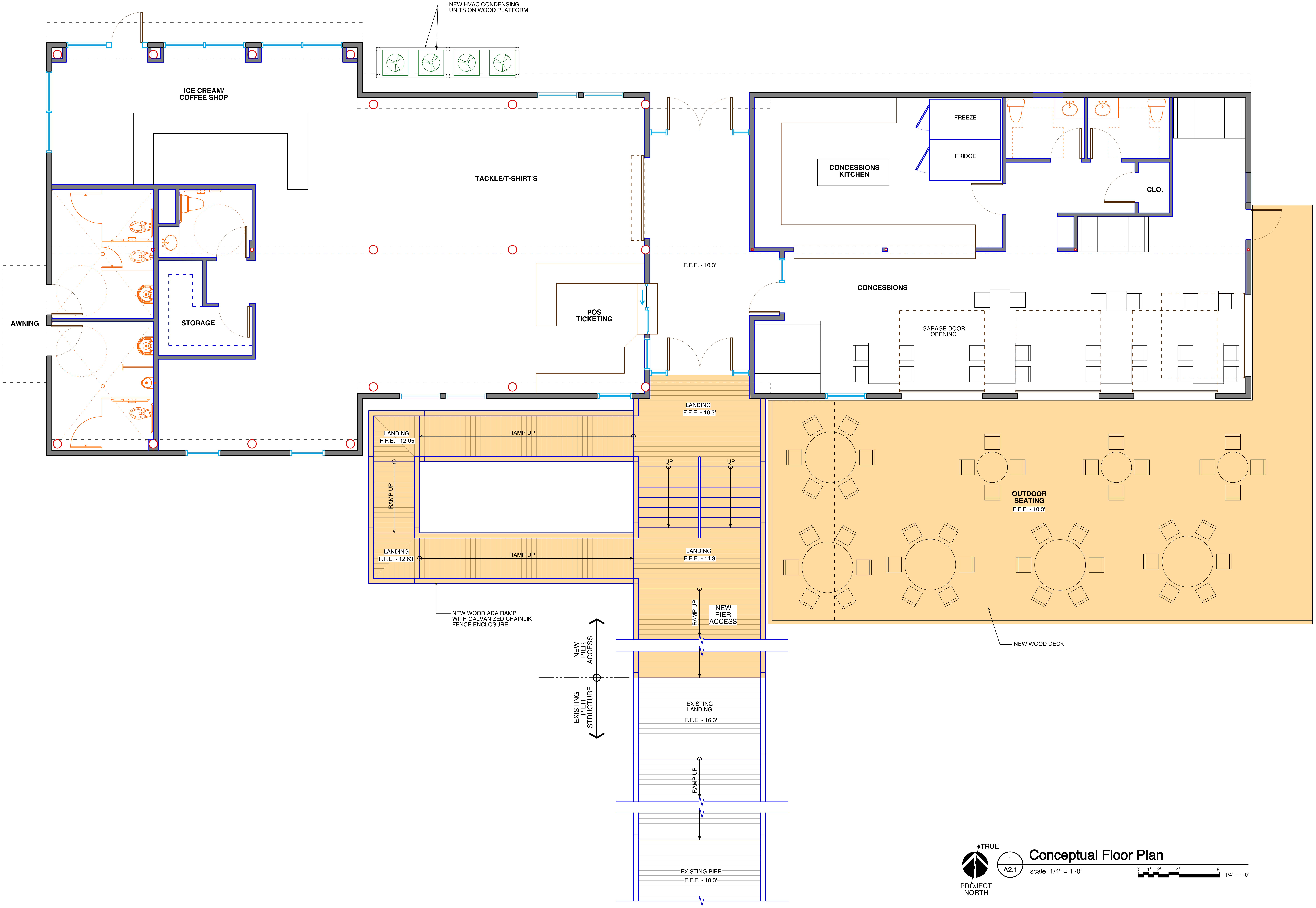
DRAWN BY
MG

CHECKED BY
GCH

DATE
12/8/22

REVISIONS

SHEET NUMBER
A2.0



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CERT. NO. 50424
NORTH CAROLINA
WILMINGTON, N.C.

Holden Beach Pier

441 Ocean Boulevard West
Holden Beach, North Carolina 28462

Conceptual Floor Plan

JOB NUMBER

DRAWN BY
MG

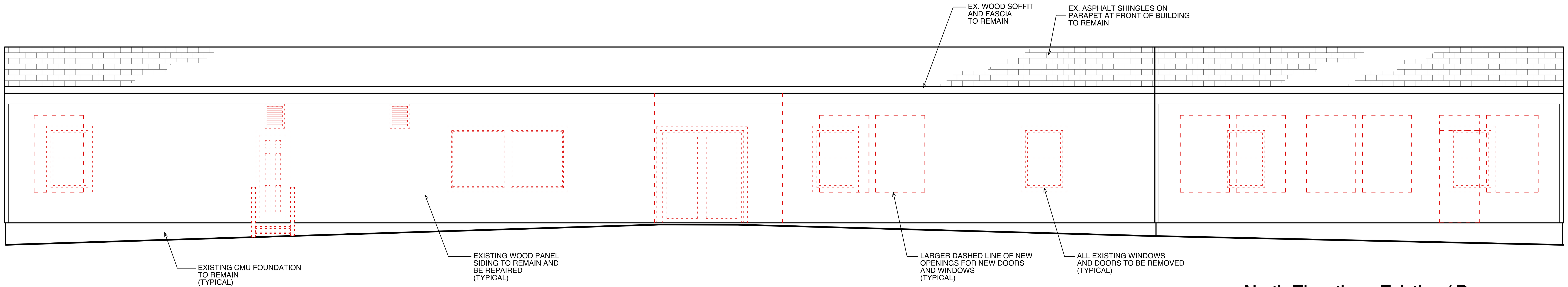
CHECKED BY
GCH

DATE
12/8/22

REVISIONS

SHEET NUMBER

A2.1



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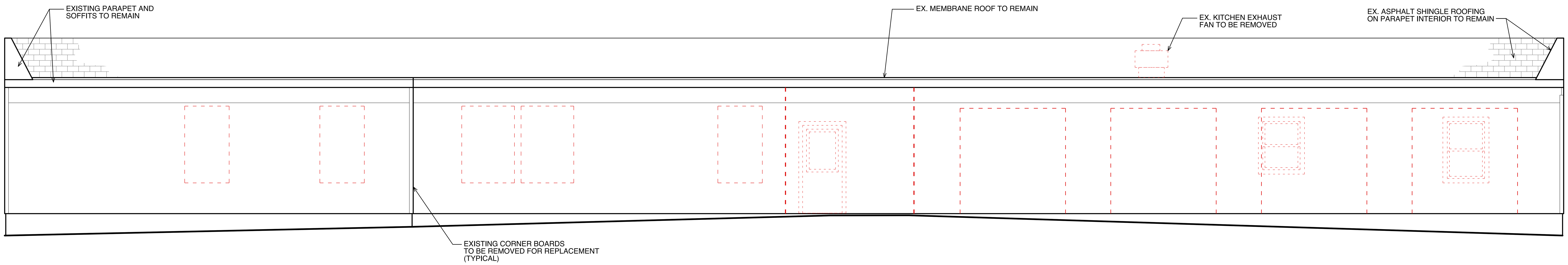

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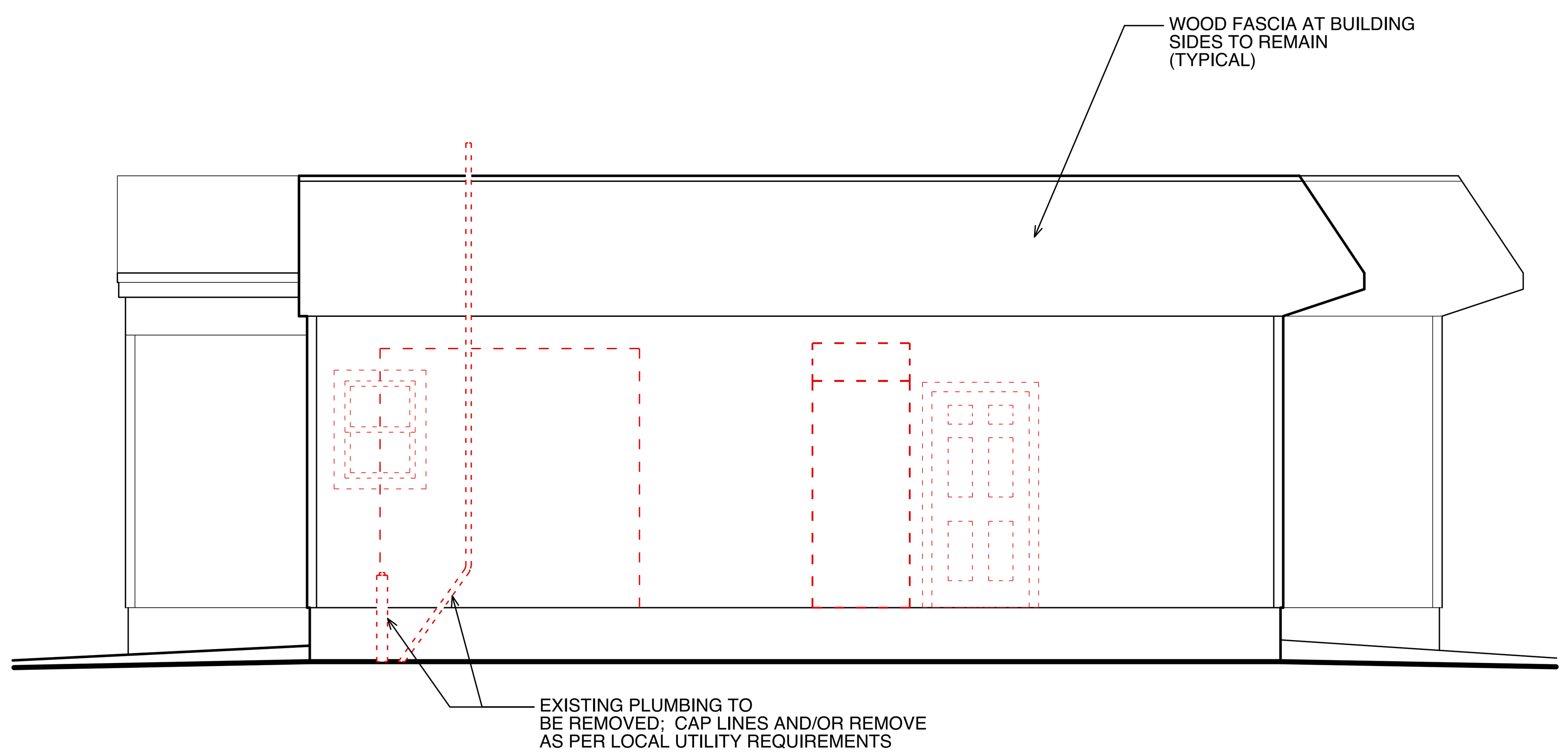

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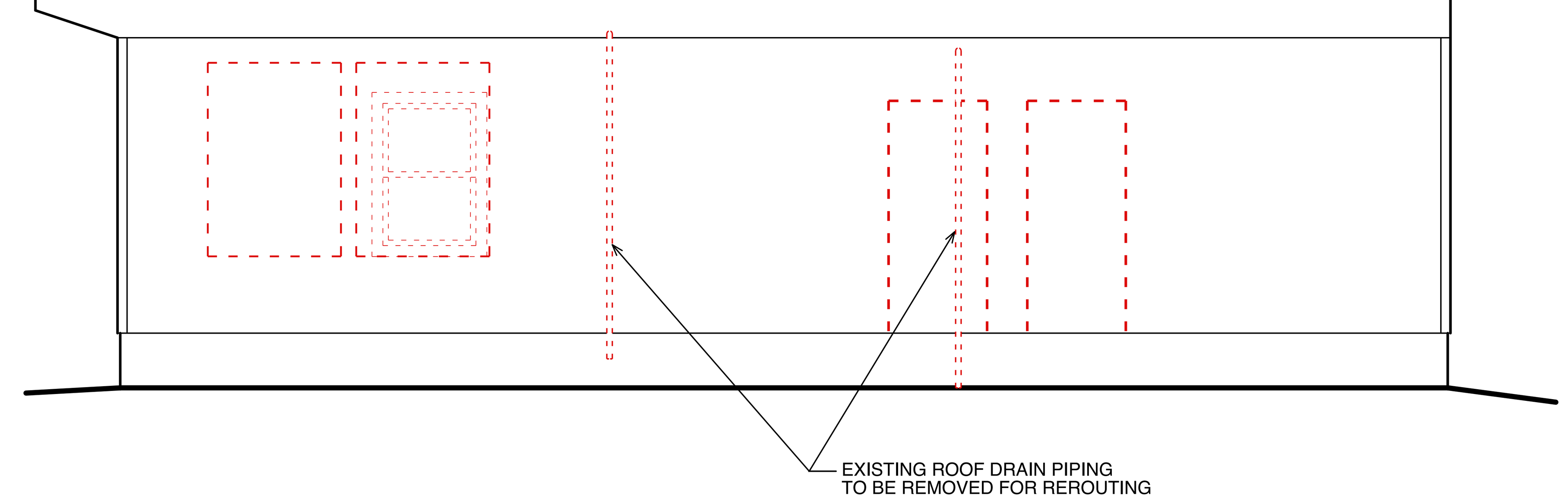

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Holden Beach Pier
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Existing / Demo Elevations

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REVISIONS

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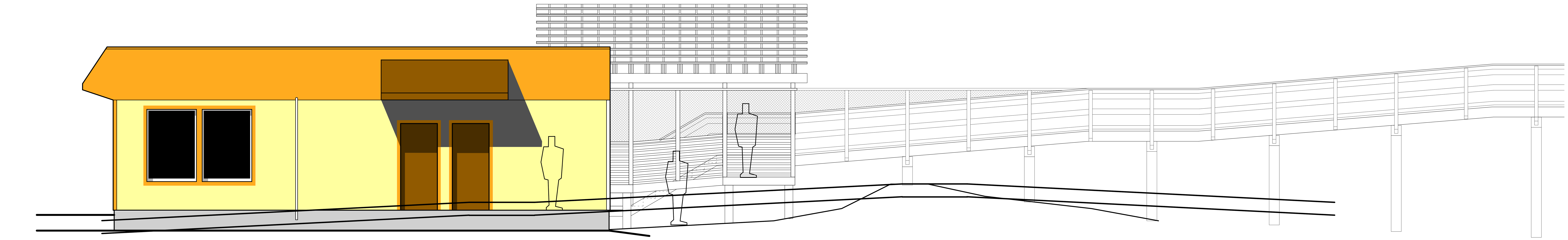
A3.0



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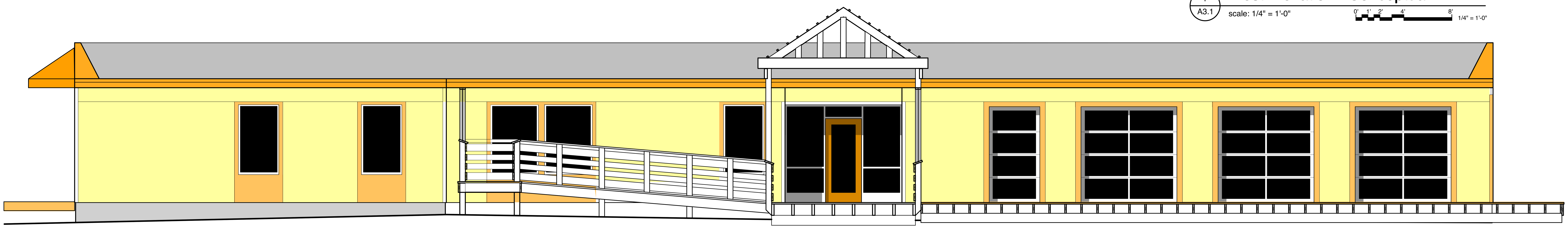

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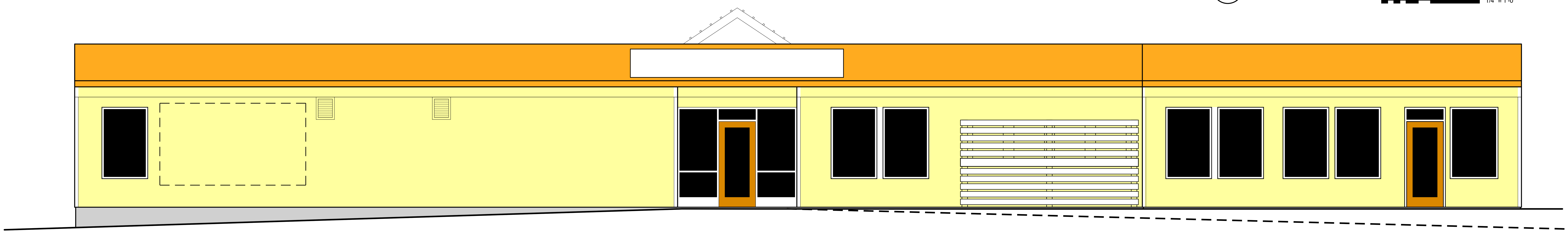

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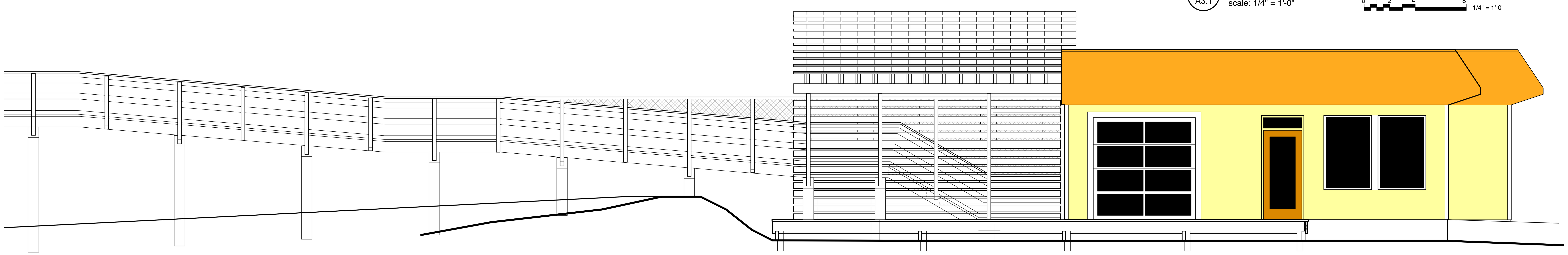

4
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East Elevation - Conceptual
scale: 1/4" = 1'-0"
0' 1' 2' 4' 8' 1/4" = 1'-0"

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REVISIONS

SHEET NUMBER
A3.1

1
A3.2

Existing Pier Elevations

scale: 1/8" = 1'-0"

0' 2' 4' 8' 16' 1/8" = 1'-0"

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Existing
Pier Elevations

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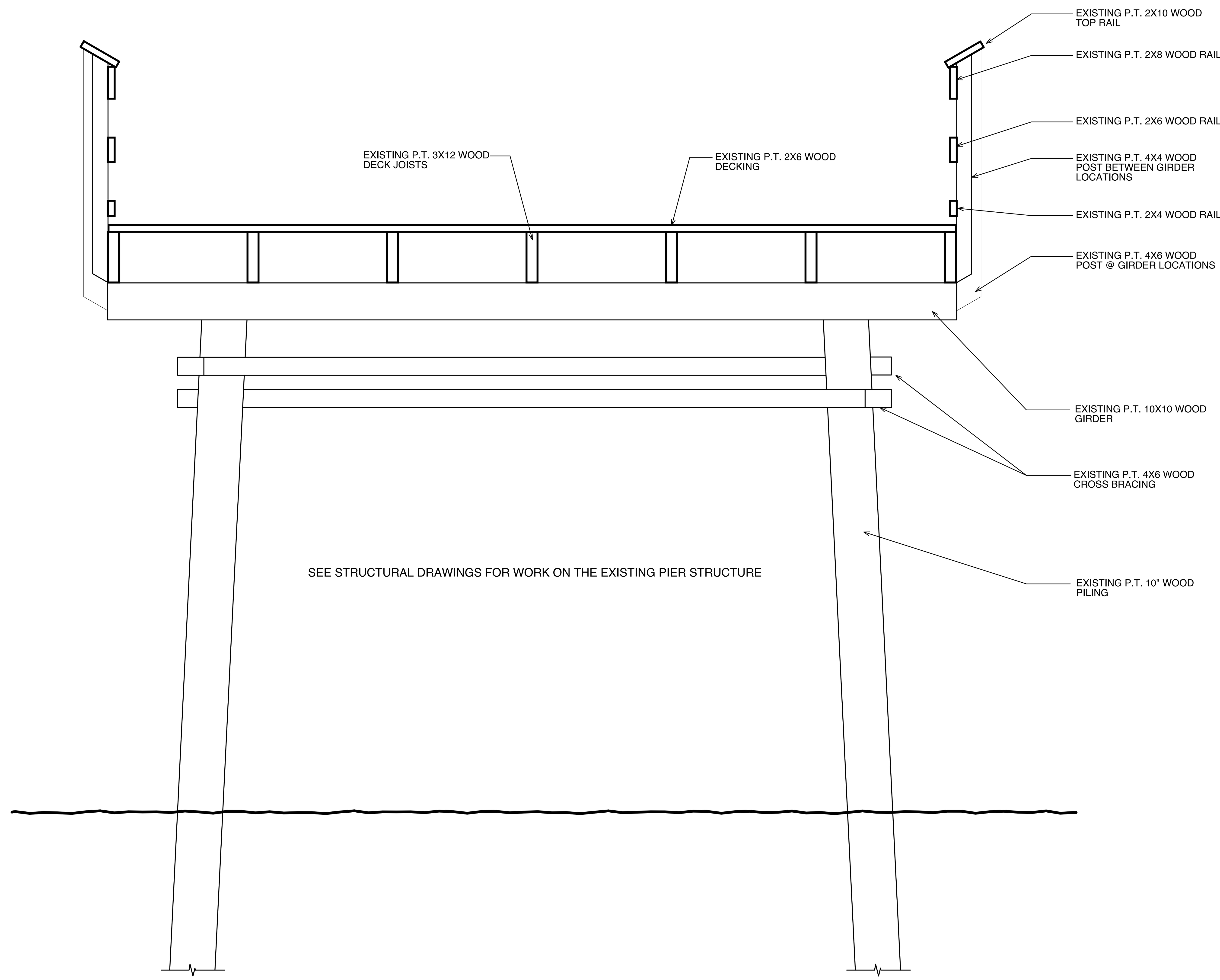
SHEET NUMBER

A3.2



1
A4.0

Existing Pier Section

scale: 3/4" = 1'-0"

0" 4" 8" 1'-4" 2'-8" 3/4" = 1'-0"

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Existing
Pier Section

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A4.0

PIER PROPERTY DEVELOPMENT

INTRODUCTION

The purpose of this document is to initiate discussion concerning development of the pier property by providing a baseline approach to that development. It is also intended to ensure that critical elements such as project cost estimates, life cycle costs, and a clearly defined project approach are addressed in the process. It is not intended to be the final project plan, but to serve as a starting point and to lay out the process for proceeding. Information presented below is partially based on discussions held with Bowman Murray Hemingway Architects (BMH), Andrew Consulting Engineers, and Mid Atlantic Engineering Partners. See attachments A and B for discussion summaries.

Development of the pier property should encompass the entire property, not just the pier and pier building. Development can however be separated into two separate components, namely the pier structure and the land parcels. Separation of the components (and components into phases) is necessary as funding is limited. Given that the pier is the primary feature of the property and considering its deteriorated condition, it is recommended that it be given first priority for funding. Development of the land parcel should not be constrained by a requirement to retain the current pier building, but should be based on a "clean sheet" approach to broaden the potential uses for the property. Renovation of a building in such poor condition that is several feet below the flood plain in an ocean front location is not advisable. A constraint that will have to be considered however are the requirements of the PARTF grant agreement that was entered into in 2022 which restricts the use of the property to recreational purposes indefinitely.

For each of these components, some form of financial/business case analysis should be performed to determine the development, operational and maintenance costs of any proposed options, as well as the potential revenue that can offset the above costs. Initial development costs will be produced in the preliminary design process and refined in the detailed design process. This information will assist decision makers in determining how/if the town can move forward as well as provide a foundation for seeking outside funding sources and partnerships. This is likely to be more complicated for parcel development in that several possible uses may have to be iteratively analyzed. Further, consideration must be given as to whether the town should enter into commercial real estate development that could compete with local businesses on the island (and off). Lessees would have to cover 100 percent of the debt service, maintenance and operations cost, insurance, etc. Otherwise they would be essentially subsidized by the tax payers which would not be fair to tax paying businesses on the island. Given today's delivery oriented society, dedicated space for deliveries from local businesses may be a viable option.

PIER

The pier component of the project needs to be addressed from two perspectives, namely repair and replacement. Preliminary design work, project cost estimates and life cycle costs (30 years) need to be developed by the technical agent for each perspective to support decision making.

PIER REPAIR

With regard to repairing the pier, the initial RFP issued by the town came in with a low bid that was 100% over the budgeted amount. This RFP was considered the minimum amount of work to be done to reopen the pier as efficiently as possible. In order to more closely match the budget, it was suggested that the scope be reduced and the project rebid. At that time, the primary cost reduction tool was to water jet the new pilings in versus driving them in. Subsequent discussions with BMH, Andrew

Consulting Engineers and Mid-Atlantic Engineering Partners determined that the piles must be driven in. Driving piles provides a determination/verification of the pile capacity (bearing load and uplift resistance) and greater resistance to lateral loading which cannot be obtained by jetting alone. However, cost savings could be achieved by doing the piling installation from the pier deck to minimize the use of floating plant (a significant cost driver). To accomplish repairs from the deck, the pier would have to be repaired from the shore out (replacing fasteners, bracing, etc) and possibly strengthened (additional stringers) to support equipment and materials for replacing piles and other structure. The added benefit of this approach is that future pile replacement, maintenance and storm damage repairs could likely be done from the deck avoiding considerable cost and accomplished in a more timely fashion. A structural analysis and design will be required to support this approach. The existing pier building would have to be razed to provide access for equipment and materials onto the pier. It should be noted that all present at the BMH meeting agreed that the building is a tear down. Since the building is in such poor condition that is several feet below the flood plain in an ocean front location, razing it should not be an issue.

The pier repairs will likely need to be accomplished in phases to fit within the available funding and not jeopardize higher priority projects. Preliminary design work, and project cost estimates for each phase must be developed for proper decision making. Suggested phases would be as follows:

1. Structural Stabilization of the existing pier – This will include replacement of all 16 major/ severely damaged piles, replacement of all fasteners, and a significant portion of the bracing, if not all, depending on analysis results. Analysis may call for additional bracing as well.

2. Safety repairs – This phase would complete repairs to make the pier safe for the public, to include handrails, ADA access, etc.

3. Complete remaining repairs – These repairs include plumbing, electrical and decking replacement.

4. Extend the pier to 250 feet – This final phase would restore the pier to its original 1000 feet and reach significantly deeper fishing waters than that available at the current 750 ft (4-8ft).

These phases could be combined into combinations of base bids with options based on funding availability.

PIER MAINTENANCE

Given the age of the pier components, (anywhere from 25 to 65 years), maintenance costs must be planned for. Contrary to what was originally reported in the pier inspection reports, the pier pilings are not greenheart hardwood (Greenheart wood is naturally decay and marine organism resistant, has a service life of 50 years, and is significantly stronger than treated pine or fir), but are pressure treated green wood of an unknown species (see final Mid Atlantic Report). Unfortunately, there are no maintenance or repair records available for the pier, so the exact age of the piles is not known. The current assumption is the last pile installation was possibly in 1999. Based on discussions with industry professionals, pressure treated pilings have an expected service life of 25 years. Fortunately, piling inspection results that included pic penetration and hammer testing found most, if not all the piles to be sound, except those with cracks or fissures. It should be noted that several of the damaged piles had damage at the pile cap where the dowel pin connection was made, which is likely to be an ongoing problem in the future. Consequently, a condition based maintenance program should be implemented with periodic and post storm inspections of the pier to allow for planned maintenance and repair. In addition to planned maintenance, repairs from storm damage need to be considered as well.

Given this consideration and the maintenance challenges cited above, a capital reserve fund for supporting the pier may be advisable.

PIER REPLACEMENT

The initial assumption here is that a new wood pier will be constructed as opposed to a concrete pier primarily due to cost. Although a concrete pier is preferred, it may not be financially supportable for a small tax base like Holden Beach. While the upfront cost to replace the pier will be higher than repairing the pier, the life cycle costs will likely be less. A better design with more robust components (larger/concrete piles, better bracing, known pile embedment, greater height above the surf) will provide a more storm resistant structure and new materials will greatly reduce maintenance costs for many years after construction. It may also be possible to leverage off the Oak Island pier replacement project to reduce engineering and cost estimating costs as well (Andrew Consulting was the design agent). It should be noted that the Oak Island pier was replaced for approximately 2.6M in the 2017-2019 time frame.

Funding a pier replacement will likely require financing the project with some sort of loan or bond. Any option to finance a pier replacement should be approved by the property owners/voters in a referendum or by some other reliable method. It is also possible to phase this project too by replacing the current 750 feet initially and constructing the last 250 feet at a different time to for funding flexibility.

Again, a condition based maintenance program should be implemented with periodic and post storm inspections of the pier to allow for planned maintenance. In addition to planned maintenance, repairs from storm damage need to be considered as well. Given this consideration and the maintenance challenges cited above, a capital reserve fund for supporting the pier may be advisable.

SITE DEVELOPMENT

Public (primarily the tax payers) input and the aforementioned financial analysis will drive the features to be developed on the site. In addition, site development will have to comply with the requirements of the PARTF grant contract. If a conflict arises, a contract modification could be possibly negotiated. For the features that are chosen, an annual cost for maintenance, repair and operation (life cycle cost) must be developed. This along with any debt service payments will be needed for decision making and budgeting purposes. In the event that some sort of building(s) are considered, the design should not impede access to the pier for maintenance and repair purposes. All features must be ADA compliant of course.

GOING FORWARD

It is recommended that the following tasks be initiated as soon as financially possible to provide decision making information for the BOC to determine how and when to proceed with the project. Specific Statements of Work should be developed for the technical agent to ensure the desired outcomes are obtained. In addition, a competent project manager needs to be identified to oversee this work.

- Task 1 - Initiate preliminary design work for repair of the current pier from the deck(in phases similar to that outlined above), to include cost estimates for each phase and a draft Maintenance and Repair Plan with yearly cost estimates.

- Task 2 - Initiate preliminary design and cost estimates for a new wooden pier (in phases as outlined above), to include cost estimates for each phase and a draft Maintenance and Repair Plan with yearly cost estimates.

- Task 3 - Initiate preliminary land site wide conceptual design(s) that comply with PARTF requirements to include initial cost estimates for construction, operation and maintenance.

- Task 4 - Conduct a financial/business case analysis should be performed to determine potential revenue that can offset the development costs. This should include some type of market analysis of any potential commercial/retail facilities that may be on the site.

FINANCING

Unexpended funds from the pier repair account should be available this year to fund the above preliminary design and financial work. For constructing the project, see attachment C, Town of Holden Beach Debt Service. It can be seen that in FY25-26, debt service will be reduced by approximately 484K. In FY26-27, another 702K debt is eliminated providing a running total of 1.186M that could be available to fund pier construction. It should be noted that in FY 27-28 the Central Reach Beach Renourishment debt will be paid off, but that the available funds may be applied to the Beach and Inlet reserve fund.

It is imperative that it be understood that **the pier is an amenity and will have to compete against critical infrastructure and other non critical projects for funding.** Examples of critical infrastructure projects include water system capacity increases, stormwater projects, fire station replacement (for 24/7 manning), road paving, beach and inlet maintenance, etc.

If the project cannot be funded within the existing budget, alternative financing such as a loan, bond, or grants, or some other method may be an option. In order to pursue these options, the above tasks must be complete so prospective financiers can adequately evaluate the request. It should also be noted, that from a state and county perspective, there are four other ocean fishing piers within an hour's drive from the Holden Beach causeway. This fact could adversely affect the attractiveness of state and county assistance. This is further exacerbated by the beach, canal and several fishing locations already in existence at Holden Beach.

Last, and perhaps most important, any financing arrangement must be approved by the voters/property owners given the magnitude of the costs involved. While a public hearing may be all that is legally required, they typically result in very poor attendance in part due to the fact that around 70% of the property owners do not live here and the hearings are not extensively advertised. A referendum during an election year (2025) may be more appropriate or some other iron clad way of assessing the property owners' position.

NOTIONAL TIMELINE

The following time line is an educated guess based on experience and will necessarily have to be refined based on more detailed discussion. It is also based on using the current technical agents (BMH, Andrew Consulting) to leverage off the already completed work and Andrew Consulting's experience with designing the Oak Island Pier

Task 1 – 3 months – 7/1/2024-10/1/2024
Task 2 - 3 months – 09/1/2024-12/01/2024
Task 3 - 6 months – 02/01/2025-07/01/2025
Task 4 – Pier portion– 7/1/2024-10/1/2024; Site Portion - TBD depends on task 3 results

Actual construction times for pier repairs and land parcel development will depend on available funding and selected site features. Replacement of the pier is estimated to take 3 years based on construction of the Oak Island pier.

OTHER OPTIONS
Suggestions have been made to pursue a Public Private Partnership (PPP) in an effort to reduce the financial and operational burden on the Town. While a PPP is a viable option, attachments D, E and F clearly demonstrate that a lot of work must be completed before a partnership can be considered.

STAKEHOLDERS
The primary stakeholders for this project are the Holden Beach property owners as they have the financial responsibility for all costs associated with the pier, whether they use it or not. Businesses on the island are secondary stakeholders in that financial support for the pier could affect their overhead and for those businesses near the pier, their foot traffic volume. Day visitors are secondary stakeholders in that they are not financially responsible for the pier given that using the pier is optional for them. Renters/vacationers and are not considered stakeholders as they are customers of the rental property owners. Consequently, their interests are presumably represented by the rental property owners.

SUMMARY
The purpose of this document is to initiate discussion concerning development of the pier property by providing a baseline approach to that development. It is not intended to be the final project plan, but to serve as a starting point. Development of the pier property should encompass the entire property, not just the pier and pier building, with priority given to addressing the pier. Phases have been suggested to make the development financially manageable. A notional timeline for preliminary work has been outlined with possible funding scenarios to accomplish it. Last information concerning public private partnerships is provided along with stakeholder information.

3-14-2024 Meeting Summary

The following is a summary of the meeting discussions held on Thursday, March 14, at 10:30 between Rick Paarfus, Chip Hemingway of Bowman Murray Hemingway Archetects (BMH), Neal Andrew and Zachery Norris of Andrew Consulting Engineers (structural engineering).

At the onset of the meeting, Mr. Paarfus, who is a sitting commissioner for the Town of Holden Beach, stated that he was not there representing the Town of Holden Beach, had no authority to direct or authorize any participants to take action on behalf of the Town or encumber the town in any manner. He further stated that he was there seeking information concerning the Holden Beach pier on his own accord as a private individual and was solely responsible for all costs incurred for the meeting.

Mr. Paarfus inquired if the structural repairs were based only on the documentation provided by the Town or if they had performed their own inspections and incorporated their findings into the repair design. Mr. Andrew stated that they had done their own inspections as well as reviewed the provided documentation to develop the repair designs.

Mr. Paarfus inquired about formal project cost estimates that were developed by the firms for the Town and was informed that they were not requested and consequently not provided. Mr. Hemingway was pressed by the Town Manager for a number for budgetary purposes and he provided a guestimate verbally of 2.1M. It was noted by Mr. Paarfus that without a proper cost estimate it limits the owner's ability to negotiate with a contractor and that it is not good practice to go to bid without a formal cost estimate on a project of this value. It was agreed that formal project cost estimates should be developed prior to any future bidding.

Pile installation methods were discussed next. After consulting with their geotechnical engineer, it was determined that the piles must be installed in the same manner as originally called for in the pier repair bid documents, i.e. driving. It was noted that some jetting may be necessary to penetrate hard pan beneath the mud line, but the final portion of the installation has to be done by driving. Driving not only provides a determination of the pile capacity (bearing load and uplift resistance), but also provides greater resistance to lateral loading of the pile which cannot be obtained with jetting alone.

Mr. Paarfus inquired if jetting piles in could have contributed to the pile cap failures (breakage) and loss of load bearing contact in the inspection reports. Mr. Andrew did not attribute those issues to jetting, but did note that the dowel pins used to attach the horizontal members to the pile caps can corrode and expand sufficiently that when combined with lateral loading can break the pile cap. His preferred method to connect the structure would be through bolting vs. doweling.

The possibility of repairing pile caps vs. replacing piles was briefly discussed and it was determined that this is not recommended unless it is the only repair that the town could afford.

Reduction of the scope was then discussed. The approach to reduce the scope would be to minimize the need for floating plant to make repairs and accomplish the work from the pier deck. To accomplish this, the pier structure would have to be repaired from the shore out (replace all fasteners, bracing, etc.) and possibly strengthened (additional stringers) to be able to support equipment and materials to do the work. Mr. Paarfus noted that the inspection reports indicated that the stringers were held in place with nails, brackets, or no visable form of attachment to the horizontal structural members. A structural analysis will be required to support this approach.

ATTACHMENT A

In order to accomplish repairs from the pier deck, the center of the pier house will have to be removed to allow equipment to access the pier. Importantly, it should be noted that all in attendance consider the pier house a tear down. It was agreed by all present that it did not make sense to renovate a building in such poor condition that was several feet below the flood plain in an ocean front location. In fact, BMH nearly turned down the job because of the previous BOC's insistence that the pier house be renovated.

The discussion turned to how the pier repairs might be phased in order to accommodate a limited budget. Structural stabilization of the pier is the first step to be considered. The second phase would be to complete repairs to make the pier safe for the public (handrails, other safety issues). The third phase would be to complete ADA requirements, electrical and plumbing repairs. Formal cost estimates for each of these phases will have to be prepared to see if the current budget can support them.

Maintenance and repair of the pier was also briefly discussed. Mr. Paarfus noted that the existing piles are not green heart wood as stated in the original inspection reports, but that the species is not known (see final Mid-Atlantic Engineering report). In addition, pressure treated piles are thought to have a service life of roughly 25 years in the marine environment. He stated that he understands that remaining service life is difficult to assess, but some sort of starting point is necessary for maintenance planning. Plans can be adjusted based on inspections over time. Mr. Andrew also noted that planning for the inevitable storm damage repairs must also be considered.

Future tasking relative to the pier project was discussed. It was agreed that a clear scope of work/task statement should be developed for the whole property. The plan should include

Repair of the current pier in phases, with cost estimates
Preliminary design and cost estimates for a new wooden pier (possibly leverage off of Oak Is. Design)
Preliminary site wide design and cost estimates for entire property with cost estimates
Preliminary Draft Maintenance & Repair plan with yearly cost estimates

All of the above should be divided into phases to support multi year funding due to limited resources. Mr. Paarfus addressed the fact that the property's use is currently constrained by a Parks and Recreation Trust Fund grant that will have to be considered in planning for the property. He also said that pier project funding has to compete against other higher priority critical infrastructure projects for resources. However, if the above project information was available, the BOC would be in a much stronger position to develop a funding strategy and to pursue other funding sources.

Last, Mr. Paarfus inquired about the evolution of the project with regard to direction from the previous BOC. Based on the dates on the pier house drawings and the pier repair drawings, it appears that the BOC focus had initially been on the pier house for the first year, until around the May 2023 timeframe and then the direction shifted to the pier repairs to get it open. BMH confirmed that this is correct. Mr. Paarfus stated that he felt the pier project was handled in a way others do not agree with which was also the general consensus of those in attendance. It was noted that the intent was to get the pier reopened as cost efficiently as possible but the cost still proved to be over budget.

The meeting adjourned at roughly 11:34 a.m.

Prepared by Rick Paarfus

Discussion with Stuart Lewis, P.E., MidAtlantic Engineering Partners 2-27-24@9:45 a.m.

Subject: Project GES-2201, Holden Beach Pier - Due Diligence Inspection

Stuart and I discussed the findings of the subject report (2022-05-17_GES-2201_LetterReport_2.0), potential issues with the pier, and areas for consideration before proceeding with repairs. The inspection and following report were generated as part of a due diligence inspection of the pier in 2022 before Holden Beach's acquisition. The MidAtlantic Engineering Partners was contracted under Geosyntec to inspect the pier elements underwater. This discussion included the following items:

1. Inspection
2. Piles
3. Overall Pier Structure
4. Pre-Construction
5. Cost Benefit Analysis
6. Construction Approach

Inspection:

- We performed the Due Diligence Inspection following ASCE Manuals and Reports on Engineering Practice No. 130 – "Waterfront Facilities Inspection and Assessment" standards. A Due Diligence inspection aims to form an engineering opinion of the general condition of a structure and estimate the order-of-magnitude replacement costs and repair costs.
- All timber piles were inspected visually and tactilely during the inspection, from the caps down to the mudline.
- Tactile inspection included hammer and pic penetration on the piles. The tactile inspection aims to determine the physical condition of the elements compared with the original as-built condition.
- We found most, if not all, of the piles to be sound, except for those with cracks or fissures, as noted in the report.
- The timber piles (except where noted) were in minor condition, i.e., looked good from the mud line up to the bracing, with no significant damage or deterioration noted.

Piles:

- Typically, 1-2 ft. below the mudline, timber piles are usually in good shape due to a lack of oxygen, no marine bores, rot, or deterioration.
- The timber piles' point of fixity results in piles either breaking at the mudline or at other points of fixity (near bracing).
- Most piles from the current shoreline to the offshore end are pressure-treated green piles but unknown timber species or pressure-treated material. Based on Mr. Lewis's experience, these piles have a service life of 25 years. The pressure treatment does not penetrate the pile fully and can wash out on the exterior. EPA rules/regulations no longer permit creosote timber piles in the marine environment.
- Mr. Lewis recommends replacing piles with pre-cast concrete piles for longevity. He also noted that composite piles are around 1.75 times as expensive as pre-cast concrete piles.
- You can install pre-cast concrete piles without causing damage.
- Mr. Lewis has used composite piles in the New York City harbor; they have superior abrasion resistance compared to concrete and timber.

ATTACHMENT B

- Mr. Lewis does not recommend jetting piles in for public access structures like a fishing pier. Resistance to uplift forces is a big concern (surface friction), and the pile capacity (end bearing and surface friction) cannot be determined/evaluated as with pile driving.

Pier Structure:

- Overall, Mr. Lewis thought the structure needed a more robust design for the environmental forces from the Atlantic Ocean.
- Current bracing could be more adequate.
- Pier deck height requirements can vary based on local requirements.
- We did not perform a load rating analysis as part of MidAtlantic's scope. However, the pier likely was designed to be 100 lbs/SF.

Pre-Construction:

- As per the ASCE Manual, a design-level inspection and additional engineering activities should be performed before construction.
- Pile bracing needs to be redesigned, as they appeared to be undersized based on the level of braces broken.
- Should a re-build of the pier be considered, using pre-cast concrete piles for replacements. However, due to the geographic location and possible hurricanes, even concrete piles can fail with specific loads.
- To open the pier before repairs, the city should develop Pier closure criteria to include the number of people allowed on the pier, certain load limits around specific areas where known failed piles and caps exist, weather conditions that dictate temporary closure, etc.

Cost-Benefit Analysis

- Given the geographic location of the pier and the unpredictability of the Atlantic and Hurricanes, even the most robust pier can fail to mother nature.
- A more robust pier will be more expensive. The alternative could involve installing a lower-quality pier that we can replace. Certain criteria for use would be implemented, i.e. weather restrictive use.
- Perform annual inspections of the pier before peak-season tourism to minimize downtime of the pier. (perform inspection between Feb-March to allow for repairs to be completed in April)

New Pier Construction

- Build out from shore, remove the need for floating construction.
- We should evaluate pier loading to determine what equipment loads are acceptable, if any.
- Wilmington, NC, and Charleston have reputable marine contractors for this work.
- Create a nationwide solicitation for qualified contractors for the new pier construction.

Town of Holden Beach, NC

Debt Service By Issue for All Types from 07/01/2022 to 07/01/2038

All Types

Schedule	Maturity Dates
Profile as Of	07/01/2022
Frequency	Annual
First Period End	07/01/2023
End Date	07/01/2038

	interest rate	FY 23	FY 24	FY 25	FY 26	FY 27
BLOCK Q 2022 Promissory Note	3.180%	365,133.33	354,533.33	343,933.33	-	-
EOC 2015 Note - Real Estate	2.420%	93,334.83	93,334.83	93,334.83	-	-
VAC TRUCK 2021 Capital lease	2.100%	64,770.39	64,770.39	64,770.39	64,770.40	-
2005 Sanitary Sewer Revolving Loan	2.205%	181,366.67	177,691.67	174,016.67	170,341.67	-
2004 Sanitary Sewer Revolving Loan	2.205%	415,821.67	415,821.67	415,821.65	415,821.66	-
CENTRAL REACH 2016 Note - Flood and Erosion Control	2.180%	1,317,720.00	1,291,560.00	1,265,400.00	1,239,240.00	1,213,080.00
TOWN HALL 2008 Note - Real Estate	3.810%	237,793.45	230,173.45	222,553.45	214,933.45	199,267.48
2019B Taxable Enterprise Systems Revenue Refunding Bonds	2.347%	518,174.85	518,964.01	519,407.29	519,176.31	519,505.64
LS REIMBURSEMENT 2021 Note - Sanitary Sewer	1.920%	152,443.06	150,153.55	147,864.05	145,574.54	143,285.03
LS REIMBURSEMENT 2021A Note	2.290%	69,312.07	68,120.49	66,928.91	65,737.33	64,545.75
PIER 2022 Installment Financing Contract	3.180%	277,959.90	279,175.12	273,099.04	267,022.95	260,946.86
Annual Debt Payment		**3,693,830.22**	**3,644,298.51**	**3,587,129.61**	**3,102,618.31**	**2,400,630.76**

ATTACHMENT C

FY 28	FY 29	FY 30	FY 31	FY 32	FY 33	FY 34	FY 35	FY 36	FY 37	FY 38
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
520,152.04	517,583.78	-	-	-	-	-	-	-	-	-
140,995.53	138,706.02	136,416.51	134,127.00	131,837.49	129,547.99	127,258.48	124,968.97	122,679.46	120,389.95	-
63,354.16	62,162.58	60,971.00	59,779.41	58,587.82	57,396.24	56,204.66	55,013.08	53,821.50	52,629.92	-
254,870.78	248,794.69	242,718.60	236,642.52	230,566.44	224,490.35	218,414.26	212,338.18	206,262.09	200,186.00	194,109.84
979,372.51	**967,247.07**	**440,106.11**	**430,548.93**	**420,991.75**	**411,434.58**	**401,877.40**	**392,320.23**	**382,763.05**	**373,205.87**	**194,109.84**

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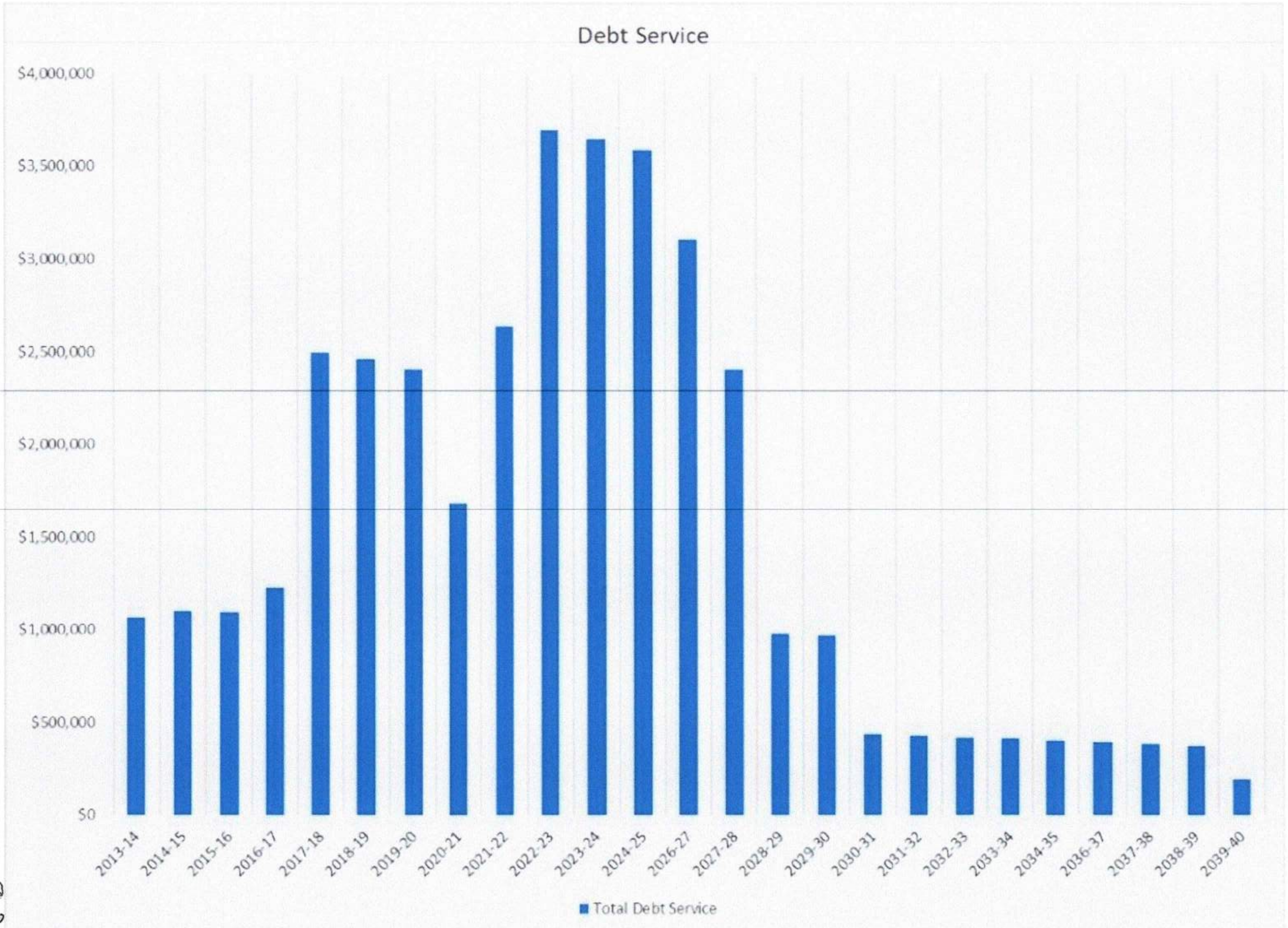
Debt Service
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$3,500,000
$3,000,000
$2,500,000
$2,000,000
$1,500,000
$1,000,000
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2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
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2032-33
2033-34
2034-35
2036-37
2037-38
2038-39
2039-40
Total Debt Service

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UNC SCHOOL OF GOVERNMENT

Coates' Canons NC Local Government Law

New Construction Delivery Methods – Public-Private Partnerships (P3)

Published: 03/05/14

Author Name: Norma Houston

In my last two posts, I described the new **design-build** and **design-build bridging** construction delivery methods authorized by the General Assembly during the 2013 legislative session. This post completes our discussion of the new delivery methods by outlining the third method authorized in **S.L. 2013-401/H857** – public-private partnerships (P3).

What is a Public-Private Partnership?

The basic concept of the P3 legislation is to provide flexible contracting authority under which units of government can partner with a private developer for the construction, operation, and financing of a capital project. Prior to the legislation's enactment, local governments had to seek authorization from the General Assembly through local acts to enter into public private partnerships. The new legislation makes this development and financing option available statewide to all public entities.

Public-private partnerships are not new in North Carolina. This type of contracting method has been authorized from time to time by the General Assembly, such as for the Department of Revenue's Tax Information Management System in 2009 (**S.L. 2009-451, Sec. 6.20**), the Town of Matthews in 2010 (**S.L. 2010-52**), Onslow County in 2013 (**S.L. 2013-37**), and certain Department of Transportation projects (**G.S. 136-28.1**) and toll roads (**S.L. 2012-184**). Similar public-private financing authorization has been available for well over a decade for NCSU's Centennial Campus, UNC-CH's Horace Williams Campus, and the Millennial Campuses of other UNC constituent institutions (**Article 21B of Chapter 116**). Public schools have had public-private partnership authorization since 2006 for built-to-suit capital leases (**G.S. 115C-532**; this statute expires July 1, 2015). Public-private partnerships were the subject of a **2009 legislative study commission** and a study by **NCSU's Institute for**

ATTACHMENT D

Emerging Issues. What is new is the statutory framework for entering into a P3 contract and the availability of this contracting and financing method for any unit of local government without having to obtain specific legislative authorization through a local act.

A public private project is defined under the new **G.S. 143-128.1C** as a "capital improvement project undertaken for the benefit of a governmental entity and private developer pursuant to a development contract that includes construction of a public facility or other improvements, including paving, grading, utilities, infrastructure, reconstruction, or repair, and may include both public and private facilities."[1] Under the P3 construction delivery method, the unit of government is authorized to acquire, construct, own, lease (as lessor or lessee), and operate a public-private project or facilities within a public-private project, and may make loans or grants for these purposes. Importantly, the private developer must provide at least 50% of the financing for the total cost of the project.[2] The Local Government Commission must approve the contract if it involves a capital or operating lease.[3]

P3 Contracting Process

To enter into a P3 contract, units of government must comply with the statutory requirements set out in **G.S. 143-128.1C.** The procedures are similar to those required for design-build and design-build bridging contracts only in that they are based on the Mini-Brooks Act. Otherwise, the P3 procurement requirements are substantially different.

Adopt Written Findings: To begin the P3 contracting process, the unit of government must make written findings that it has a critical need for the project. While the statute does not specifically require governing board approval, entities that are a public body under the Open Meetings Act (**Article 33C of Chapter 143**) must adopt these findings at an open meeting of the body, which for local governments means the governing board must approve the findings. Unlike the design-build and design-build bridging statutes, there are no specific criteria that must be adopted by the governing board other than a finding that there is a critical need for the project.

Determine Programming Needs: After approving the use of the P3 method, the unit must determine its programming requirements for the facilities to be constructed under the P3 contract and the form in which private developers submit their qualifications. This information forms the basis of the RFQ the unit advertises.

Publish Notice of RFQ: Next, the unit must advertise notice for interested private developers to submit their qualifications. The advertisement must be published in a newspaper of general circulation within the county in which the unit is located. The statute does not specify a minimum timeframe for the publication period, but units should choose a time sufficient for interested parties to develop a proposal taking into consideration the complexity of a P3 project. While the unit is not required to

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publish the programming requirements in the advertisement itself, it must make these requirements available to potential respondents in whatever form the unit deems appropriate.

Receive Responses: Units may choose to receive responses to its RFQ in any form it deems appropriate; sealed proposals and a public opening are not required. Private developers must submit the following information as part of their response to the RFQ:

1) Evidence of financial stability (the statute specifies that information that constitutes a "trade secret" under **G.S. 66-152(3)** remains confidential).

2) Experience with similar projects.

3) An explanation of project team selection by either listing licensed contractors, licensed subcontractors, and licensed design professionals whom the private developer proposes to use for the project's design and construction, or a statement outlining a strategy for open contractor and subcontractor selection based competitive bidding procedures.

4) A statement of the developer's availability to undertake the public-private project and projected time line for project completion.

5) Any other information required by the unit.

Evaluate Responses and Select Developer: The unit may award the development contract to the private developer it determines to be best qualified, which is the standard of award under the Mini-Brooks Act (**G.S. 143-64.31**). However, unlike a traditional Mini-Brooks Act selection process, the unit may negotiate with one or more of the respondents during the evaluation process. The statute is silent on the criteria the unit must use in evaluating the qualifications of the respondents, so the unit is free to develop their own criteria based on its programming needs, project scope, and any other factors related to the project it deems appropriate.

Award Development Contract: The unit's governing board must award the development contract at an open meeting after a public hearing and at least 30 days' published notice of the terms of the contract. The advertisement of the terms of the contract and the public hearing must be in a newspaper of general circulation within the county in which the unit is located. The unit must also make available a summary of the contract terms and conditions, and indicate how to obtain a copy of the complete contract.

Development Contract Terms and Conditions: The development contract between the unit and the private developer specifies the parties' interests, roles, and responsibilities for the project. At a minimum, the contract must address:

1) The property interests of the unit and the private developer (this could include ownership, lease arrangements, or both).

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2) The development responsibilities of the unit and the private developer (this could include both construction and on-going operation and maintenance activities).

3) The financing responsibilities of the unit and the private developer (remember that the private developer must provide at least 50% of the financing for the total cost of the project).

4) The parties' good faith efforts to comply with HUB participation requirements and to recruit and select small business entities (the term "small business entities" is not defined in the statute).

The development contract also may require the developer to be responsible for some or all of the construction, purchase of materials and equipment, compliance with HUB participation requirements, and to use the same contractor(s) as the unit. It also may require the developer to purchase materials for the project at a reasonable price. If the project utilizes the design-build construction delivery method, the procurement requirements of the new design-build statute (**G.S. 143-128.1A**) apply. Performance and payment bond requirements also apply, and the statute sets out specific procedures for claims under a payment bond made against the private developer.[4]

The private developer with whom the unit contracts cannot perform any design or construction work on the project unless a contractor defaults, a qualified replacement cannot be obtained in a timely manner, and the unit approves.

Finally, the private developer and its contractors must comply with state HUB participation requirements, which include bidders' good faith efforts to solicit historically underutilized businesses on building construction projects costing $300,000 or more (**G.S. 143-128.2**).

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[1] G.S. 143-128.1C(a)(8).

[2] G.S. 143-128.1C(b).

[3] G.S. 143-128.1C(j). A capital or operating lease involving a public school cannot contain provisions relating to student assignment (G.S. 143-128.1C(l)).

[4] G.S. 143-128.1C(g).

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Public-Private Partnership

A new law became effective on October 10, 2023, and applies to any covered public enterprise agreements executed on or after that date.

Part IV of S.L. 2023-138 (See attachment F) compels LGC approval of any agreement in which a local government concedes or transfers control of a public enterprise that the local government owns or operates to a nongovernmental entity.

The requirements for these arrangements include holding a public hearing describing the terms of the agreement. After the public hearing, the local unit's governing board may proceed only after adopting a resolution declaring that the proposed arrangement is in the public interest. In making this determination, the board must consider ALL the following:

1. The physical condition of the public enterprise;
2. The capital replacements, additions, expansions, and repairs needed for the public enterprise to provide reliable service and meet all applicable federal standards;
3. The availability of federal and State grants and loans for system upgrades and repairs of the public enterprise;
4. The willingness and the ability of the nongovernmental entity to make system upgrades and repairs and provide high-quality and cost-effective service;
5. The reasonableness of the amount to be paid to the unit of local government to enter the arrangement;
6. The reasonableness of any amounts to be paid by the unit of local government to exit the arrangement;
7. The service quality guarantees provided by the arrangement and the consequences of any failure to satisfy the guarantees;
8. The most recent income and expense statement and asset and liabilities balance sheet of the nongovernmental entity and any consolidated nongovernmental entity;
9. The projected rates to customers of the public enterprise during the term of the arrangement and the affordability of the services of the public enterprise resulting from such projected rates;
10. The experience of the nongovernmental entity (and, if applicable, its affiliates within the consolidated nongovernmental entity) in the operation of utility systems similar to the public enterprise that is the subject of the arrangement; and
11. The alternatives to entering the arrangement and the potential impact on utility customers if the arrangement is not entered.

Local units should record the governing board's findings addressing all these considerations as part of the written resolution or supporting documentation.

Once the governing board adopts its resolution, the LGC may consider the proposed arrangement for approval. Like a bond issuance, the local government will apply to the LGC for approval and work with Department of State Treasurer staff to prepare the appropriate documentation and address any concerns.

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Public-Private Partnership

The LGC may only approve the proposed arrangement if it finds and determines that the customers of the public enterprise will enjoy reasonable and material short-term and long-term savings and other net benefits from the arrangement during the term of the arrangement without the imposition of any material cost or charge upon termination of the arrangement.

The LGC may consider any of the following in making its determination (this is a non-exclusive list):

1. The projected financial feasibility of the proposed arrangement in the short-term and long-term, its effect on rates to be charged to the customers of the public enterprise under the arrangements being proposed, and its effect on the quality of services to be provided by the public enterprise under the arrangement.

2. The projected rates to customers of the public enterprise during the term of the arrangement, the basis for the establishment of such rates and the reasonableness of the basis, and the affordability of the services of the public enterprise resulting from such projected rates.

3. If the unit of local government will receive an initial payment for participating in the arrangement, a summary of the unit of local government's proposed plans for the use of the initial payment.

4. If there is any indebtedness of the unit of local government associated with the public enterprise, the plans for the retirement or defeasance of such indebtedness.

5. The financial condition of the nongovernmental entity and its affiliates within the consolidated nongovernmental entity and its ability to carry out the undertakings required of the nongovernmental entity in the arrangement.

6. The experience of the nongovernmental entity and its affiliates within the consolidated non-governmental entity in the operation of utility systems similar to the public enterprise that is the subject of the arrangement.

7. The nongovernmental entity's plans to finance its initial participation in the arrangement and future improvements to the public enterprise and the expected participation of the unit of local government in any financing.

8. The obligations of the nongovernmental entity set forth in the agreement for the maintenance of the public enterprise and the installation of improvements to the public enterprise during the term of the arrangement and the requirements of the agreement that adequate reserves be maintained during the term of the arrangement for such maintenance and improvements.

9. The plans set forth in the agreements for the arrangement for maintaining the quality of the components of the public enterprise to be returned to the control of the unit of local government at the end of the term of the agreement.

10. Any ongoing financial and other commitments of the unit of local government under the arrangement during its term.

11. Any financial payments the unit of local government is expected to be required to pay to the nongovernmental entity or any other person or entity at the end of the arrangement.

12. The effect, if any, of the arrangement on the tax status of interest on debt obligations issued by the unit of local government, or any other units of local government on account of contractual arrangements the other unit of local government may have with the unit of local government proposing the agreement being considered.

As with other contracts requiring LGC approval, any agreement subject to this new law that is executed without LGC approval is void. And the law makes it unlawful for any officer, employee, or agent of a local unit to take any actions pursuant to the agreement.

alteration, or removal, the cost shall (i) include all labor and materials costs associated with the project for the applicable dam and (ii) not include the costs associated with acquisition of land or right-of-way, design, quality control, electrical generating machinery, or constructing a roadway across the dam.

(3) Immediately upon completion of construction, repair, alteration, or removal of a dam, the owner shall file a certification with the Director, on a form prescribed by the Department, and accompanying documentation, which shows actual cost incurred by the owner for construction, repair, alteration, or removal of the applicable dam.

a. The owner's certification and accompanying documentation shall be filed with the as-built plans and the engineer's certification.

b. If the Director finds that the owner's certification and accompanying documentation contain inaccurate cost information, the Director shall either withhold final impoundment approval, if applicable, or revoke final impoundment approval, if applicable, until the owner provides accurate documentation and that documentation has been verified by the Department.

(4) Final approval to impound shall not be granted until the owner's certification and the accompanying documentation are filed in accordance with subdivision (3) of this subsection and the remainder of the application processing and compliance fee has been paid as provided by this subsection.

(5) Payment of the application processing and compliance fee shall be by check or money order made payable to the Department and reference the applicable dam.

(b) The Dam Safety Account is established as a nonreverting account within the Department. Fees collected under this section shall be credited to the Account and shall be applied to the costs of administering this Part."

PART IV. REQUIRE APPROVAL BY THE LOCAL GOVERNMENT COMMISSION FOR LOCAL GOVERNMENTS TO ENTER INTO AGREEMENTS TO CEDE OR TRANSFER CONTROL OVER A PUBLIC ENTERPRISE TO A NONGOVERNMENTAL ENTITY; PROHIBIT LOCAL GOVERNMENTS FROM ENTERING NONDISCLOSURE AGREEMENTS IN ORDER TO RESTRICT ACCESS TO PUBLIC RECORDS SUBJECT TO DISCLOSURE UNDER THE PUBLIC RECORDS ACT

SECTION 5.(a) Article 8 of Chapter 159 of the General Statutes reads as rewritten:

"Article 8.

"Financing Agreements and Other Financing ~~Arrangements.~~Arrangements; Arrangements for Nongovernmental Control of Public Enterprises.

…

"§ 159-154. Nongovernmental control of public enterprises.

(a) For purposes of this section, the following definitions apply:

(1) Adjusted revenues. – Gross revenue of a public enterprise minus the cost of commodity purchases and wholesale electricity purchases for the public enterprise.

(2) Consolidated nongovernmental entity. – Collectively, all affiliated nongovernmental entities, which includes each entity's parents,

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subsidiaries, and each other entity that owns, directly or indirectly, at least ten percent (10%) of the capital or voting rights of the entity, and each other entity in which the entity owns, directly or indirectly, at least ten percent (10%) of the capital or voting rights.

(3) Control. – Any one or more of the following, except that a contractual arrangement by a unit of local government with a nongovernmental entity to provide specified maintenance services for a fixed fee or fee per service basis alone does not create control of the public enterprise for purposes of this section:

a. The authority to expend or otherwise manage during any fiscal year more than fifty percent (50%) of a public enterprise's adjusted revenues.

b. Responsibility for provision to the public of the services previously provided by the public enterprise.

c. Responsibility for operation and maintenance of a material portion of the assets and facilities of the public enterprise.

d. The authority to manage a material portion of the staff responsible for operation and maintenance of the assets and facilities of the public enterprise.

(4) Nongovernmental entity. – Any person or entity other than (i) the State, (ii) a unit of local government, or (iii) a public body created pursuant to Chapter 159B of the General Statutes.

(5) Public enterprise. – All or a material portion of one or more of the systems set forth in G.S. 160A-311, G.S. 153A-274, and Chapter 162A of the General Statutes.

(6) Unit of local government. – A "unit of local government" as defined in G.S. 159-7 and a "public authority" as defined in G.S. 159-7.

(b) No unit of local government may concede or transfer control of any public enterprise that the unit of local government owns or operates to any nongovernmental entity or consolidated nongovernmental entity or enter into an agreement to do so unless the concession or transfer of control and the agreement thereunder have been approved by the Commission pursuant to this section as evidenced by the secretary's certificate thereon. Any agreement subject to Commission approval under this section that does not bear the secretary's certificate thereon shall be void, and it shall be unlawful for any officer, employee, or agent of a unit of local government to take any actions thereunder.

(c) Before executing an agreement subject to this section, the governing board of the unit of local government shall file an application for Commission approval of the agreement with the secretary of the Commission. The application shall state such facts and have attached to it such documents concerning the proposed agreement and the arrangements proposed to be carried out thereunder as the secretary may require. The Commission may prescribe the form of the application. Before the secretary accepts the application, the secretary may require the governing board or its representatives to attend a preliminary conference at which time the secretary and deputies may informally discuss the proposed agreement and arrangements proposed to be carried out thereunder.

(d) Prior to the Commission's consideration of whether to approve an agreement subject to this section and the arrangements thereunder, the governing body of the unit of local government shall conduct a public hearing on whether the proposed arrangement is in the public interest and following the public hearing the governing body shall adopt a resolution or take a similar action stating that it determines that the proposed arrangement is in the public interest. The public hearing shall be held by the governing body of the unit of

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local government proposing the arrangement following publication of notice of the public hearing at least 10 days prior to the public hearing. The notice of public hearing shall describe the proposed arrangement in general terms. In determining that the arrangement is in the public interest, the governing body of the unit of local government shall consider, at a minimum, all of the following:

(1) The physical condition of the public enterprise.

(2) The capital replacements, additions, expansions, and repairs needed for the public enterprise to provide reliable service and meet all applicable federal standards.

(3) The availability of federal and State grants and loans for system upgrades and repairs of the public enterprise.

(4) The willingness and the ability of the nongovernmental entity to make system upgrades and repairs and provide high-quality and cost-effective service.

(5) The reasonableness of the amount to be paid to the unit of local government to enter into the arrangement.

(6) The reasonableness of any amounts to be paid by the unit of local government to exit the arrangement.

(7) The service quality guarantees provided by the arrangement and the consequences of any failure to satisfy the guarantees.

(8) The most recent income and expense statement and asset and liabilities balance sheet of the nongovernmental entity and any consolidated nongovernmental entity.

(9) The projected rates to customers of the public enterprise during the term of the arrangement and the affordability of the services of the public enterprise resulting from such projected rates.

(10) The experience of the nongovernmental entity and its affiliates within the consolidated nongovernmental entity in the operation of utility systems similar to the public enterprise that is the subject of the arrangement.

(11) The alternatives to entering into the arrangement and the potential impact on utility customers if the arrangement is not entered.

(e) The Commission may approve an agreement for a unit of local government to concede or transfer control of a public enterprise and the arrangement to do so if it finds and determines that the customers of the public enterprise will enjoy reasonable and material short-term and long-term savings and other net benefits from the arrangement during the term of the arrangement without the imposition of any material cost or charge on the unit of local government or its customers upon termination of the arrangement. In determining whether a proposed agreement and the arrangements thereunder shall be approved, the Commission shall have authority to inquire into and to give consideration to such matters that it may believe to have bearing on whether the proposed agreement and the arrangement thereunder should be approved. Such matters may include any of the following:

(1) The projected financial feasibility of the proposed arrangement in the short-term and long-term, its effect on rates to be charged to the customers of the public enterprise under the arrangements being proposed, and its effect on the quality of services to be provided by the public enterprise under the arrangement.

(2) The projected rates to customers of the public enterprise during the term of the arrangement, the basis for the establishment of such rates and the reasonableness of the basis, and the affordability of the services of the public enterprise resulting from such projected rates.

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(3) If the unit of local government will receive an initial payment for participating in the arrangement, a summary of the unit of local government's proposed plans for the use of the initial payment.

(4) If there is any indebtedness of the unit of local government associated with the public enterprise, the plans for the retirement or defeasance of such indebtedness.

(5) The financial condition of the nongovernmental entity and its affiliates within the consolidated nongovernmental entity and its ability to carry out the undertakings required of the nongovernmental entity in the arrangement.

(6) The experience of the nongovernmental entity and its affiliates within the consolidated non-governmental entity in the operation of utility systems similar to the public enterprise that is the subject of the arrangement.

(7) The nongovernmental entity's plans to finance its initial participation in the arrangement and future improvements to the public enterprise and the expected participation of the unit of local government in any financing.

(8) The obligations of the nongovernmental entity set forth in the agreement for the maintenance of the public enterprise and the installation of improvements to the public enterprise during the term of the arrangement and the requirements of the agreement that adequate reserves be maintained during the term of the arrangement for such maintenance and improvements.

(9) The plans set forth in the agreements for the arrangement for maintaining the quality of the components of the public enterprise to be returned to the control of the unit of local government at the end of the term of the agreement.

(10) Any ongoing financial and other commitments of the unit of local government under the arrangement during its term.

(11) Any financial payments the unit of local government is expected to be required to pay to the nongovernmental entity or any other person or entity at the end of the arrangement.

(12) The effect, if any, of the arrangement on the tax status of interest on debt obligations issued by the unit of local government, or any other units of local government on account of contractual arrangements the other unit of local government may have with the unit of local government proposing the agreement being considered.

(f) The Commission may require that any projection or other analysis provided to the Commission in connection with its consideration of the arrangement be prepared by a qualified independent expert approved by the Commission.

(g) If the Commission tentatively decides to deny the application because it cannot be supported from the information presented to it, it shall so notify the unit of local government filing the application. If the Commission approves or denies the application, the Commission shall enter its order setting forth such approval or denial of the application. If the Commission enters an order denying the application, the proceedings under this section shall be concluded. An order approving an application shall not be construed as an approval of the legality of the agreement in any respect.

(h) If the Commission approves an agreement and the arrangements thereunder as provided in this section and thereafter the parties determine to terminate the agreement voluntarily prior to the expiration of its stated term, the unit of local government shall not enter into any such termination arrangement unless the termination is approved by the

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Commission following a procedure similar to the procedure for initial approval of the agreement and arrangement required by this section. This section shall not prohibit the termination of an agreement in the exercise of legal remedies following a breach of the agreement in accordance with its terms.

(i) If the Commission approves an agreement and the arrangements thereunder as provided in this section and thereafter the parties determine to amend the agreement in a material respect, the unit of local government shall not enter into any such amendment unless the amendment is approved by the Commission following a procedure similar to the procedure for initial approval of the agreement.

(j) Nothing in this section shall be construed to apply to the sale of a public enterprise to a utility regulated by the North Carolina Utilities Commission."

SECTION 5.(b) G.S. 132-1 is amended by adding a new subsection to read:

"(c) No political subdivision of this State may enter into a nondisclosure agreement in order to restrict access to public records subject to disclosure under this Chapter. The contract by which a political subdivision of this State agrees not to disclose information deemed confidential under State law shall be a public record, unless the existence of the contract is also deemed confidential under State law. If a nondisclosure agreement is associated with one or more closed session meetings under Article 33C of Chapter 143 of the General Statutes, the nondisclosure agreement shall be included in the minutes of each closed session meeting."

SECTION 5.(c) Subsection (b) of this section becomes effective November 1, 2023, and applies to any nondisclosure agreement entered into on or after that date. The remainder of this section is effective when it becomes law.

PART V. EMPLOYEE CLASSIFICATION AND COMPENSATION EXEMPTIONS FOR UTILITIES COMMISSION AND PUBLIC STAFF

SECTION 6.(a) G.S. 62-14 reads as rewritten:

"**§ 62-14. Commission staff; structure and function.**

(a) The Commission is authorized and empowered to employ hearing examiners; court reporters; a chief clerk and deputy clerk; a commission attorney and assistant commission attorney; transportation and pipeline safety inspectors; and such other professional, administrative, technical, and clerical personnel as the Commission may determine to be necessary in the proper discharge of the Commission's duty and responsibility as provided by law. The chairman shall organize and direct the work of the Commission staff.

(b) The salaries and compensation of all such personnel shall be fixed in the manner provided by law for fixing and regulating salaries and compensation by other State ~~agencies.~~agencies, except that the Commission and its employees are exempt from the classification and compensation rules established by the State Human Resources Commission pursuant to G.S. 126-4(1) through (4); G.S. 126-4(5) only as it applies to hours and days of work, vacation, and sick leave; G.S. 126-4(6) only as it applies to promotion and transfer; G.S. 126-4(10) only as it applies to the prohibition of the establishment of incentive pay programs; and Article 2 of Chapter 126 of the General Statutes, except for G.S. 126-7.1.

(c) The chairman, within allowed budgetary limits and as allowed by law, shall authorize and approve travel, subsistence and related expenses of such personnel, incurred while traveling on official business."

SECTION 6.(b) G.S. 62-15 reads as rewritten:

"**§ 62-15. Office of executive director; Public Staff, structure and function.**

(a) There is established in the Commission the office of executive director, whose salary and longevity pay shall be the same as that fixed for members of the Commission.

F-5

Appendix A3

Photo Log


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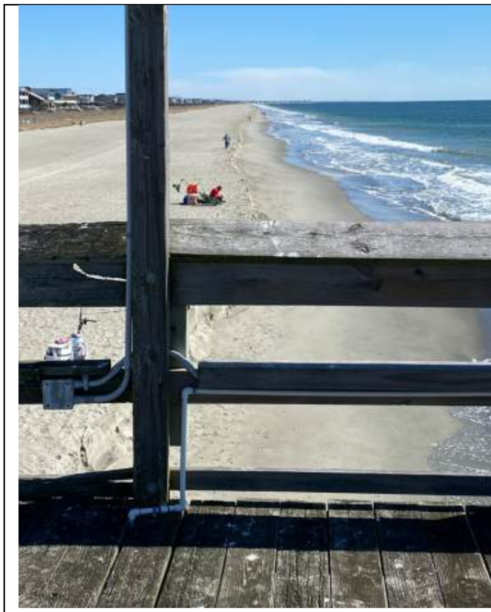 Photo 13: Top Rail Split and Conduit Running along Midrails near station 2+75	 Photo 14: Typical Checks and Splits in the Cross Bracing near station 3+00
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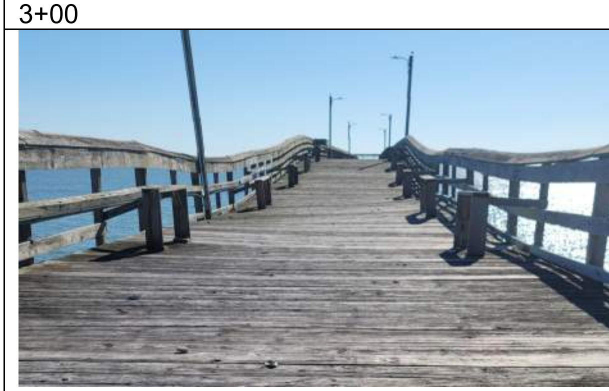 Photo 17: Typical Deck Warping between station 3+25 and station 4+10	 Photo 18: Typical Deck Warping between station 3+25 and station 4+10

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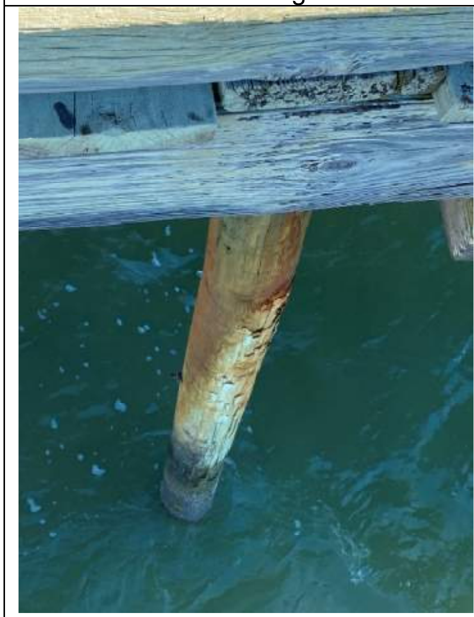

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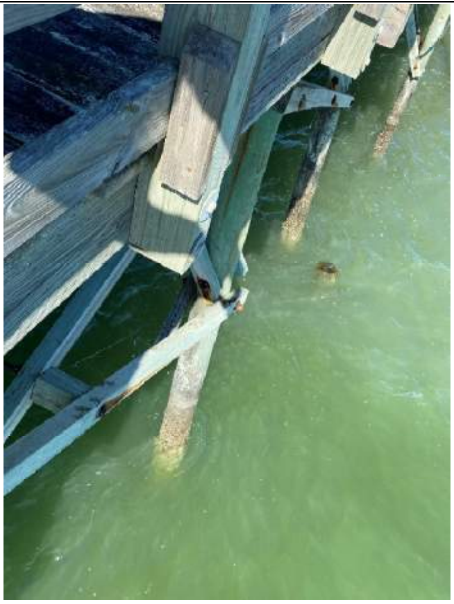
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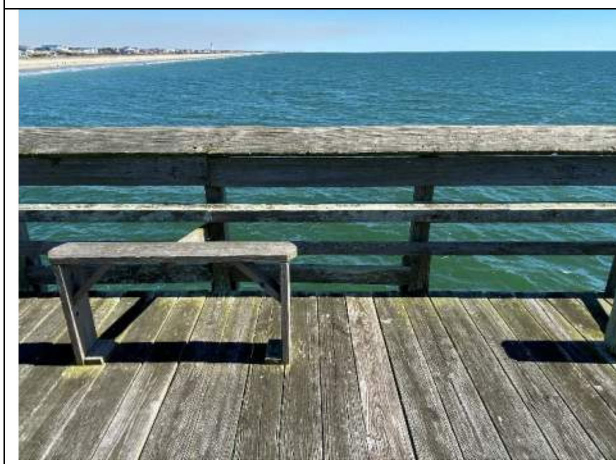
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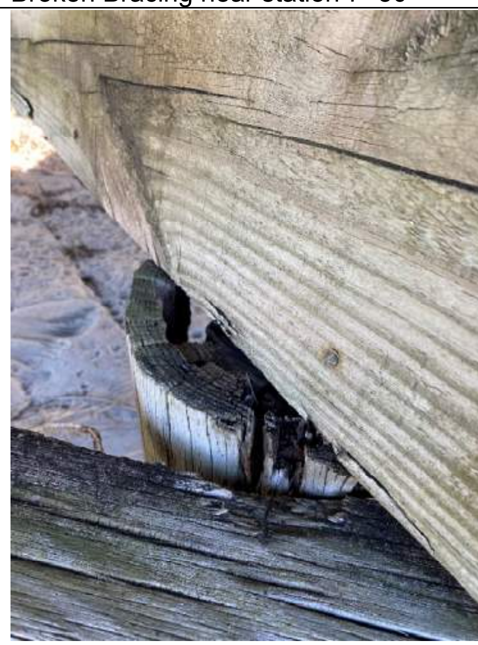
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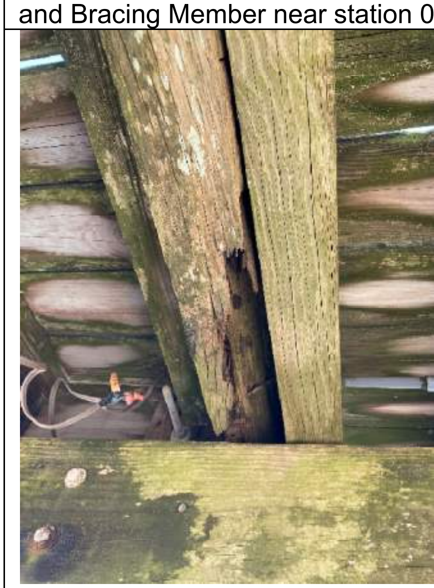
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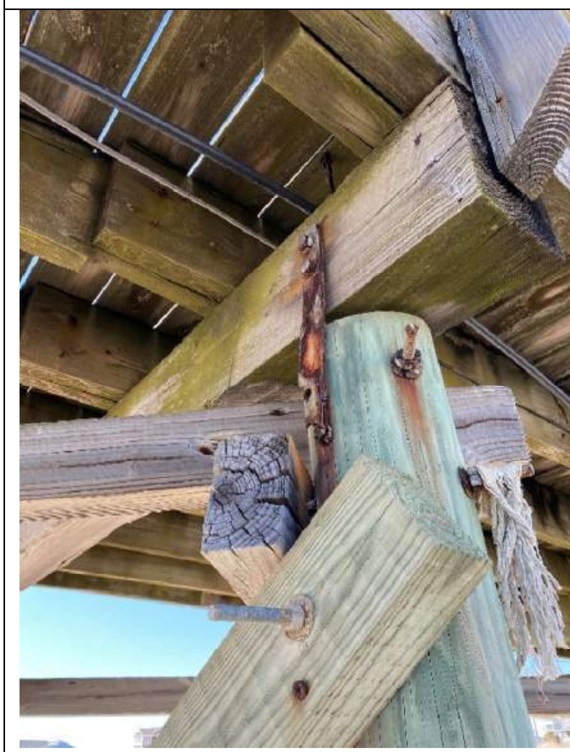 Photo 75: Corroded and Failed Pile / Pile Cap Connection near station 2+50	 Photo 76: Corroded Pile / Pile Cap Connection and Cross Bracing Connection near station 2+50

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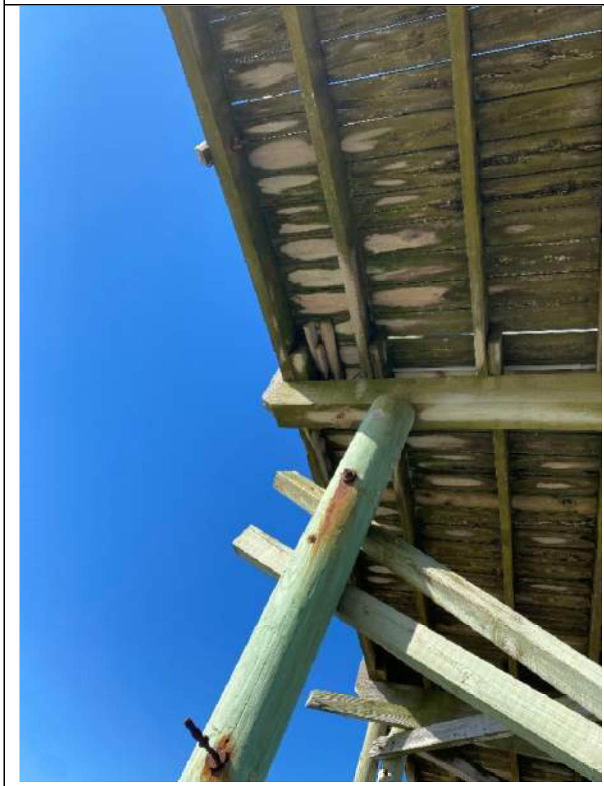

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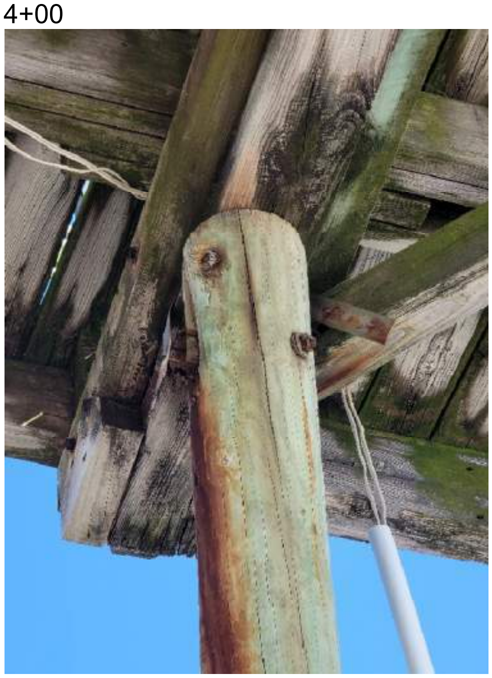

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Appendix A4

Condition Assessment Terminology

Table D-1: Condition Assessment Ratings	
Rating	**Description**
Good	No visible damage, or only minor damage is noted. Structural elements may show very minor deterioration, but no overstressing is observed. No repairs are required.
Satisfactory	Limited minor to moderate defects or deterioration are observed, but no overstressing is observed. No repairs are required
Fair	All primary structural elements are sound, but minor to moderate defects or deterioration is 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.
Poor	Advanced deterioration or overstressing is 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.
Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of primary structural components. Local failures are possible and load restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high priority basis with strong urgency.
Source: Waterfront Facilities Inspection and Assessment, ASCE Manuals and Reports on Engineering Practice No. 130, Edited by Ronald E. Heffron., 2015, Published by American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400; p 59.	

Appendix B

Basis of Design

hdrinc.com

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101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020

Town of Holden Beach Basis of Design

Town Pier Preliminary Reconstruction

HDR Engineering, Inc. of the Carolinas
Project No. 10426190

Holden Beach, North Carolina

July 1, 2025

PRELIMINARY – FOR REVIEW ONLY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.

ENGINEER: LUKE CRESSMAN, PE
LICENSE NUMBER: 055975
FIRM: HDR ENGINEERING, INC.

NCBELS Firm Registration No. F-0116

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1 Introduction and Background

1.1 Project Overview and Description

In the spring of 2022, the town of Holden Beach, North Carolina (the Town) purchased a recreational pier property. The site currently includes a historic pier house, an ocean fishing pier, an 80-space parking lot, modular restrooms, two public beach access points, one emergency beach access and a six-site campground with utility hookups.

Due to the age and heavy deterioration, both the recreational fishing pier and the historic pier house – now over 65 years old – have been closed to the public. The overall site layout is shown in Figure 1-1.

To support the revitalization of this landmark facility, the Town has engaged HDR to provide preliminary design services and develop cost estimates for revitalizing the historic fishing pier.

Figure 1-1. Existing Pier Site Plan

1.2 Location of Site

The Town is a municipal corporation located in Brunswick County, North Carolina serving a community of nearly 1,000 year-round residents, with a significantly larger population during the tourist season. The pier is situated on the oceanfront side of Holden Beach, just off Ocean Boulevard West. The site's location is illustrated in the map provided in Figure 1-2.

Figure 1-2. Site Location Map

1.3 Project Scope

The existing 750-foot-long recreational pier will be completely replaced and extended out to a final length of approximately 1,000 feet as part of this project. However, the adjacent pier house, located at the landward end of the pier structure, is not included within the current project scope.

HDR will develop a preliminary design for the new replacement pier and prepare a 30-year lifecycle maintenance plan that aligns with the proposed reconstruction strategy. A Class 3 cost estimate will be provided, encompassing both the construction of the replacement pier and the associated long-term maintenance requirements.

The new pier will be designed for a 30-year service life, consistent with the duration of the lifecycle assessment and the typical longevity of timber piles subjected to standard coastal wind and wave conditions. The design life does not account for potential damage resulting from extreme weather or storm events, due to the inherent unpredictability of their frequency, intensity, and impact.

A beach profile survey, conducted by subconsultant McKim and Creed, will be used to support the preliminary structural design. The scope of work also includes utility restoration, specifically reestablishing electrical and water service to the new pier.

2 Existing Conditions and Data Collection

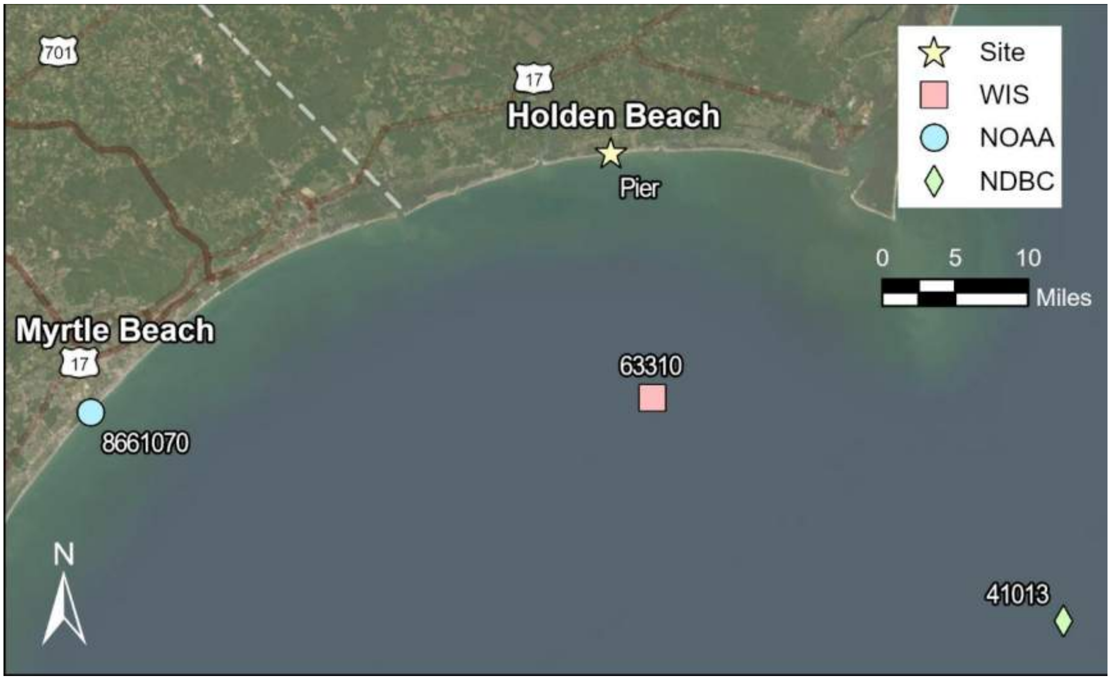

Figure 2-1. Station Locations Used During Data Collection

2.1 Datum

Horizontal plane coordinates will be referenced to the 2011 adjustment of North American Datum of 1983 (NAD83 2011), State Plane Coordinate System, North Carolina Zone (NC-3200) US feet. The vertical datum for the project is the North American Vertical Datum of 1988 (NAVD88) GEOID 18 Epoch 2001 US feet. All project measurements will use US standard units and all elevation values presented in this document will be referenced to NAVD88.

2.2 Beach Profile Surveys

Beach profile surveys were taken by subconsultant McKim & Creed on March 19, 2025, under favorable conditions. Data was collected using an RTK GNSS 200 kHz single beam echosounder for offshore measurements and an RTK GNSS rover for upland and nearshore areas. The alongshore spacing was designed to position a profile as close to the existing structure as safely possible, with the subsequent two profiles spaced 100-foot away, resulting in approximately 450 feet between the two outermost profiles.

The cross-shore extent of the profiles was defined to start in-line with Station 0+00 of the pier structure and extend 2,000 ft offshore (i.e., twice the length of the proposed pier design).

Based on the McKim & Creed survey, the existing ground/bed elevations at the upland and offshore ends of the proposed 1,000-foot pier structure were found to be +9.5 feet and -14 feet, respectively.

The raw survey data files from will be provided to the Town by HDR as a project deliverable.

2.3 Geotechnical Data and Subsurface Conditions

The Town provided a copy of a 2023 geotechnical investigation report for the project site, prepared by S&ME, Inc. (S&ME). The report titled, "*Report of Geotechnical Exploration – Holden Beach Pier and Pier House*" (S&ME Job No. 23060076), is dated July 24, 2023, and is included in Appendix E of the Summary Report. The geotechnical boring data from this report provides the basis for existing site conditions, while the results from HDR's geotechnical evaluation will provide the design parameters for the replacement pier structure.

2.4 Water Levels

2.4.1 Tides

The anticipated range of water surface elevations for the project site was obtained from the NOAA Station 8661070 located at the Springmaid Pier in Myrtle Beach, SC, as shown in Table 2-1. For design purposes, the maximum water elevation was considered to be the Highest Astronomical Tide (HAT) at EL. +4.2 ft and the minimum water elevation was taken as the Lowest Astronomical Tide (LAT) at EL. -4.7 ft. A summary of the water elevations from the tidal gauge is below, with additional details about the tidal gauge station provided within the Metocean report (Appendix D of the Summary Report).

Table 2-1. Design Tidal Datums from NOAA Station 8661070 in Myrtle Beach, SC

Water Level	Datum (ft)	
	NAVD88	MLLW
Mean Higher High Water (MHHW)	+2.44	+5.60
Mean High Water (MHW)	+2.05	+5.21
Mean Sea Level (MSL)	-0.45	+2.71
Mean Tide Level (MTL)	-0.46	+2.70
Mean Low Water (MLW)	-2.97	+0.19
Mean Lower Low Water (MLLW)	-3.16	0.00

Water surface elevations and wave heights will be affected by rainfall, wind direction (including velocity and duration), vessel traffic, and tidal fluctuations. Additionally, tropical weather events such as tropical storms and hurricanes can significantly impact both water surface elevations and wave heights.

2.4.2 Flood Base Elevation

The FEMA National Flood Hazard Layer (NFHL) map for Holden Beach, NC (Panel #2015) shows varying base flood elevations (BFE) across the pier property. Table 2-2 presents the range of BFE values along with their corresponding locations.

Table 2-2. FEMA Base Flood Elevations Across Pier Property

Location	BFE (Ft-NAVD88)
Pier structure between approx. Stations 0+20 to 1+20	+13
Pier structure seaward of Station 1+20	+16

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(910) 398-9020

2.4.3 Relative Sea Level Rise

Relative Sea Level Rise (RSLR) for this project is based on the NOAA intermediate-high projection scenario. Over the 30-year design life of the structure, this scenario is projected to result in 1.7 feet of RSLR above the year 1992 reference sea level. This RSLR timeframe was used based on the available RSLR data and the mid-year for the tidal datum analysis period of the NOAA station in Myrtle Beach, SC (Section 2.4.1).

2.5 Seismicity

The project site is located in a region of low seismic activity, with anticipated peak ground accelerations being minimal. As a result, seismicity is not a factor in the design considerations. Acceleration value maps are provided in Appendix B1.

2.6 Wind Data

The wind gust speed for structural design was determined using ASCE 7-16 standards. The project site is located in a hurricane-prone region as defined by ASCE/SEI 7-16 Section 26.2. The design wind speed is provided in Appendix B1.

Wind time series data is sourced from both the NOAA Station 8661070 in Myrtle Beach, SC and the USACE Wave Information System (WIS) hindcast model station offshore of Holden Beach (ST63310). The NOAA time series will be compared to the modeled WIS hindcast data to validate the suitability of the WIS dataset. Design wave information will be based on the statistical summaries derived from the WIS data. For further discussion on the WIS time series, see Section 2.7.

2.7 Wave Data

Wave data for the project was sourced from the USACE-developed Wave Information System (WIS) hindcast time series. The dataset spans a 43-year period from 1980 through 2023 and represents modeled wave conditions based on global historical weather records. Key design inputs will be extracted from this model output, including extreme event analysis, percent occurrence statistics, and hourly time series data.

Design wave parameters were identified using the highest recorded events within the WIS time series. These top events are considered appropriate for design purposes, given that the dataset spans a continuous 43-year record – nearly 50% longer than the pier's 30-year design life. Table 2-3 summarizes the wave information used in the project design.

The wave height used for design is noted to be depth-limited, constrained by the standard 0.78 breaker index criterion. To determine the depth that limits the wave height, the 50-year return period water surface elevation (WSEL) for the year 2060 (i.e., nearest year with available data to the 30-year design lifespan) was used. This WSEL will include RSLR projections.

Table 2-3. Wave Information Used for Project Design

Scenario	WSEL (Ft-NAVD88)	Depth (ft)	Wave Height (ft)	Wave Period (sec)
With RSLR (2055), Offshore 50-yr Event Wave	-	59.1	19.7	15.5
With RSLR (2055), 50-yr Event Depth-Limited Wave	+9.0	23	17.9	15.5

2.8 Shoreline Change

Shoreline change and related morphological analyses were not included within the scope of this project. According to Town records, Holden Beach has undergone multiple beach nourishment events in recent decades, with approximately 2 million cubic yards of sand placed between 2002 and 2014. Given the expectation that engineered shoreline management such as continued nourishment will persist into the future, the project design assumes that the shoreline erosion will not progress to a level that compromises the structural stability of the proposed pier.

3 Operational and Functional Considerations

3.1 Project Layout

The existing Holden Beach Pier is located off Ocean Blvd. W and features an 80-space parking lot in front of the pier house. It is understood that the existing pier house will be completely demolished by others. The new recreational pier will be constructed in approximately the same location as the existing timber pier, with a new paved path connecting the pier entrance to the existing parking lot. During construction, the existing parking lot and six-space campground will be used as a staging and laydown area for the contractor.

3.1.1 Pier Layout

The new pier will be constructed entirely of timber and designed to meet ADA standards. An accessible ramp at a 12H:1V slope will provide a safe pedestrian transition from existing grade to the working elevation of EL +19 feet. At the top of the access ramp, a sitting/viewing balcony will be located landward of the existing dunes, with the potential for a second emergency egress connection from this area.

The pier design will be 16-feet wide to accommodate pedestrian traffic and recreational fishing. Benches will be installed at a regular interval along the pier to provide public seating. The structure shall be designed to extend approximately 1,000 feet into the water – 250-feet beyond the length of the existing pier – and shall terminate in a T-head that includes a covered seating area.

3.2 Pier Operations

The new pier is intended to support a variety of public recreational activities, including fishing, sightseeing, and general pedestrian access. Benches will be placed at regular intervals along the pier to provide seating, and a covered area at the pier's end will offer shade and comfort for users. A fish cleaning station will be located near the pier entrance for the convenience of anglers. The pier shall be equipped with electrical and potable water utilities to support general lighting and operation of the fish cleaning station.

3.3 Vehicle and Equipment Data

3.3.1 Trucks

The pier is not designed to accommodate maintenance or other vehicular access.

3.3.2 Utility Vehicles

Topsides access for maintenance and emergency services (EMS) utility vehicles is not included in the new pier design.

3.3.3 Construction Equipment

The new recreational pier is not intended to support construction equipment loads. All demolition of the existing pier and construction of the replacement pier will require the use of barges or temporary structures, such as work trestles, to facilitate access and construction operations.

3.4 Special Equipment

3.4.1 Fire Prevention and Extinguishing Equipment

Fire prevention and suppression systems – such as dedicated water lines for firefighting - are not included in the new pier design.

3.4.2 Potable Water and Electrical

Potable water and electrical lines will be the only utilities provided along the new pier. Lighting will be installed to ensure pedestrian safety, with fixtures similar in style and function to those on the existing pier. The water lines will supply the fish cleaning stations and may also support potential shower facilities located at the upland end of the pier.

4 Constraints

4.1 Permitting

The Town will be responsible for applying for and obtaining the necessary USACE and CAMA Permits. It is assumed that the pier replacement would require a CAMA Major Permit. To support timely and successful permitting, it is strongly recommended that the Town consider agency review timelines and engage in early pre-coordination with the relevant regulatory agencies prior to advancing beyond the preliminary design phase.

4.2 Client & Code Constraints

The Town has specified a preference for an all-timber pier, consisting of a timber superstructure supported by timber bents, bracing and piles. While the 2018 North Carolina Building Code (NC IBC) includes requirements related to means of egress and the use of noncombustible materials for substructures, a 2023 legislative change has reinstated the applicable standards from the 2009 NC IBC.

Specifically, NC IBC 2018 Chapter 3606.8.2 states:

> "Piers intended for recreational fishing, assembly, or educational distances with travel distance to exit discharge exceeding 600 feet and greater than 15 feet above mean low water shall have emergency access ladders at 300 feet intervals and at the end of the pier. The pier shall be constructed of noncombustible material, with the exception that the floor decking may be heavy timber."

However, General Assembly Session Law 2023-137, Section 35 mandates the reinstatement of Chapter 36 from the 2009 NC IBC for docks, piers, bulkheads, and other waterway structures built within estuarine waters.

As a result of this legislative update, the design is not subject to the noncombustible structures and egress requirements outlined in the 2018 code. These provisions will not impact the design of the new pier and shall not be considered.

Additionally, any FEMA A/AE zones on the pier property will be effectively considered as V/VE zones per Town Code §154.20 (D).

4.3 Environmental Constraints

Construction activities will need to adhere to restrictions related to federally protected species, including plants, fish, birds and sea turtles, through designated construction windows and specific methods of work. Early coordination with United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Services (NMFS) will be carried out during the design and permitting process to determine required surveys and moratoria windows of federally listed aquatic species. Seabeach amaranth (*Amaranthus pumilus*) is a federally listed plant that occurs on barrier beaches in North Carolina. Qualified biologists should complete plant surveys during the permitting and agency coordination phase of the project. It is not anticipated that the project will impact the existing dunes.

Anticipated regulatory permits include but are not limited to Clean Water Act (401/404/Section 10) permits from U.S. Army Corps of Engineers (USACE) and N.C. Department of Environmental Quality (DEQ), and a N.C. Coastal Area Management Act (CAMA) permit.

4.4 Existing Underground Features

4.4.1 Pipelines

According to the National Pipeline Mapping System, there are no known pipeline crossings beneath the existing recreational pier or the project site property.

4.4.2 Utilities

The Town has indicated that there are no known underground utility features, nor any overhead utilities or other known obstructions, along the shoreline in the area of the proposed pier.

4.5 Existing Facilities

4.5.1 Pier

The existing 750-foot-long recreational fishing pier features a timber superstructure supported by a timber substructure comprised of a series of pile bent systems. The substructure includes 64 bents generally spaced 12 feet apart. The existing pier will need to be demolished and removed before the installation of the replacement pier.

4.6 Easements and Property Constraints

The location of the replacement pier might need to be slightly offset from the existing pier due to remaining broken piles or other residual structures not removed during the demolition process. The existing pier is situated at least 68 feet away from the western adjacent parcel, ensuring that the replacement pier, if placed adjacent to the existing one, will not impact any private landowners / stakeholders. Additionally, it is HDR's understanding that the nearest adjacent parcel is Town-owned, with a clearance of approximately 120 ft from the nearest landowner. A parcel map is provided in Figure 4-1.

The location of the replacement pier will not obstruct any existing public beach access points. Since the historic pier house was demolished in April 2025, the design and utility connections for the replacement pier will not be constrained by the existing pier house.

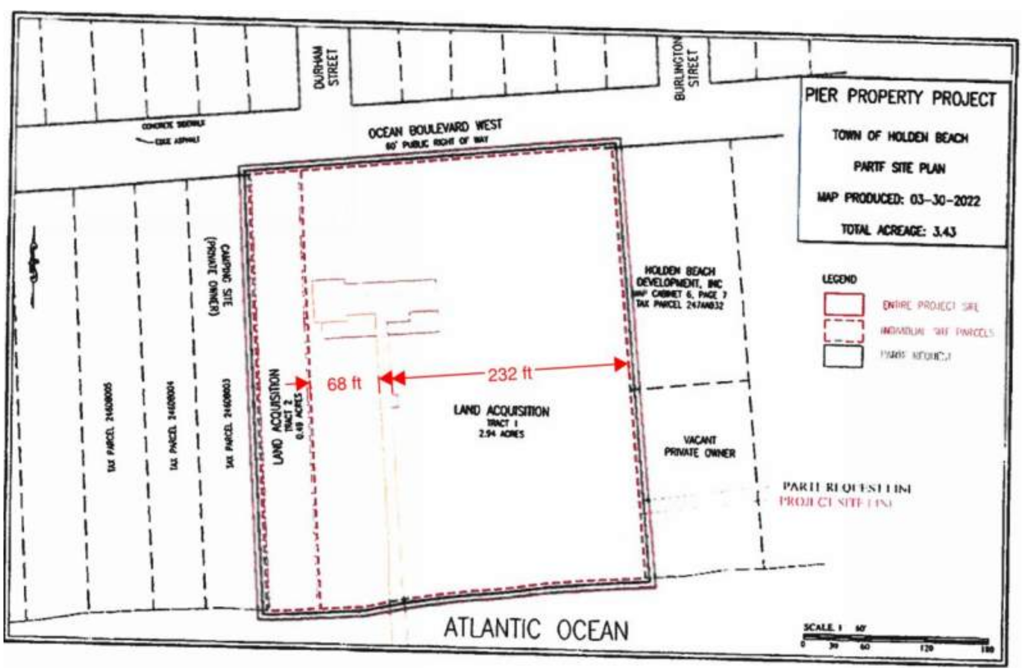


Figure 4-1. Holden Beach Pier Property Limits

HDR Engineering, Inc.
101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020

4.7 Material and Equipment Availability

It is assumed that the material and equipment required for construction and operation of the structure will be readily available at the time of construction. The design will prioritize the use of commonly available and appropriate components to help minimize risks related to schedule delays or cost escalation.

5 Design Loads

5.1 Dead Load

Dead loads to be evaluated will include the self-weight of the structure, as well as any permanent equipment or fixtures associated with the facility. The following unit weights will be used in determining dead loads in the design:

Table 5-1. Material Unit Weights

Material	Unit Weight
Steel or Cast Steel	490 pcf
Aluminum Alloys	175 pcf
Treated Timber	60 pcf
Salt Water	64 pcf
Source: UFC 4-152-01	

5.2 Live Loads

5.2.1 Operational Loading

Operational live loads will be based on pedestrian personnel loading as outlined in UFC 4-152-07, NC IBC 2018, and ASCE MoP 50 and will be taken as 60 psf. Additionally, the pier will be designed to support a 400-lb concentrated point load at any location along the structure.

5.2.2 Vehicular Loading

5.2.2.1 Truck / EMS Loading

Topside access for maintenance and emergency service (EMS) utility vehicles is not considered in the new pier design.

5.2.2.2 Vehicle and Vessel Impact Loading

The pier is not designed for lateral loads due to vessel (small watercraft) or debris impacts to the timber structure / piles. Similarly, the pier is not designed for lateral loads due to vehicular impact from any vehicles which may be driving on the beach or landside portion of the pier.

5.2.2.3 Construction Equipment Loading

The structure is not designed to support heavy construction equipment (e.g. cranes) or to accommodate lifting and/or mooring operations during construction. Therefore, load calculations for construction equipment live loads will not be included in the design.

5.3 Wind Loads

Wind loading on the structure will be calculated based on wind speeds at the project site as outlined in ASCE 7-16. The maximum design 3-second gust wind speed of 148 mph shall be used for structures, determined by the geographical location, Class II structure risk category, and wind speeds specified in Chapter 26 of ASCE 7-16.

5.4 Hydrodynamic and Hydrostatic Loads

5.4.1 Wave Loading

Wave loading on the structure is based on the 50-year WSEL event as reported by the offshore WIS station but reduced to a depth-limited height due to nearshore shoaling. The wave break criteria will follow the standard 0.78 wave height-to-water depth ratio.

Wave loading calculations will use standard Goda equations for estimating lateral forces on the pile caps, the Morison equation for lateral forces on the pile, and AASHTO guidelines for lateral and uplift forces on the superstructure.

5.4.2 Current Loading

The lateral inertial and drag forces on the structure's piles shall be calculated using Morison's equation. The water velocity used within the equation is assumed to be 1 ft/s based on general surf zone conditions during storm events.

5.5 Load Combinations

Load combinations will be performed in general conformance with ASCE 7-16, as shown below. One change is proposed from the standard ASCE 7 load combinations. Wave loads and hydrodynamic loads for marine structures are typically based on a design storm with modeled hydrodynamic conditions. Other design guidelines specific to marine structures and piers (such as UFC 4-152-01) recommend a reduced load factor for hydrodynamic loads (compared with ASCE 7) due to less uncertainty surrounding the likelihood and definition of the loading. The pier design will adopt a 1.2 (LRFD) and 1.0 (ASD) load factor to remain consistent with industry guidelines for marine structures.

5.5.1 Load Symbols

The following load symbols are applicable for Tables 5-2 and 5-3:

D = Dead load
L_u = Live load (uniform)
L_c = Live load (concentrated)
I = Impact load (for L_c only)

B = Buoyancy load
C = Current and wave load on structure
W = Wind load on structure

5.5.2 Load and Resistance Factor Design (LRFD)

Load combinations are presented in Table 5-2. Load Combination 3 removed by inspection.

Table 5-2. Load Combinations - Load and Resistance Factor Design (LRFD)

	1	2	4	5
D	1.4	1.2	1.2	0.9
(Lc+I)|Lu	-	1.6	1.0	-
B	1.4	1.2	1.2	0.9
C	-	-	1.2[1]	1.2[1]
W	-	-	1.0	1.0

5.5.3 Service Load Design/Allowable Stress Design (ASD)

Load combinations are presented in Table 5-3. Load Combination 3 removed by inspection.

Table 5-3. Load Combinations - Allowable Stress Design (ASD)

	1	2	4	5	6	7
D	1.0	1.0	1.0	1.0	1.0	0.6
(Lc+I)|Lu	-	1.0	0.75	-	0.75	-
B	1.0	1.0	1.0	1.0	1.0	0.6
C	-	-	-	1.0[1]	1.0[1]	1.0[1]
W	-	-	-	0.6	0.45	0.6

6 Design Methodology

6.1 Pier Approach

6.1.1 Layout

The new recreational pier will be designed with a total length of 1,000 feet and will terminate in a T-head configuration. It will feature a timber superstructure supported by a series of timber bent substructures. Utility connections for water and electrical will be incorporated to support lighting and one or more fish cleaning stations. The pier walkway elevation will be established to ensure the superstructure remains above the FEMA base flood elevation of +16.0 feet.

[1] UFC 4-152-01 load factor for currents and waves on the structure are used in lieu of ASCE 7 flood load factors.

6.1.2 Design Approach

The structural design will follow a defined load path as outlined below, with all members evaluated for both strength and serviceability.

Decking – The decking will be designed as a one-way system to span its maximum distance while supporting a live load of 60 PSF or a concentrated load of 400-lbf (whichever produces a more critical load effect) in accordance with NC IBC 2018, and ASCE MoP 50. Loads will be transferred and distributed to the supporting timber joists.

Joists – Timber joists will span between the bent cap beams and are designed for a max clear span of 12-ft. The joists support the decking and will be designed to transmit vertical and lateral loads from the superstructure to the bent cap beams. They will be designed for strength and serviceability.

Bent Cap Beams – Timber bent cap beams will span between timber piles and transfer the loads from the joists above. They will be designed for a clear span of up to 12 feet, not exceeding the overall pier walkway width of 16 feet.

Piles – Round timber piles will be spaced no more than 12 feet apart both longitudinally and transversely along the pier walkway. They will be designed to resist both axial and lateral loads in accordance with applicable design standards.

6.1.3 Design Software

- APILE v2022, by ENSOFT for determining the axial requirements for the timber piles
- GROUP v2022, by ENSOFT for analysis of stress, soil-structure pile interaction, and relative deformation of pile groups subjected to axial and/or lateral loading.
- LPILE v2022 by ENSOFT for analysis of stress and deformation of individual piles or drilled shafts under axial and/or lateral loading.

6.1.4 Additional Design Criteria

The recreational pier will also be designed for the following general criteria:

- Maximum design scour allowance of 10 feet
- Top of pier walkway elevation will be +19 feet.
- Overall width of the Pier walkway structure shall be 16 feet.
- The T-head is currently assumed to have both a length and width of 48 feet, pending further guidance from the Town.
- Pile diameters will be based on a maximum of 15-inch timbers, subject to material availability.
- Sufficient anchorage against uplift forces between all components, except elements specifically designed to break away, shall be provided. The resisting capacity shall be at least 1.5 times the applied uplift force.

6.2 Utility Design

6.2.1 Water

The water service will be extended from the existing supply at the meter to the new pier. A backflow preventer assembly will be installed near the meter in accordance with local utility standards. The proposed water line will use materials that meet applicable local utility standards. The new line will be routed along the pier to service hose bibs and fish cleaning stations. Final pipe sizing will be determined based on the quantity and spacing of these fixtures to ensure adequate flow and pressure. A valve and discharge will be provided at the low point of the system for drainage as needed. All components shall conform to local utility standards and approved details.

6.2.2 Electrical

A new 120/240V, single phase service will be provided for the pier. An equipment rack will be installed on shore which will support the new electric utility meter, service disconnect and panelboard. The service disconnect will be an enclosed 60A breaker with a lockable NEMA 4X stainless steel enclosure. The panelboard will be 100A main lug-only type with 18-poles for branch breakers and housed in a lockable NEMA 4X stainless steel enclosure. The panelboard will be protected by an externally mounted, NEMA 4X surge protection device.

Exposed conduits at the service equipment rack will be rigid aluminum conduit. Conduits installed below grade or run exposed along on the pier will be fiberglass type (reinforced thermosetting resin conduit). Outlet boxes and junction boxes will be cast aluminum. Receptacles will be GFCI type, weather and corrosion resistant, and will have a cast aluminum cover rated as weatherproof while in use. Receptacle quantity and locations will be coordinated with the Town. Pole mounted light fixtures on the pier will consist of LED fixtures with cast aluminum housing, IP68 rating, and full cutoff optics. Desired lighting levels will be coordinated with the Town and regulatory agencies. Dusk-to-dawn operation of the lights will be provided by photocells installed on the first light pole on the pier.

7 Corrosion Protection & Lifespan

7.1.1 Design Life

The design service life of the new timber pier is 30 years.

7.1.2 General Concept

Corrosion protection for this facility will be a combination of details, material specifications, and coatings.

7.1.3 Coating

All structural steel shall be either stainless steel or hot-dip galvanized after fabrication.

7.2 Construction Material Requirements

7.2.1 Timber

i. All timber shall be new, southern yellow pine, Grade No. 2 or better.

ii. All timber shall be treated with chromated copper arsenate (CCA) to a retention of 2.5 lb/cu-ft.

iii. The timber piles and planks shall be installed to the following tolerances:

   a. Variance from horizontal alignment ½ inch per 20 ft

   b. Variance from plumb (front to back) ½ inch per 10 ft

   c. Variance from plumb (side to side) ¼ inch per 10 ft

   d. Variance in elevation 1 inch

iv. Timber piles shall meet the requirements of ASTM D-25.

v. Timber piling shall not be notched so that the cross-section is reduced below 50 percent.

vi. Wood species, preservative treatment, minimum lumber size and grade shall be in accordance with Table 7-1 below.

Table 7-1. Specifications for Southern Pine Lumber in Fresh and Saltwater Service

Table 3605.3
SPECIFICATIONS FOR SOUTHERN PINE[b] LUMBER IN FRESH AND SALT WATER SERVICE

LOCATION	COMPONENT	AWPA USE CATEGORY[a, d]		DIMENSIONS (inches)	LUMBER GRADE		MOISTURE CONTENT AT TREATMENT
		Saltwater	Freshwater		Saltwater	Freshwater	
Above Normal High Water	Decking[c]	3B	3B	$^5/_4$ 2 Nominal Min.	Premium No. 2	Premium No. 2	Surfaced Dry 19%
	Guardrails	3B	3B	2 Nominal Min.	No. 2	No. 2	Surfaced Dry 19%
	Wallcaps	3B	3B	2 Nominal Min.	No. 2	No. 2	Surfaced Dry 19%
	Walers	3B	3B	4 × 6 Nominal	No. 2	No. 2	Surfaced Dry 19%
	Cross Bracing	3B	3B	2 to 4 Nominal	No. 2	No. 2	Surfaced Dry 19%
Splash Zone	Split Pile Caps	4B	4B	2 to 4 Nominal	No. 2	No. 2	Surfaced Dry 19%
	Stringers	4B	4B	2 Nominal	No. 2	No. 2	Surfaced Dry 19%
Below Normal High Water	Sheet Piles	5B	4C	2 to 4 Nominal	Marine No. 1[g]	No. 2	Surfaced Dry 19%
	Walers	5B	4C	4 × 6 Nominal	Marine No. 1[g]	No. 2	KD 20% or less or Dry 23%
	Cross Bracing	5B	4C	2 to 4 Nominal	Marine No. 1[g]	No. 2	Surfaced Dry 19%
	Rectangular Timber Piles	Not Allowed[f]	4C	6 × 6 Nominal	Not Allowed[f]	No. 2	KD 20% or less or Dry 23%
	Round Timber Piles	5B[f]	4C	ASTM D25	ASTM D25	ASTM D25	KD 25% or Less
Engineered Lumber	Glulam Timber	5B	4B	4 Nominal Min.	Note e	Note e	12% Average
	Parallel Strand Lumber	5B	4B	$3^1/_2$ Minimum	1.8E or Better	1.8E or Better	per manufacturer's specifications

a. Lumber shall be pressure treated with preservative treatment in accordance with AWPA U1.
b. At the discretion of the building official, lumber species other than Southern Pine may be approved when span tables for wet use conditions are submitted, and the lumber is treated for comparable service life to the treatment specifications required by Table 3605.3.
c. Wood composite decking, treated or untreated, shall provide equivalent service life to the treated decking specified in Table 3605.3.
d. All notches, holes, and field cuts shall be field treated in accordance with AWPA M4.
e. Glulam grade shall be specified as a layup combination or stress class in accordance with the National Design Specification or the manufacturer's published data. Layup combinations shall consist of species and grades capable of the treatment retentions equivalent to the AWPA use categories specified in Table 3605.3.
f. Commercial pile wraps may be used to extend the life expectancy of timber piles exposed to marine borers.
g. AWPA requirements for Marine No. 1 specify that no heartwood be exposed on any face prior to preservative treatment.

7.2.2 Structural Steel

i. Steel work shall be performed in accordance with ANSI/AISC 360-05, "Specification for Structural Steel Buildings", American Institute of Steel Construction, Steel construction Manual.

ii. Welding shall conform to the requirements of ANSI/AWS D1.1.

iii. Anchor bolts shall conform to the requirements of ASTM F1554, unless otherwise noted.

iv. Structural bolts shall conform to ASTM A325.

v. Steek bolts, rods, and other hardware shall be hot-dip galvanized and no smaller than 5/8-inch diameter.

vi. Threaded fasteners shall not be tightened directly against wood surfaces but used in conjunction with standard ogee or flat washers.

8 Design Codes and References

8.1 Marine Structures

New marine structures shall be designed in accordance with codes and references listed in this section as applicable. Refer to other sections in this document for modifications and/or limitations of these codes and references as they apply to different components of the project.

8.1.1 Design Codes and Manuals

The following codes, references, and standards shall be utilized in the project design as applicable unless modified by individual sections in the Design Basis:

American Association of State Highway and Transportation Officials (AASHTO), LRFD Bridge Design Specifications, 6th Edition, 2012

American Institute of Steel Construction, Steel Construction Manual, 14th Edition, 2011

American Institute of Steel Construction, Specification for Structural Steel Buildings (ANSI/AISC 360-10)

American Wood Council National Design Specification (NDS), 2018

ANSI/ASCE 7-16, Standard, Minimum Design Loads for Buildings and Other Structures, 2016

ASCE Manuals and Reports on Engineering Practice No. 50 – Planning and Design Guidelines for Small Craft Harbors, Third Edition (ASCE MoP 50)

ANSI/AWS D1.1, Structural Welding Code - Steel, Latest Edition

International Code Council, International Building Code (IBC), 2018

Occupational Safety and Health Administration

Unified Facilities Criteria – General Criteria for Waterfront Construction (UFC 4-151-10)

Unified Facilities Criteria – Design: Piers and Wharves (UFC 4-152-01)

8.1.2 Previous Reports

Report of Geotechnical Exploration – Holden Beach Pier and Pier House, July 2023

Appendix B1

ASCE 7 Hazard Data

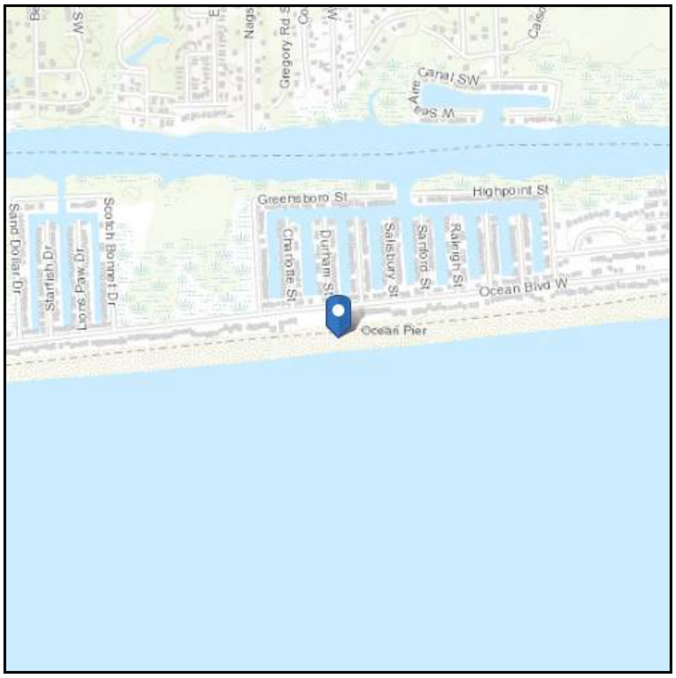
hdrinc.com HDR Engineering, Inc.
101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020

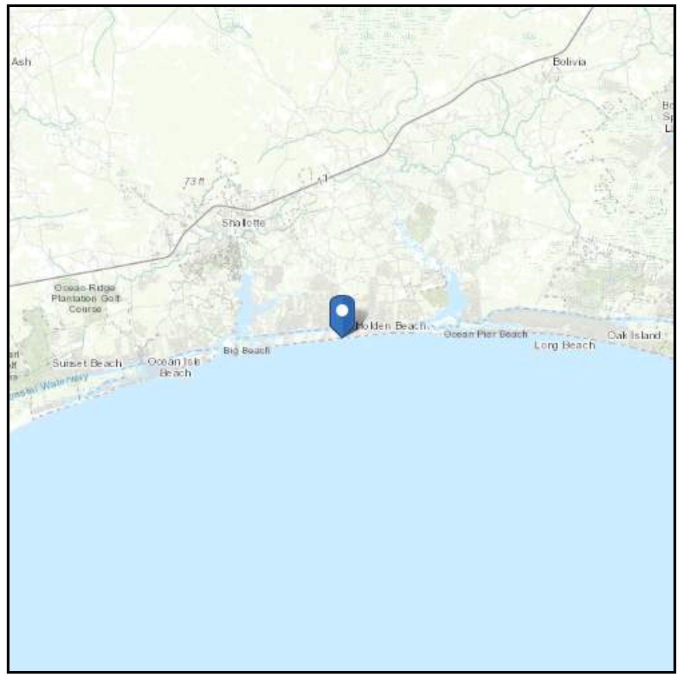
ASCE Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: undefined

Latitude: 33.910656
Longitude: -78.297109
Elevation: 0.50000945825752 ft (NAVD 88)





Wind

Results:

Wind Speed	148 Vmph
10-year MRI	80 Vmph
25-year MRI	95 Vmph
50-year MRI	107 Vmph
100-year MRI	118 Vmph

Data Source: ASCE/SEI 7-16, Fig. 26.5-1B and Figs. CC.2-1–CC.2-4, and Section 26.5.2
Date Accessed: Mon May 12 2025

Value provided is 3-second gust wind speeds at 33 ft above ground for Exposure C Category, based on linear interpolation between contours. Wind speeds are interpolated in accordance with the 7-16 Standard. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (annual exceedance probability = 0.00143, MRI = 700 years).

Site is in a hurricane-prone region as defined in ASCE/SEI 7-16 Section 26.2. Glazed openings shall be protected against wind-borne debris as specified in Section 26.12.3.

The ASCE Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

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Appendix C

Lifecycle Analysis Report

hdrinc.com

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(910) 398-9020

Town of Holden Beach Life Cycle Plan

Town Pier Reconstruction

HDR Engineering, Inc. of the Carolinas
Project No. 10426190

Holden Beach, North Carolina

July 1, 2025

NCBELS Firm Registration No. F-0116

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Appendix C-1: Life Cycle Analysis

1 Introduction

1.1 Pier Overview

In 2022, the Town of Holden Beach acquired a coastal pier property with the goal of restoring public access to a key recreational amenity. Located along Ocean Boulevard West in Brunswick County, North Carolina, the site includes an 80-space parking lot, beach access points, modular restrooms, and a small campground. The main focal point – a timber recreational fishing pier and adjacent pier house – was closed to the public due to advanced age and structural deterioration. The overall site layout is shown in Figure 1-1.

Figure 1-1. Overall Site Layout

To address this need, the Town has initiated a project to replace the 750-foot-long fishing pier. The adjacent pier house is outside the current project scope and is planned to be demolished separately. A new, 1,000-foot pier will be constructed at the same location and will restore opportunities for fishing, sightseeing, and shoreline access. This life cycle plan is intended to guide long-term maintenance, funding, and renewal activities following reconstruction of the pier.

1.2 Ownership and Management Responsibility

The pier is owned and managed by the Town of Holden Beach. As the responsible entity, the Town will oversee operations, maintenance, inspections, and capital reinvestment over the life of the asset. This plan supports the Town's stewardship by providing clear guidance on sustaining asset performance and managing funding over time.

1.3 Design and Construction Details

The new pier will be constructed entirely of timber and designed in accordance with coastal resiliency best practices, with pressure-treated timber and stainless-steel hardware expected to be the primary materials. The structure includes ADA-compliant access via a ramp and a T-head with a covered area at the seaward end. The 16-foot-wide pier will include benches and other features to support public use. The design prioritizes durability in a saltwater environment while remaining consistent with the character of the original pier. The pier is not designed to support vehicle or construction loads; all construction will be performed via barge or temporary trestles. No fire suppression system is included.

1.4 Life Cycle Plan

The life cycle plan provides a structured approach to managing the pier throughout its service. It outlines strategies to support ongoing maintenance, protect asset condition through preservation, address issues through periodic rehabilitation, and plan for future replacement needs. The life cycle approach enables the Town to estimate long-term costs, prioritize reinvestment, and make informed decisions that align with available resources and service expectations.

1.5 Key Assumptions

The following assumptions inform the life cycle planning approach and support long-term maintenance and funding strategies:

- The new timber pier is designed for a 30-year design life, consistent with exposure to coastal wind, wave, and saltwater conditions.
- A 50-year life cycle horizon is used to capture longer-term maintenance and renewal needs beyond the initial service period.
- Life cycle costs are presented in current year dollars (2025).
- Reactive work was not included as part of the life cycle plan; see Section 3.3.5 for additional details.
- The pier will be used exclusively by pedestrians and will not be designed for vehicle access, construction loading, or fire suppression systems.
- Utilities (potable water and electrical) are part of the pier design and have been incorporated into the life cycle plan.
- No buried utilities or subsurface conflicts have been identified, and therefore these factors are not included in the life cycle plan.

2 Life Cycle and Performance Expectations

2.1 Functional Intent

The new pier is intended to support passive recreational use, including walking, fishing, and public gathering. Design features such as ADA-accessible pathways, public seating, and shaded areas will enhance usability and comfort. The pier will also include lighting, potable water service, and a fish cleaning station, with infrastructure located above deck level for ease of access and maintenance. These elements have been incorporated into the life cycle plan.

2.2 Service and Maintenance Requirements

While the structural elements are designed for a 30-year service life, several components – including decking, benches, railings, and utilities – will require more frequent inspection and replacement. Routine maintenance will focus on ensuring pedestrian safety, maintaining appearance, and preventing deterioration from exposure to saltwater and coastal weather.

The pier's timber structure will require regular condition assessments to monitor for signs of decay, marine borer activity, corrosion of fasteners, and settlement. Utility system maintenance will need to be tracked as part of the life cycle plan, with recommended activities based on material type and corrosion risk.

2.3 Access and Operational Constraints

Given that the pier will not support vehicles or heavy equipment, all life cycle activities will need to be performed from the pier deck or via watercraft access. This constraint must be factored into planning for inspections, utility access, and future repairs. Emergency response access will also be limited to the pier entrance and adjacent beach areas.

2.4 Life Cycle Performance Goals

Establishing clear performance goals helps define the expected function and condition of the pier over time, providing a basis for planning maintenance, monitoring performance, and guiding future investments. Life cycle performance goals over the life of the pier include:

- Maintaining safe and unobstructed public access to the end of the structure.
- Ensuring utilities remain operational and meet safety standards.
- Preserving visual condition and minimizing the appearance of deterioration.
- Managing risk from environmental exposure through timely maintenance and repair.

While the pier will be designed in accordance with applicable standards and coastal engineering methods, the life cycle plan does not account for severe damage from extreme weather events. With that said, reactive life cycle activities have been incorporated in the life cycle plan; however, such events should be addressed through separate emergency response and disaster recovery planning.

3 Life Cycle Planning

3.1 Life Cycle Approach

Holden Beach Pier’s life cycle plan establishes life cycle activities and implementation decisions based on age, current conditions, risks to asset failure, cost-benefit information, and available funding. The benefit of applying life cycle planning is the ability to balance short-term spending and long-term needs to manage the pier in an efficient, cost-effective manner.

Piers deteriorate over time because of exposure to a variety of factors such as environmental impacts, construction and material quality, maintenance frequency, and human impacts. Holden Beach considers the impacts of these factors in life cycle planning and performance forecasting to determine the most cost-effective investment strategies to maximize the life of the pier. Figure 3-1 presents a conceptual illustration of asset deterioration and the impact of regular asset maintenance and preservation activities. When applied to the piers at the right time, preservation treatments help extend asset life at a fraction of the cost of more expensive repairs and replacements.

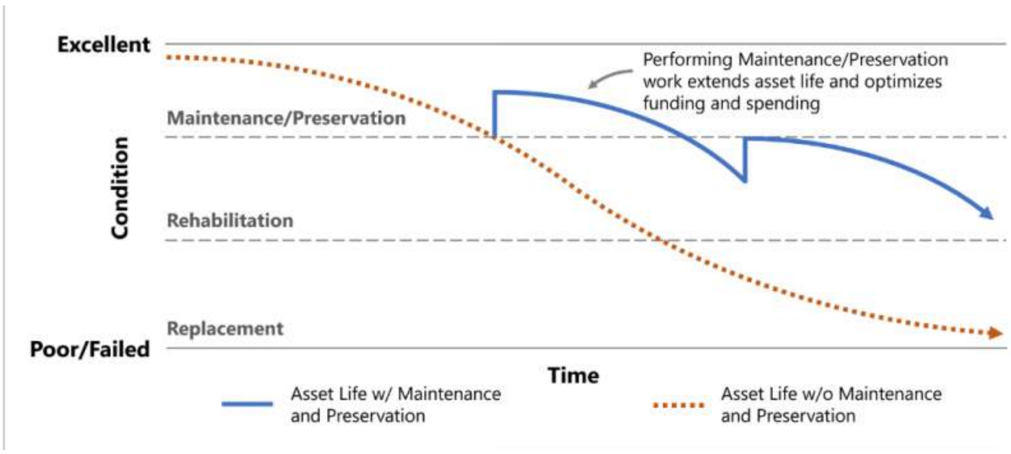

Figure 3-1: Extending Asset Life with Maintenance and Preservation

3.2 Life Cycle Strategies

The Town’s life cycle activities can be broken into the following five key categories:

- ***Maintenance*** – Ongoing activities focused on routine inspections, preventative care, and minor upkeep to ensure the pier remains safe, functional, and visually appealing throughout its service life. These are activities that are performed with shorter frequencies (every 7 years or less) to keep the pier in a state of good repair. This includes activities such as inspecting, cleaning, and sealing.
- ***Preservation*** – Minor repair activities to address specific deterioration and/or extend the expected service life of the pier. These are targeted actions designed to slow deterioration, extend the life of components, and preserve the structural integrity of the pier without major repairs or replacements. This includes activities such as pile wraps, reinforcing critical members, and cleaning.

- ***Rehabilitation*** – More substantial repairs or upgrades performed to restore functionality, address localized deterioration, or enhance structural performance beyond routine maintenance. This includes activities such as decking repair and additional pile bracing.
- ***Replacement*** – Full replacement or reconstruction of the entire pier or a large portion of it. Before performing these activities, a rehab versus replacement analysis should be conducted to confirm that the activities will be cost effective over the remaining life of the pier. End-of-life actions involving the full replacement of major structural elements or complete removal of the pier when no longer serviceable.
- ***Reactive Work*** – Response activities designed to address unforeseen damage or failures. These actions are incorporated into life cycle planning to support timely repair and restoration of the pier's safety and functionality following unexpected events such as storms, vessel impacts, or sudden deterioration.

3.3 Life Cycle Activities, Frequencies, and Costs

The recommended life cycle activities to manage and maintain Holden Beach's pier are summarized in Table 3-1 on the following page.

The activity frequency column lists the recommended or estimated time in years between applications of the given activity. The frequency values have been determined based on a compilation of other agencies recommended pier best practices, industry standards, and subject matter experts. Frequency ranges are presented (denoted as low and high in the table), where applicable, along with the proposed frequency for life cycle planning purposes.

The activity cost estimate and comment columns provide the basis for estimating the cost of these activities. These costs are estimated in current year dollars and align to the pier's preliminary design plans. Cost estimates include a combination of average bid prices and man-hour assessments.

By performing maintenance and preservation activities in a timely manner, the frequency of major rehabilitations and replacements is predicted to decrease.

The five life cycle strategies are presented in the following sub-sections, along with the specific activities associated with each to support effective pier life cycle management.

Category	Activity		Frequency - Low	Frequency - High	Frequency	Activity Cost	Comments
Maintenance	Inspection	Above Water Inspection and Condition Assessment	3 yrs	5 yrs	4 yrs	$20,000	
		Under Water Inspection and Condition Assessment	-	-	5 yrs	$25,000	
	Preventative Maintenance	Debris Management	-	-	4x / yr	$1,200	
		Sealing and Re-Coating of Decking	5 yrs	10 yrs	7 yrs	$48,000	
Preservation	Pile Protection	Pile Wrap Installation or Reapplication	-	-	1/ life cycle (at 16 yrs)	$89,595	Only 50% of piles assumed to get wrapped
	Cleaning & Drainage Maintenance	Cleaning of Pier Superstructure	-	-	1 yr	$16,000	
		Cleaning of Pier Substructure	3 yrs	5 yrs	4 yrs	$6115	
Rehabilitation	Partial Deck Rehab	Decking Repairs	-	-	10 yrs	$3,913	Estimated 20% of boards will need to be replaced every 10 years
	Structural Strengthening	Addition of Bracing of Pile Caps	5 yrs	10 yrs	7 yrs	$5,250	Assuming 2.5% of elements are braced every occurrence
	Upgrading Benches	Upgrade and/or replace worn benches	15 yrs	20 yrs	17 yrs	$15,000	Includes all benches
Replacement	Upgrading Utilities and Fixtures	Electrical and Lighting Upgrades	-	-	1/ life cycle (at 30 yrs)	$262,000	Replacement of entire electrical system
		Plumbing Upgrades	-	-	1/ life cycle (at 30 yrs)	$19,000	Replacement of entire plumbing system
	Full Deck Replacement		-	-	1/ life cycle (at 30 yrs)	$124,000	Replacement of entire superstructure
	Pile Replacement		-	-	1/ life cycle (at 30 yrs)	$375,000	10% of piles over beach replaced, 50% of piles over water replaced
	Full Roof Replacement		-	-	1/ life cycle (at 30 yrs)	$4,600	Replacement of entire roof structure

Table 3-1: Proposed Pier Life Cycle Framework

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3.3.1 Maintenance

Maintenance includes routine inspections, preventive care, and minor upkeep to keep the pier safe and functional. The following life cycle activities for maintenance include:

- ***Inspections*** – Systematically examine the pier's structural components, surfaces, and fixtures to identify signs of wear, damage, or potential safety hazards. This includes checking for cracks, corrosion, loose or damaged elements, and any changes in condition that could affect performance. Regular documentation and condition tracking are essential to monitor deterioration trends and prioritize maintenance needs. These inspections include:
  - ***Above Water Inspection and Condition Assessment*** – Evaluate visible structural and surface elements, and overall visible condition of the pier (*Frequency: 3-5 Years*)
  - ***Under Water Inspection and Condition Assessment*** – Involves detailed examination of submerged piles and supports for marine growth, corrosion, structural integrity, and potential scour (*Frequency: 5 Years*).
- ***Preventive Maintenance*** – Consists of scheduled activities aimed at preserving the pier's condition and slowing deterioration. These tasks include regular removal of debris to prevent damage or drainage blockages and protective treatments applied to decking surfaces to guard against water and environmental exposure. Key activities include:
  - ***Debris Management*** – Involves clearing trash, natural debris (like seaweed or driftwood), and accumulated sediments from decking, drainage channels, and structural components to reduce moisture retention and prevent clogging that can lead to water damage or accelerated material decay. (*Frequency: Quarterly*).
  - ***Sealing and Recoating of Decking*** – Entails applying water-resistant sealants or protective coatings to wood and/or decking surfaces to shield against UV damage, moisture intrusion, and wear from foot traffic. (*Frequency: 5-10 Years)*

3.3.2 Preservation

Preservation includes targeted minor repairs to slow deterioration and extend the service life of pier components. The following life cycle activities for preservation include:

- ***Pile Protection (Pile Wrap Installation and Reapplication)*** – Focuses on maintaining the integrity of piles against environmental and biological threats such as marine borers and physical impacts. This requires regular inspection and timely maintenance or replacement of protective coverings to prevent deterioration. *(Frequency: 1 per life cycle at 15-20 Years)*
- ***Cleaning and Drainage Maintenance*** – Entails the removal of debris, marine growth, and contaminants that could accelerate deterioration or obstruct drainage systems. Key activities include:

  - ***Cleaning of Pier Superstructure*** – Involves washing down structural surfaces to remove salt, dirt, and other airborne contaminants; clearing out joints and utility supports; and removing buildup from ledges and connections where debris can collect. (*Frequency: Annually*)
  - ***Cleaning of Pier Substructure*** – Involves removing marine growth, sediment, and debris from piles, pile caps, and other submerged or partially submerged components. (*Frequency: 3-5 Years)*

3.3.3 Rehabilitation

Rehabilitation includes more substantial repairs or upgrades to restore or improve pier functionality and address localized deterioration. The following life cycle activities for rehabilitation include:

- ***Partial Deck Replacement*** – Addresses localized areas of decking that have deteriorated beyond preservation thresholds but do not require full deck replacement. This involves inspecting and replacing deck sections showing significant wear or damage. (Frequency: 10 Years)
- ***Structural Strengthening*** – Entails adding bracing, pile caps, or other structural supports as identified through detailed inspections and analyses to extend the pier's service life. (Frequency: 5-10 Years)
- ***Upgrading Benches*** – Replace worn benches with durable, accessible seating using weather-resistant materials. (*Frequency: 15-20 Years)*

3.3.4 Replacement

Replacement includes full reconstruction or removal of major pier elements at the end of service life. The following life cycle activities for replacement include:

- ***Full Deck Replacement*** – Involves the complete removal and reconstruction of the pier deck, planned based on condition data and anticipated service life. (*Frequency: at 30 Years)*
- ***Pile Replacement*** – Includes the removal and replacement or reinforcement of piles that have deteriorated significantly and can no longer be preserved. Timing depends on condition monitoring and structural evaluations. *(Frequency: at 30 Years)*
- ***Upgrading Utilities and Fixtures*** – Covers periodic updates to electrical systems, lighting, plumbing, and other amenities to improve safety, efficiency, and user experience. Key activities include:
  - ***Electrical and Lighting Upgrades*** – Replace outdated wiring, panels, and fixtures; upgrade to latest energy-efficient lighting. (*Frequency: at 30 Years)*
  - ***Plumbing Upgrades*** – Update aging pipes and fixtures to improve reliability, reduce water use, and meet current codes. (*Frequency: at 30 Years)*
- ***Full Roof Replacement*** – Entails replacing the entire roof system at the end of its service life or due to significant deterioration. (*Frequency: at 30 Years)*

3.3.5 Reactive Work

Reactive work is intended to cover unplanned repairs and urgent actions that fall outside the scope of routine, preventive, or planned maintenance activities. This primarily includes storm damage and vessel collision repairs, such as replacing broken decking, realigning pilings, and clearing debris. It also addresses unexpected deterioration or failures caused by factors like marine borers, corrosion, or climate impacts, that are not covered under preventive maintenance. Accounting specifically for reactive needs helps maintain the pier's safety, functionality, and longevity without disrupting scheduled activities.

Following any event or when unexpected issues are suspected, a special inspection should be conducted to assess the extent and nature of the damage. This inspection helps prioritize repairs, inform budgeting, and guide decisions about necessary interventions. The inspection may include visual assessments, underwater surveys, and material testing, depending on the damage suspected.

Typical reactive work activities may include:

- Repair or replacement of broken or dislodged decking planks, handrails, and structural members.
- Realignment or resetting of pilings that have shifted, tilted, or been impacted.
- Removal of debris and obstructions caused by storms or vessel collisions.
- Emergency replacement or reinforcement of timber piles or structural members affected by marine borers or other accelerated deterioration.
- Tightening or replacement of unexpected, corroded bolts, fasteners, and steel connectors.
- Reactive treatment or replacement of rusted hardware and exposed steel components showing corrosion.

Reactive work typically accounts for approximately 5% to 15% of the total life cycle budget, depending on asset condition, exposure, and risk tolerance. In addition to this baseline, a separate contingency should be held to address major events such as hurricanes, vessel impacts, or other extreme conditions that may require significant emergency repairs beyond the typical reactive response.

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4 Financial Life Cycle Plan

4.1 Life Cycle Framework

The life cycle framework described in Section 3 provides the basis for the financial life cycle plan. It defines the timing, frequency, and unit costs of key maintenance, preservation, rehabilitation, and replacement activities over the 50-year horizon. For clarity, the financial life cycle plan is presented in two parts: **recurring activities** (maintenance, preservation, and rehabilitation) and the one-time **mid-life replacement** activity. These inputs are used to generate the life cycle cost projections, which help forecast long-term funding needs and maintenance requirements for the pier.

4.2 Recurring Activities Cost Forecast

A cost forecast was developed for recurring life cycle activities – specifically maintenance, preservation, and rehabilitation – based on an unconstrained, or "fully funded," scenario in which all scheduled work is performed as planned.

Figure 4-1 illustrates the resulting year-by-year spending, showing considerable variability due to the assumption that each activity occurs in the exact year it is due. Notable spikes include a major preservation project to wrap piles in 2041. While full pier replacement is anticipated at the end of the 50-year period, its cost is not included in this forecast.

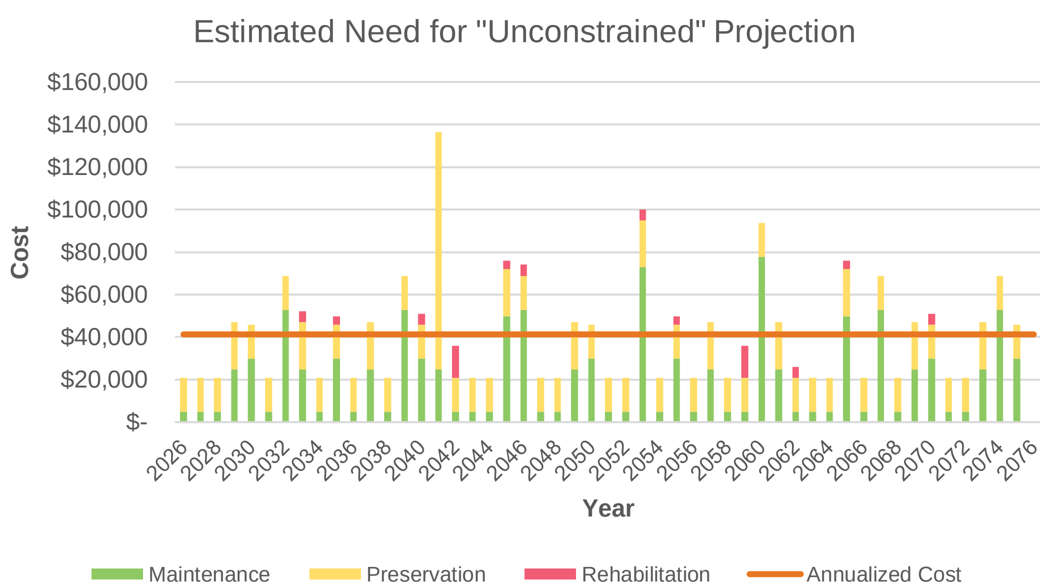

Figure 4-1: Estimated Need for "Unconstrained" Scenario

This idealized scenario is intended to illustrate the general magnitude and timing of recurring financial needs. It focuses exclusively on maintenance, preservation, and rehabilitation—costs that are ongoing, frequent, and central to long-term management. Replacement activities are addressed separately in Section 4.3.

Over the 50-year analysis period, the average annual cost is approximately $41,296, as shown by the horizontal line in Figure 4-1. This average helps contextualize the variability and informs long-term funding strategies.

To improve practicality, the activity schedule was later optimized to reflect likely implementation conditions. For example, rehabilitation activities near the end of the pier's life were eliminated, and partial deck replacements were timed to align with inspection intervals. These adjustments reduce inefficiencies and support a more practical, deliverable plan.

4.3 Recurring Activities Annualized Cost

An annual investment is necessary to maintain the pier's desired condition. Based on the estimated cost and frequency of the life cycle activities (as shown in Table 3-1), an annualized unit cost is assigned to each life cycle category. This results in a total annualized cost for all the pier life cycle activities. Table 4-1 below shows the annualized cost for each activity type and the total cost over the 50-year period. These annualized costs represent a high-level annual estimate and are calculated based on the initial design of the pier. A more detailed breakdown of Table 4-1 can be found in Appendix C-1.

Activity Type	Avg. Annual Cost	50-Year Cost
Maintenance	$20,901	$1,066,000
Preservation	$18,881	$962,975
Rehabilitation	$1,512	$77,151
Total*	**$41,296**	**$2,106,127**

**Replacement activities are not included; see Section 4.3 for more details.*

Table 4-1: Future Annualized Funding Needs Projection (in 2025 $)

The unconstrained scenario only accounts for maintenance, preservation, and rehabilitation activities and leaves out the one-time major replacement activity. It is shown this way to better illustrate the annual cost required to keep the pier in good condition. Since replacement activities represent a large, one-time cost, including the replacement would skew the average annual cost. The total life cycle costs with replacement activities included are presented in Section 4.5.

4.4 Mid-Life Replacement Cost

Figure 4-1 shows the calculated average annual cost, which includes only planned maintenance, preservation, and rehabilitation activities. Not included in that projection is a major capital project classified as replacement work, anticipated in 2056 at the 30-year mark.

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This replacement effort, detailed in Section 3.3.4, is expected to cost $784.7K and is intended to extend the pier's service life to 50 years in a cost-effective manner, avoiding the need for full reconstruction. Table 4-2 provides a breakdown of the estimated costs for the 2056 replacement activities. Note that the following replacement line-item costs are not inclusive of construction methodology considerations (i.e., barge rentals, trestle construction, etc.). The line items include base labor and material costs only.

Activity	Cost	Notes
Utility Replacements	$281,000	Electrical and Plumbing systems replacement
Deck Replacement	$124,000	Complete replacement of superstructure
Roof Replacement	$4,600	Complete replacement of roof structure
Pile Replacement	$375,100	Replacement of approx. 38% of piles
Total	**$784,700**	

Table 4-2: Replacement Activities Cost in 2056 (in 2025 $)

4.5 Total Life Cycle Annualized Cost

Table 4-3 shows the annualized funding needs projection similar to the one shown in Table 4-1, however Table 4-3 includes the annualized cost of replacement activities. Adding replacement costs provides a more complete picture of the full life cycle cost and shows the resulting increase in average annual cost due to major replacement work.

Activity Type	Avg. Annual Cost	50-Year Cost
Maintenance	$20,901	$1,066,000
Preservation	$18,881	$962,975
Rehabilitation	$1,512	$77,151
Replacement	$15,386	$784,700
Total*	**$56,682**	**$2,890,827**

**Reactive activities not included in Total Costs; see Section 4.3 for more details.*

Table 4-3: Total Future Annualized Funding Needs Projection (in 2025 $)

5 Life Cycle Implementation

To carry the life cycle plan forward into long-term practice, several actions should be taken as the pier transitions from construction to operation. These steps help embed the plan into ongoing maintenance, management, and decision-making processes so that it remains practical, current, and aligned with the pier's performance over time. The following activities outline how to implement, monitor, and maintain the life cycle plan.

1. ***Monitor Construction Progress and Adjust the Plan as Needed*** – Track construction activities to ensure alignment with life cycle expectations. Identify any design changes or material substitutions that may affect long-term performance or maintenance strategies. Update the life cycle plan to reflect construction realities, including any deviations from the original assumptions. Regular coordination between construction and the Town will support timely updates. This helps ensure that the life cycle plan remains a living, relevant document from the start.
2. ***Capture Critical Documentation at Handover*** – During handover, compile a complete set of baseline records for the pier, including as-built drawings, inspection reports, O&M manuals, warranties, and equipment specifications. These records form the foundation for future maintenance, renewal, and repair decisions. Ensure all documentation is verified, digitized, and stored in an accessible format. This step is essential for establishing an accurate asset inventory and understanding operational requirements prior to commissioning.
3. ***Develop Operational Procedures Aligned with the Life Cycle Plan*** – Establish routine and non-routine procedures that reflect the full range of interventions defined in the life cycle plan – maintenance, preservation, rehabilitation, replacement, and reactive actions. Set criteria for larger repairs, supported by cost-effectiveness reviews, and include protocols for end-of-life replacement and emergency response. Clear roles and responsibilities will ensure consistent execution and long-term performance.
4. ***Define and Monitor Key Performance Indicators (KPIs***) – Implement KPIs to track asset condition, maintenance effectiveness, safety performance, and cost trends over time. These indicators provide objective feedback on how the pier is performing relative to life cycle expectations. Use KPI trends to support continuous improvement and adjust life cycle strategies as needed.
5. ***Conduct Final Review of the Life Cycle Plan Before Commissioning*** – Prior to full operation, review and refine the life cycle plan to ensure it incorporates the latest construction and handover information. Confirm that asset hierarchies, inspection protocols, and baseline condition data are all in place. Identify any remaining gaps in documentation or procedures.
6. ***Schedule Periodic Updates to the Life Cycle Plan*** – Plan for regular review and updates of the life cycle plan every five years, or following major weather events, operational changes, or structural upgrades. Use performance data and inspection findings to refine future maintenance and investment strategies. This will help keep the life cycle plan aligned with the pier's actual performance and evolving needs.

Appendix C-1

Life Cycle Analysis

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			Activity	Frequency - Low	Frequency - High	Frequency	2026	2027	2028	2029	2030	2031	2032
Frequency	Maintenance	Inspection	Above Water inspection and Condition Assessment	3 yrs	5 yrs	4 yrs	0	0	0	1	0	0	0
			Under Water inspection and Condition Assessment	-	-	5 yrs	0	0	0	0	1	0	0
		Preventative Maintenance	Debris Management	-	-	4x / yr	4	4	4	4	4	4	4
			Sealing and re-coating of decking	5 yrs	10 yrs	7 yrs	0	0	0	0	0	0	1
	Preservation	Pile Protection	Pile Wrap installation or reapplication			1/ lifecycle	0	0	0	0	0	0	0
		Cleaning & Drainage Maintenance	Cleaning of Pier Superstructure	-	-	1 yr	1	1	1	1	1	1	1
			Cleaning of Pier Substructure	3 yrs	5 yrs	4 yrs	0	0	0	1	0	0	0
	Rehabilitation	Partial Deck Rehab	Decking inspections and repairs			10 yrs	0	0	0	0	0	0	0
		Structural Strengthening	Addition of bracing of pile caps	5 yrs	10 yrs	7 yrs	0	0	0	0	0	0	0
			Replacing Benches	15 yrs	20 yrs	17 yrs	0	0	0	0	0	0	0
	Replacement	Upgrading Utilities and Fixtures	Electrical and Lighting Upgrades			30 yrs	0	0	0	0	0	0	0
			Plumbing Upgrades			30 yrs	0	0	0	0	0	0	0
			Full Deck Replacement			after 30 yr	0	0	0	0	0	0	0
			Pile Replacement			after 30 yr	0	0	0	0	0	0	0
			Full Roof Replacement			30 yrs	0	0	0	0	0	0	0

			Activity	Cost/Activity	2026	2027	2028	2029	2030	2031	2032
Cost	Maintenance	Inspection	Above Water inspection and Condition Assessment	$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -
			Under Water inspection and Condition Assessment	$ 25,000.00	$ -	$ -	$ -	$ -	$ 25,000.00	$ -	$ -
		Preventative Maintenance	Debris Management	$ 1,200.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00
			Sealing and re-coating of decking	$ 48,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 48,000.00
	Preservation	Pile Protection	Pile Wrap installation or reapplication	$ 89,595.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Cleaning & Drainage Maintenance	Cleaning of Pier Superstructure	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00
			Cleaning of Pier Substructure	$ 6,115.06	$ -	$ -	$ -	$ 6,115.06	$ -	$ -	$ -
	Rehabilitation	Partial Deck Replacement	Decking inspections and replacement	$ 3,912.96	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Structural Strengthening	Addition of bracing or pile caps	$ 5,250.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Replacing Benches	$ 15,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Replacement	Upgrading Utilities and Fixtures	Electrical and Lighting Upgrades	$ 262,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Plumbing Upgrades	$ 19,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Full Deck Replacement	$ 124,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Pile Replacement	$ 375,100.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -
			Full Roof Replacement	$ 4,600.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -

	2026	2027	2028	2029	2030	2031	2032
Maintenance	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 24,800.00	$ 29,800.00	$ 4,800.00	$ 52,800.00
Preservation	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00
Rehabilitation	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Replacement	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	**$ 20,800.00**	**$ 20,800.00**	**$ 20,800.00**	**$ 46,915.06**	**$ 45,800.00**	**$ 20,800.00**	**$ 68,800.00**
Annualized Cost	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62

2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0
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2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
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2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052
$ 24,800.00	$ 4,800.00	$ 29,800.00	$ 4,800.00	$ 24,800.00	$ 4,800.00	$ 52,800.00	$ 29,800.00	$ 24,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 49,800.00	$ 52,800.00	$ 4,800.00	$ 4,800.00	$ 24,800.00	$ 29,800.00	$ 4,800.00	$ 4,800.00
$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 111,710.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00
$ 5,250.00	$ -	$ 3,912.96	$ -	$ -	$ -	$ -	$ 5,250.00	$ -	$ 15,000.00	$ -	$ -	$ 3,912.96	$ 5,250.00	$ -	$ -	$ -	$ -	$ -	$ -
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$ 52,165.06	**$ 20,800.00**	**$ 49,712.96**	**$ 20,800.00**	**$ 46,915.06**	**$ 20,800.00**	**$ 68,800.00**	**$ 51,050.00**	**$ 136,510.06**	**$ 35,800.00**	**$ 20,800.00**	**$ 20,800.00**	**$ 75,828.02**	**$ 74,050.00**	**$ 20,800.00**	**$ 20,800.00**	**$ 46,915.06**	**$ 45,800.00**	**$ 20,800.00**	**$ 20,800.00**
$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62

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0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
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0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072
$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -	$ 20,000.00	$ -	$ -	$ -
$ -	$ -	$ 25,000.00	$ -	$ -	$ -	$ -	$ 25,000.00	$ -	$ -	$ -	$ -	$ 25,000.00	$ -	$ -	$ -	$ -	$ 25,000.00	$ -	$ -
$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00
$ 48,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 48,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ 48,000.00	$ -	$ -	$ -	$ -	$ -
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$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 16,000.00
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$ -	$ -	$ 3,912.96	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,912.96	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ 5,250.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,250.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,250.00	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ 15,000.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
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2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072
$ 72,800.00	$ 4,800.00	$ 29,800.00	$ 4,800.00	$ 24,800.00	$ 4,800.00	$ 4,800.00	$ 77,800.00	$ 24,800.00	$ 4,800.00	$ 4,800.00	$ 4,800.00	$ 49,800.00	$ 4,800.00	$ 52,800.00	$ 4,800.00	$ 24,800.00	$ 29,800.00	$ 4,800.00	$ 4,800.00
$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00	$ 22,115.06	$ 16,000.00	$ 16,000.00	$ 16,000.00
$ 5,250.00	$ -	$ 3,912.96	$ -	$ -	$ -	$ 15,000.00	$ -	$ -	$ 5,250.00	$ -	$ -	$ 3,912.96	$ -	$ -	$ -	$ -	$ 5,250.00	$ -	$ -
$ -	$ -	$ -	$ 784,700.00	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
##########	**$ 20,800.00**	**$ 49,712.96**	**$ 20,800.00**	**$ 46,915.06**	**$ 20,800.00**	**$ 35,800.00**	**$ 93,800.00**	**$ 46,915.06**	**$ 26,050.00**	**$ 20,800.00**	**$ 20,800.00**	**$ 75,828.02**	**$ 20,800.00**	**$ 68,800.00**	**$ 20,800.00**	**$ 46,915.06**	**$ 51,050.00**	**$ 20,800.00**	**$ 20,800.00**
$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62

2073	2074	2075	2076
1	0	0	0
0	0	1	0
4	4	4	0
0	1	0	0
0	0	0	0
1	1	1	0
1	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

2073	2074	2075	2076
$ 20,000.00	$ -	$ -	$ -
$ -	$ -	$ 25,000.00	$ -
$ 4,800.00	$ 4,800.00	$ 4,800.00	$ -
$ -	$ 48,000.00	$ -	$ -
$ -	$ -	$ -	$ -
$ 16,000.00	$ 16,000.00	$ 16,000.00	$ -
$ 6,115.06	$ -	$ -	$ -
$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -
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$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -

2073	2074	2075	2076
$ 24,800.00	$ 52,800.00	$ 29,800.00	$ -
$ 22,115.06	$ 16,000.00	$ 16,000.00	$ -
$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -
$ 46,915.06	**$ 68,800.00**	**$ 45,800.00**	**$ -**
$ 41,296.62	$ 41,296.62	$ 41,296.62	$ 41,296.62

Appendix D

Metocean Report

hdrinc.com

HDR Engineering, Inc.
101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020

Town of Holden Beach Metocean Report

Town Pier Preliminary Reconstruction

HDR Engineering, Inc. of the Carolinas
Project No. 10426190

Holden Beach, North Carolina

June 13, 2025

PRELIMINARY – FOR REVIEW ONLY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.

ENGINEER: Bill Kincannon
LICENSE NUMBER: 033793
FIRM: HDR ENGINEERING, INC.

NCBELS Firm Registration No. F-0116

Contents

Tables

Figures

HDR Engineering, Inc.
101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020

1 Location

The Town of Holden Beach fishing pier is located near the center of the Holden Beach barrier island, extending offshore into the Atlantic Ocean. Meteorological and oceanographic data for the design were sourced from two locations, a National Oceanic and Atmospheric Administration (NOAA) tidal station to the southwest and a US Army Corps of Engineers (USACE) Wave Information Study (WIS) model extraction station to the south. These data summarize the overall conditions impacting the pier and inform the various decisions that guide project design. Figure 1-1 displays the locations of the data sources relative to the pier property.

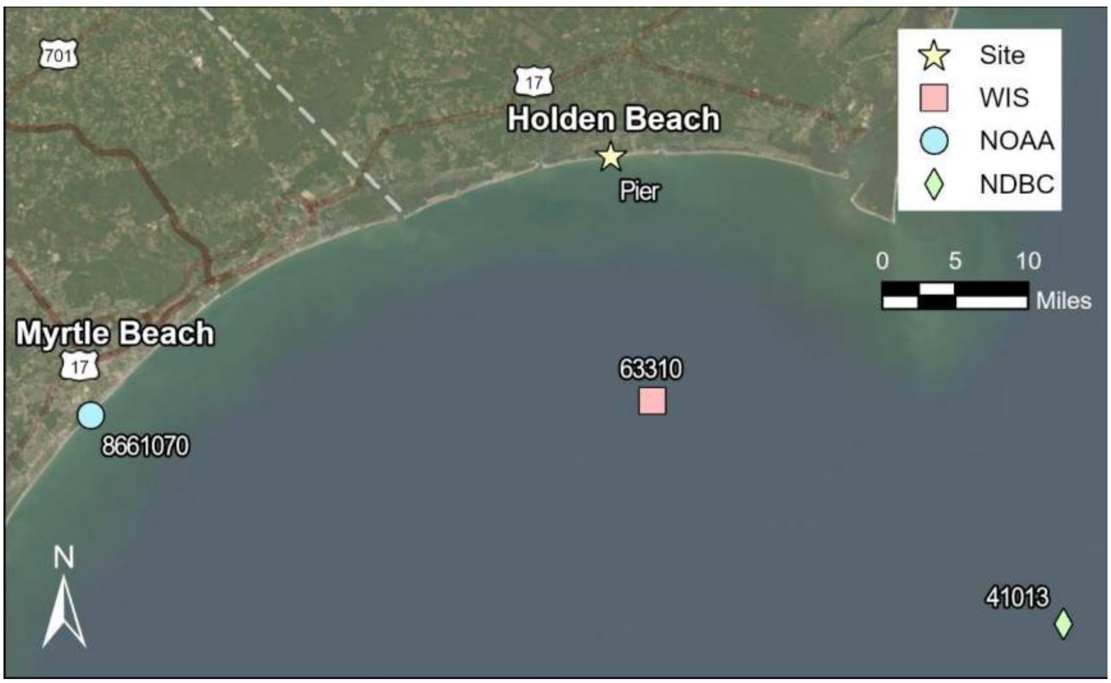

Figure 1-1. Data Source Locations With Respect To The Pier Site

2 Datums

All horizontal coordinates in this report are relative to the 2011 adjustment of North American Datum of 1983 (NAD83 2011), State Plane Coordinate System, North Carolina Zone (NC-3200) US feet. All elevations are relative to the North American Vertical Datum of 1988 (NAVD88) GEOID 18 Epoch 2001 US feet. All units will be US customary.

Table 2-1 displays the tidal datums with respect to NAVD88 using data from the NOAA Station 8661070 at Springmaid Pier in Myrtle Beach, SC (NOAA, 2025b) (Figure 1-1 for location). This station is located approximately 40 miles southwest of the project site as shown in Figure 1-1.

Table 2-1. Tidal Datums For NOAA Station 8661070 In Myrtle Beach, SC

Tidal Datum	Elevation (ft NAVD88)
Mean Higher High Water (MHHW)	+2.44
Mean High Water (MHW)	+2.05
Mean Sea Level (MSL)	-0.45
Mean Low Water (MLW)	-2.97
Mean Lower Low Water (MLLW)	-3.16
Average Tidal Range	5.02

3 Water Levels

Water level data is a key consideration for wave loading analysis and the general design of coastal structures. The local water depth influences design factors such as wave generation, the cross-shore location where wave breaking occurs, and the level of inundation or submergence during extreme events.

Water level data from NOAA Station 8661070 in Myrtle Beach, SC is plotted in Figure 3-1. Across the 24-year time series, 95% (i.e., two standard deviations) of the recorded data is between -3.56 ft and +3.04 ft NAVD88.

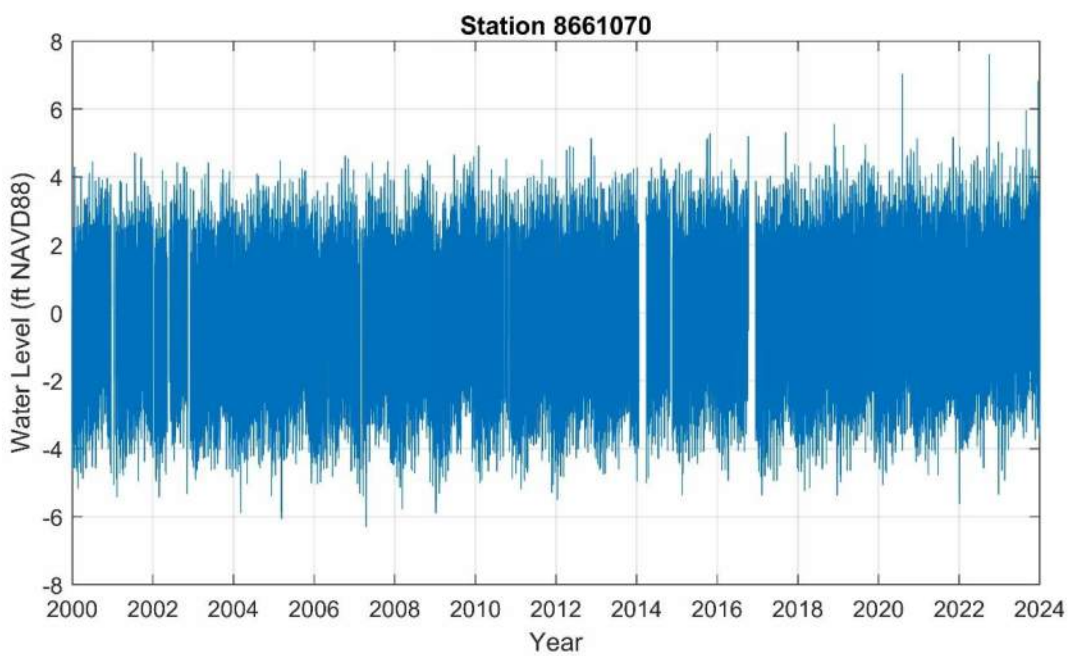

Figure 3-1. Water Level Time Series Data For NOAA Station 8661070

3.1 Extreme Water Level Events

Storm surge can contribute to upland inundation and the generation of larger waves, which are important considerations when designing the pier structure. The top five extreme water level events as recorded by NOAA Station 8661070 at Myrtle Beach, SC are listed in Table 3-1 (NOAA, 2025b).

Table 3-1. Extreme Water Level Events For NOAA Station 8661070

Date	Elevation (ft NAVD88)	Event
09/21/1989	+11.21	Hurricane Hugo
10/08/2016	+8.57	Hurricane Matthew
09/30/2022	+7.61	Hurricane Ian
08/04/2020	+7.02	Hurricane Isaias
12/17/2023	+6.81	December East Coast Storm

3.2 Sea Level Rise

Relative sea level rise (RSLR) is the net change in sea level at a location, incorporating changes in both water surface elevation and land elevation. In North Carolina, land elevation changes are typically associated with subsidence, which decreases the land elevation and increases the impacts of sea level rise. Considering RSLR projections can help increase future resiliency of a project.

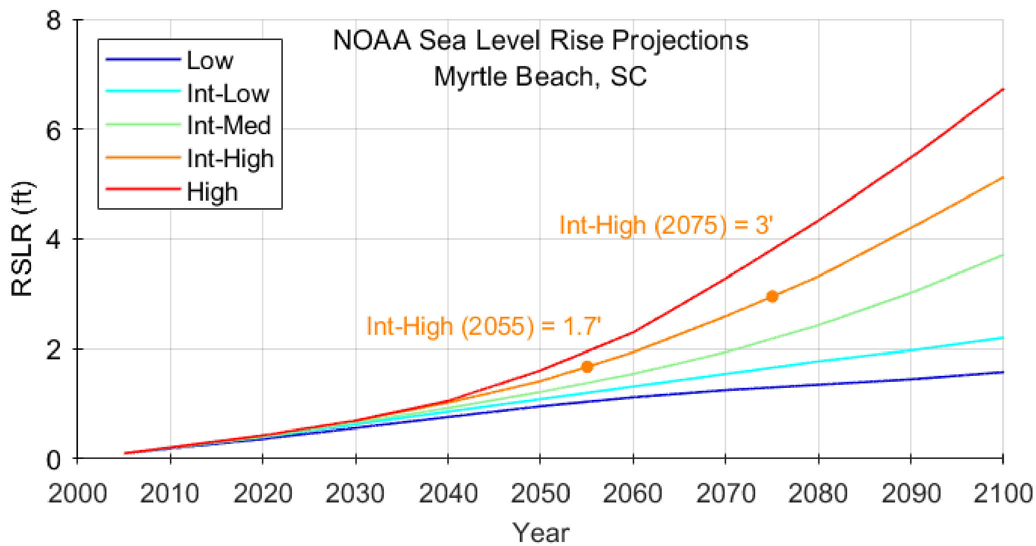

Figure 3-2. Projected Relative Sea Level Rise for Myrtle Beach, SC Using 1992 As The Reference Year (NOAA, 2025d)

The five RSLR scenarios at the Myrtle Beach, SC NOAA station are provided in Figure 3-2 (NOAA, 2025d). HDR recommends using the intermediate-high scenario. The 30- and 50-year projection values under this scenario are 1.7 ft and 3.0 ft of RSLR above the 1992 baseline values, respectively.

3.3 FEMA FIRM and FIS

The Federal Emergency Management Agency (FEMA) publishes Flood Insurance Rate Maps (FIRMs) developed from data and calculations that are documented in Flood Insurance Studies (FIS). North Carolina has created the Flood Risk Information System (NC FRIS) dashboard to comprehensively display the various FIRMs and FIS datasets in North Carolina (NCFRIS, 2025). NC FRIS includes the flood zone, base flood elevations, and coastal transect parameters.

Figure 3-3 shows the FEMA flood zones covering the site. The pier property is within four distinct flood zones: two AE zones covering the parking lot campground area with base flood elevations of 11 ft and 12 ft, and two VE zones covering the pier structure with base flood elevations of 13 ft and 16 ft. Base flood elevations within VE Zones include the effects of wave setup, runup, overtopping, and overland propagation by coastal waves (FEMA, 2018). Although sections of the property are classified as AE zones, the Town is noted to still treat these areas as effectively V/VE zones per Town Code §154.20 (D) (TOHB, 2025).

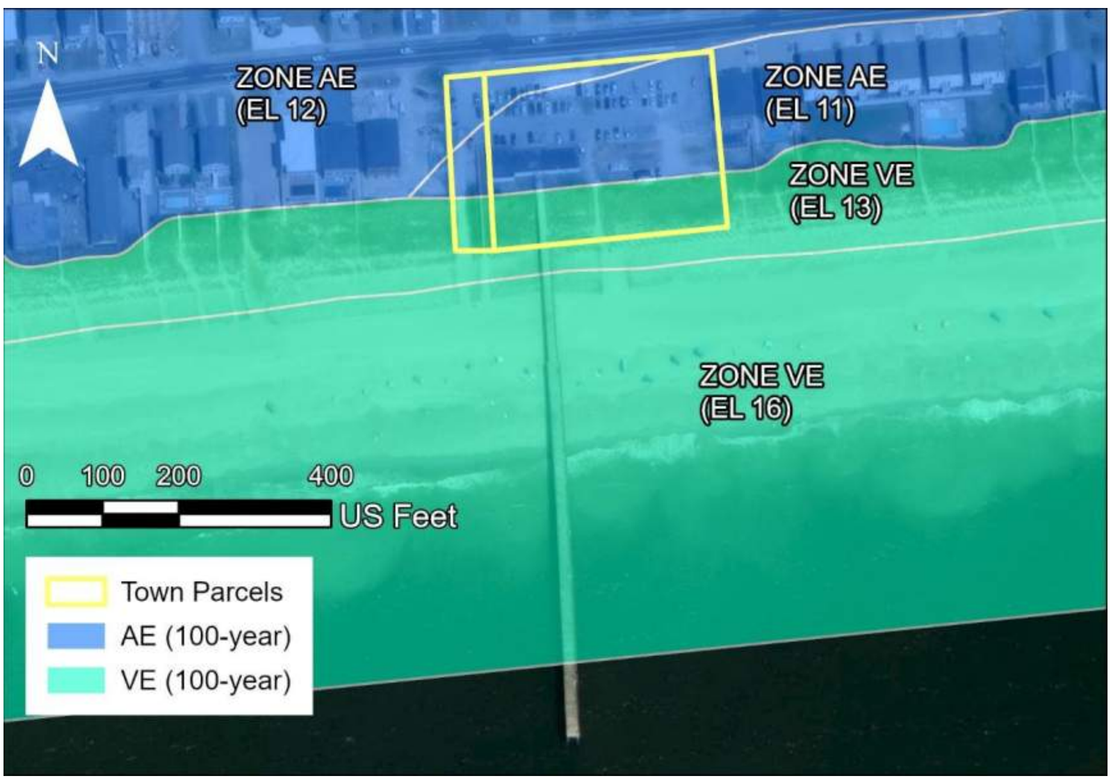

Figure 3-3. FEMA Flood Zones For The Pier Property

4 Wind

4.1 Measured Data

Wind is a primary forcing mechanism that affects the intensity and direction of a local wave field. The wind roses shown in Figure 4-1 were generated using the time series data provided by WIS Station 63310 and NDBC Buoy 42035. Wind roses classify the data in terms of speed, direction, and occurrence frequency. The data helps identify the dominant wind direction and the typical origin of the fastest windspeeds. The observed buoy and hindcasted WIS datasets show strong agreement, with winds tending to originate from either a southwesterly or northeasterly direction.

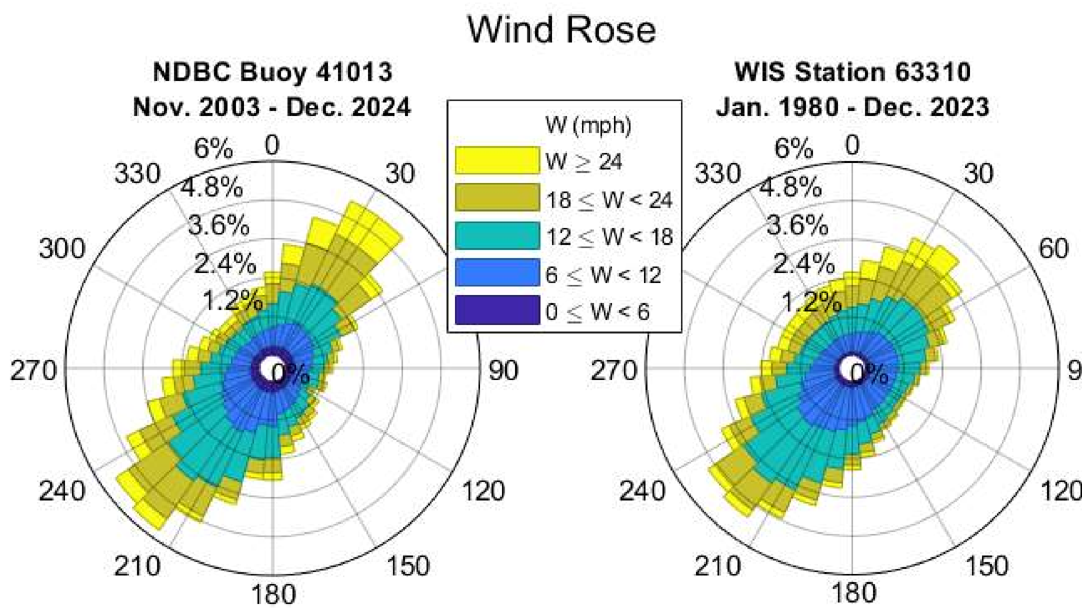

Figure 4-1. Wind Roses For NDBC Buoy 41013 (Left) And WIS Station 63310 (Right) With Wind Directions Oriented From Direction Of Origination

4.2 Wind Speed

Wind speeds were obtained from the ASCE/SEI 7-16 (ASCE, 2016) as 3-second gusts. Table 4-1 lists the 3-second gust and converted 20-minute duration wind speeds at the pier location.

Table 4-1. ASCE Effective 3-Sec Gust And Converted 20-Min Wind Speeds

Return Interval	3-Second Wind Speed (mph)	20-Minute Wind Speed (mph)
10-year	80	54.2
25-year	95	64.4
50-year	107	72.5
100-year	118	80.0
Max Design	148	100.3

4.3 Extreme Storms

Tropical cyclones are common sources for beach erosion and damage of shoreline infrastructure. Hurricane tracks within a 60 nautical mile radius of Holden Beach from 1851 to 2023 are provided in Figure 4-2 (NOAA, 2025a). Recorded storms range from tropical storms to Category 4 hurricanes. Table 4-2 provides the frequency of each recorded hurricane category impacting the Holden Beach area.

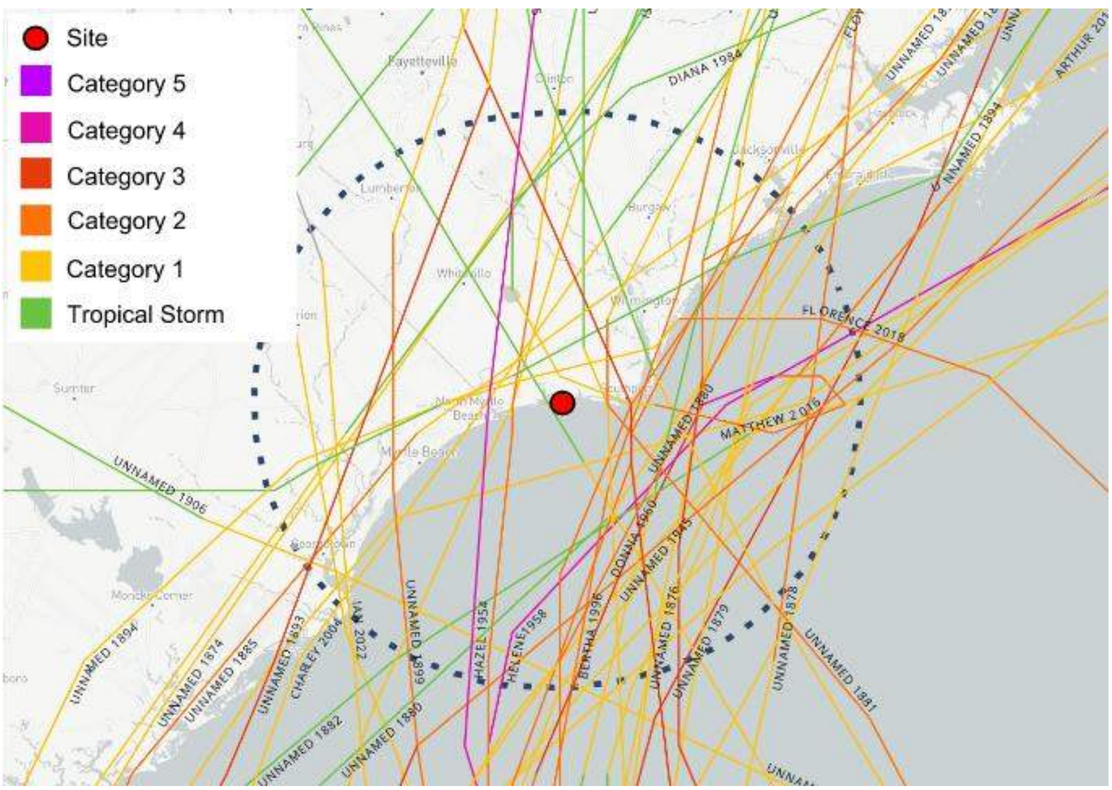

Figure 4-2. Historical Track Lines Of Tropical Storms Passing Within 60 Nautical Miles Of Holden Beach From 1851-2023 As Recorded By NOAA

Table 4-2. Occurrence Frequency Of Each Hurricane Category Passing Within 60 Nautical Miles Of Holden Beach As Recorded By NOAA

Hurricane Category	Wind Speed (mph)	Occurrences
5	≥ 157	0
4	130-156	3
3	111-129	4
2	96-110	12
1	74-95	23

5 Waves

The wave heights, periods, and directional approach at the site can contribute to sediment transport and coastal hydrodynamic loadings on the project. Wave information will be used to approximate piling scour depth and wave loadings on the structure for design purposes.

Wave information can be collected from databases consisting of observed or hindcasted metocean data. The USACE hindcast model developed for WIS Station 63310 (USACE, 2023) was used for this design with measured data from a NOAA National Data Buoy Center (NDBC) Buoy 41013 (NOAA, 2023c) used for verification.

The WIS station provides long-term hindcast climatological studies of all US coastal waters to provide historical wind and wave data time series. The top events and return period values can be identified from these time series (USACE, 2023).

A wave rose displaying the direction, height, and occurrence frequency of offshore waves from both WIS and NDBC datasets is shown in Figure 5-1. The agreement between the two roses validates the usage of referencing the WIS data set for design wave information. The slight underprediction by the modeled WIS wave heights relative to the measured NDBC wave heights is negligible as the WIS results already indicate the design wave height is capped at depth-limited conditions. The design wave period was approximated from the typical wave periods observed within the listed top extreme events.

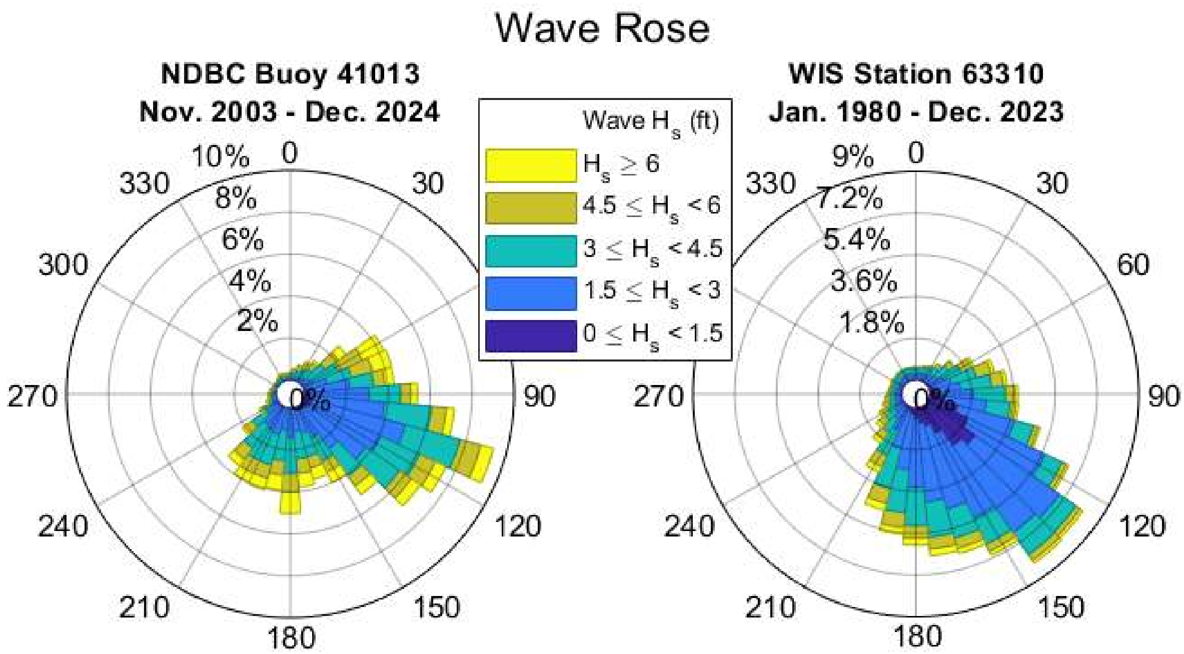

Figure 5-1. Wave Roses For NDBC Buoy 41013 (Left) And WIS Station 63310 (Right) With Wave Directions Oriented From Direction Of Origination

6 Shoreline Change

Shoreline change is a key component of coastal structure development as movements in the shoreline and bed level elevations can impact structural stability. The NC Department of Environmental Quality Division of Coastal Management (NCDCM) provides a database of calculated erosion rates and shoreline position locations since 1944 for the Holden Beach area (NCDCM, 2025). The erosion rates within approximately 1,000 ft of either side of the pier range from approximately -1.4 to -1.89 ft/year. The shoreline change from 1944 to 2020 is displayed in Figure 6-1. The information shown represents 5 selected years of shoreline positions, along with an overlay of the 2020 localized cross-shore erosion rates.

Shoreline change and related morphological analyses were not included within the scope of this project. According to Town records, Holden Beach has undergone multiple beach nourishment events in recent decades, with approximately 2 million cubic yards of sand placed between 2002 and 2014 along the Town's entire shoreline. Given the expectation that engineered shoreline management such as continued nourishment will persist into the future, the project design assumes that the shoreline erosion will not progress to a level that compromises the structural stability of the proposed pier.

Figure 6-1. NC DEQ Shoreline Locations And Change Rates From 1944-2020

7 References

American Society of Civil Engineers (ASCE), 2016. "ASCE Hazard Tool." *ASCE/SEI 7-16*. Webpage accessed March 2025. URL: https://ascehazardtool.org/

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National Oceanic and Atmospheric Administration (NOAA), 2025a. "Historical Hurricane Tracks." Webpage accessed March 2025. URL: https://coast.noaa.gov/hurricanes/#map=4/32/-80

National Oceanic and Atmospheric Administration (NOAA), 2025b. "Tides and Currents." Webpage accessed March 2025. URL: https://tidesandcurrents.noaa.gov

National Oceanic and Atmospheric Administration (NOAA), 2025c. "National Buoy Data Center" Webpage accessed March 2025. URL: https://ndbc.noaa.gov

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North Carolina Flood Risk Information System (NCFRIS), (2025). "Flood Risk Information System Map Dashboard." Webpage accessed March 2025. URL: https://fris.nc.gov/map.htm

United States Army Corps of Engineers (USACE), 2025. "Wave Information Studies." Website accessed March 2025. URL https://wisportal.erdc.dren.mil/

Appendix E

Previous Geotechnical Report

hdrinc.com

HDR Engineering, Inc.
101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020

Report of Geotechnical Exploration
Holden Beach Pier and Pier House
Holden Beach, North Carolina
S&ME Project No. 23060076

PREPARED FOR:

The Town of Holden Beach
110 Rothschild Street
Holden Beach, North Carolina 28462

PREPARED BY:

S&ME, Inc.
3006 Hall Waters Drive, Suite 100
Wilmington, North Carolina 28405

July 24, 2023

July 24, 2023

The Town of Holden Beach
110 Rothschild Street
Holden Beach, North Carolina 28462

Attention: Ms. Heather Finnell

Reference: **Report of Geotechnical Exploration**
Holden Beach Pier and Pier House
Holden Beach, North Carolina
S&ME Project No. 23060076
N.C. PE Firm License No. F-0176

Dear Ms. FInnell:

S&ME, Inc. has completed the geotechnical exploration for proposed site located at 441 Ocean Boulevard W. in Holden Beach, North Carolina. Our services were performed pursuant to S&ME proposal No. 23060076-R1 dated May 24, 2023, and accepted by Mr. David Hewett on May 30, 2023.

The purpose of this exploration was to evaluate subsurface conditions within the construction footprint as they relate to site preparation, earthwork, fill soil suitability, and foundation support for the proposed structures.

This report describes our understanding of the project, presents the results of the field exploration, laboratory testing, and engineering analysis and discusses our geotechnical conclusions and recommendations based on these considerations. S&ME, Inc. appreciates this opportunity to be of service to you. Please contact us if you have questions concerning this report or any of our services.

Sincerely,

S&ME, Inc.

Jonathan M. Prevatte
Associate Project Manager

Ronald P. Forest, Jr., P.E.
Principal Engineer
NC Registration No. 055983

NORTH CAROLINA PROFESSIONAL SEAL 055983 ENGINEER RON FOREST JR
7/24/23

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Appendices

Report at a Glance

Key geotechnical findings based on our current understanding of the proposed project are presented below. These findings are presented as an overview and should not be used in place of the more detailed recommendations presented in the remainder of this report.

Category	Key Geotechnical Findings
Site Development Challenges	The site appears generally suitable for the proposed development. Specific geotechnical issues identified on this site that should be considered include: • Jetting of the upper roughly 15 to 20 feet (maximum of 23 feet) of the piles for the pier to prevent early refusal on shallow medium dense to dense sands, followed by impact driving to the target tip depth. • Installation of piles in tidal zones.
Subsurface Conditions	• Coastal Plain sands and sand mixtures with occasional isolated thin clay seams to the maximum exploration depth of 60 feet. • Groundwater observed at depths of 1 to 7 feet. (May fluctuate in tidal zones).
Seismic Considerations	Liquefaction risk during seismic shaking is low. Site Class D for both ASCE 7-10 and 7-16.
Foundation Type	Based on boring B-2, deep foundations consisting of either 8 inch or 10 inch diameter naturally tapered timber piles will be need to support the pier. Based on boring B-1, deep foundations consisting of at least 8 inch diameter naturally tapered timber piles will be needed to support the pedestrian beach access. The required embedment depth (or design tip elevation) for the pier piles may vary as the pier advances out into the Atlantic Ocean. Subsurface conditions may differ from what was observed at boring B-2, which could affect pile installation or target tip depth, axial capacity, and lateral response. To reduce the risk of variability and allow better anticipation of necessary pile lengths along the entire pier, additional soil borings could be performed in the Atlantic Ocean along the future pier alignment. Please contact us if you would like a proposal from S&ME to perform this additional work. Any assumptions or extrapolations made by the design or construction teams regarding the subsurface conditions along the pier alignment at locations other than at our boring B-2 location are at the risk of the assuming party.
Slab Support	On-grade (soil supported); designed for scour. Modulus of subgrade reaction of 175 lbs./cu.in. is available.

1.0 Introduction

The purpose of this exploration was to obtain subsurface information to allow us to characterize the subsurface conditions at the site and to develop recommendations concerning earthwork, foundations, and other related construction issues. This report describes our understanding of the project, presents the results of the field exploration and laboratory testing, and discusses our conclusions and recommendations.

A site plan showing the approximate exploration test locations is included in Appendix I. The boring and sounding logs, discussion of the field exploration procedures, and legends of soil classification and symbols are included in Appendix II. Appendix III contains the results of the laboratory testing and our laboratory test procedures.

1.1 Site and Project Description

Project information was provided via email correspondence between Mr. Neal Andrew (Andrew Consulting Engineers) and Mr. Nate Buffum (S&ME) on May 9, 2023. The email included a drawing titled *"Holden Beach Ocean Pier and Pier House"* by Bowman Murray Hemmingway Architects dated April 21, 2023, which included the overall site plan, pier demolition plan, framing plan, building plan and details, existing pier layout, and other structural sections and framing details.

The site is located at the existing Holden Beach Pier, at 441 Ocean Blvd. W., Holden Beach, North Carolina. A site vicinity map is included in Appendix I as Figure 1. We understand that the project will include the replacement of deteriorated and broken existing piles, the replacement of the framing and piles for the existing pier area adjacent to the Pier House to be in ADA compliance, and a new pile supported outdoor seating area around the Pier House with a new pile supported pedestrian beach access with limited exposed pile height.

Updated project information was provided in email correspondence between Mr. Zackery Norris (Andrew Consulting Engineers) and Mr. Jonathan Prevatte (S&ME) on July 12, 2023. In that correspondence Mr. Norris indicated that the outdoor seating area indicated on the plans is no longer planned to be constructed.

1.2 Structural Loading Information

S&ME has not been provided with structural loads or allowable pile lateral deflections for the pier.

Structural loading parameters for the pedestrian beach access were provided by Mr. Norris on July 12, 2023, as follows:

- An axial capacity of 4,200 pounds per pile or less.
- Uplift of 2,000 pounds per pile or less.
- Lateral loads of 530 pounds per pile or less.

Based on the information provided previous projects of this nature we have made assumptions for structural loads for axial (download and uplift) and lateral loading conditions for the pier. We utilized the provided loading for the pedestrian beach access to formulate our recommendations for the beach access. If the assumed loads differ from the actual loading for this project, please contact us as our recommendations may require revision.

2.0 Exploration Procedures

2.1 Field Exploration

Before visiting the site, NC-811 was contacted for clearance to dig at the site. On June 16, 2023, representatives of S&ME, Inc. visited the site. Using the information provided, we performed the following tasks:

1. We performed a site walkover, observing features of topography, ground cover, and surface soils at the project site.
2. We advanced two Standard Penetration Test (SPT) borings (B-1 and B-2) to a target depth of approximately 60 feet each.
3. In conjunction with the standard penetration testing, split-spoon disturbed soil samples were recovered at regular depth intervals within the boring and transported to our laboratory for classification and testing.
4. The groundwater level in the borings was measured in the field at the time of boring and were immediately backfilled with soil cutting to the ground surface due to high foot traffic in the vicinity of the test locations.

A brief description of the field exploration procedures performed, as well as a soil classification legend, and the SPT boring logs are attached in Appendix II.

2.2 Laboratory Testing

After the recovered soil samples were brought to our laboratory, a geotechnical professional examined and/or tested each sample to estimate its distribution of grain sizes, plasticity, organic content, moisture condition, color, presence of lenses and seams, and apparent geologic origin in general accordance with ASTM D 2488, *"Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)"*. The resulting classifications are presented on the logs, included in Appendix II. Similar soils were grouped into representative strata on the logs. The strata contact lines represent approximate boundaries between soil types. The actual transitions between soil types in the field are likely more gradual in both the vertical and horizontal directions than those which are indicated on the logs.

We performed the following quantitative ASTM-standardized laboratory tests on recovered samples, to help classify the soils and formulate our conclusions and recommendations:

- Two split-spoon samples were tested in general accordance with ASTM D 2216, "*Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*", to measure the in-situ moisture content of the soil.
- Two split-spoon samples were tested in general accordance with ASTM D 1140, "*Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve*", to measure the percent clay and silt fraction.
- Two split-spoon samples were tested in general accordance with ASTM D 4318, "*Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*", to measure the plasticity of the soil.

A summary of the laboratory procedures used to perform these tests is presented in Appendix III. The individual test results are also included in Appendix III.

3.0 Site and Surface Conditions

This section of the report describes the general site and surface conditions observed at the time of our exploration.

3.1 Topography

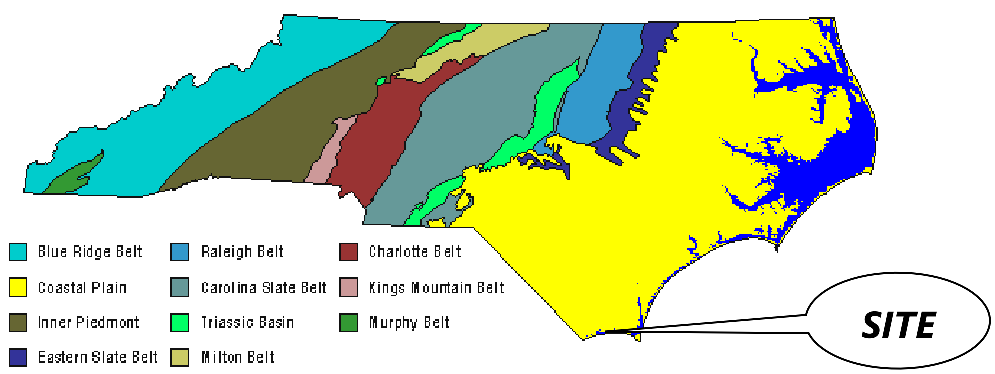
Based on Google Earth® aerial imagery, elevations at the site may range from roughly 0 to 7 feet above mean sea level (MSL) and sloping toward the Atlantic Ocean. It was beyond our scope to confirm these elevations; therefore, these elevations should be considered approximate and should not be used for design considerations. Ground surface elevations were not directly surveyed, and no site specific topographic plan was made available to us; therefore, for the purpose of our boring logs (Appendix II), the ground surface level was set to zero, which is not representative of the actual topographic conditions.

3.2 Site Surface Conditions

Test location B-1 was located north of the dune and is covered with sparse grasses and some maritime shrubs along the dunes. There was no standing water observed on the ground surface at test location B-1 at the time of this assessment. Test location B-2 was located in the tidal zone along the beach west of the existing pier.

3.3 Local Geology

Figure 3-1: Physiography



The site is located in the Coastal Plain Physiographic Region of South Carolina. The Coastal Plain Province is typically characterized by marine, alluvial, and aeolian sediments that were deposited during periods of fluctuating sea levels and moving shorelines. The soils and basal formations in the North Carolina Coastal Plain Physiographic Province are typical of those laid down in a shallow sloping sea bottom; interbedded sands and clays with irregular deposits of shells and layers of limestone and cemented sands. Alluvial sands, silts, and clays are typically present near rivers and creeks. Deposits of peat, organic silt, and organic clay are also typically present in or near current or former tidal marsh areas in the outer portion of the Coastal Plain.

According to the 1985 Geologic Map of North Carolina, the site lies within an outcrop area of the Waccamaw Formation (Tpyw) of Tertiary age.

4.0 Subsurface Conditions

The generalized subsurface conditions at the site are described below. For more detailed descriptions and stratifications at test locations, the respective boring and sounding logs should be reviewed in Appendix II.

4.1 Description of Subsurface Soils

This section describes subsurface soil conditions observed at the site.

4.1.1 Stratum I: Coastal Plain Sands and Sand Mixtures

Beginning at the ground surface at the test locations, Coastal Plain sands and sand mixtures were encountered to the maximum exploration depths of 60 feet below the ground surface. The soils encountered in this stratum generally consisted of poorly graded sand (USCS Classification "SP"), poorly graded sand with silt (SP-SM), and silty sand (SM), with occasional isolated thin seams of sandy fat clay (CH). These soils were generally moist to wet tan, brown, blueish gray, and gray to dark gray coloration. The SPT N-values within this stratum ranged from 5 to 35 blows per foot (bpf) and averaged about 17 bpf indicating a generally medium dense relative density with some loose to dense layers.

4.1.2 Groundwater

Groundwater at the completion of drilling was measured at depths ranging from 1 to 7 feet below the surface in the borings. Due to the mud rotary method of drilling used to advance borings, which uses a drilling slurry to stabilize the boreholes, the groundwater level measurement at the time of drilling is likely to be slightly greater than actual groundwater levels. Groundwater levels may fluctuate seasonally at the site, being influenced by rainfall variation and other factors. Site construction activities can also influence groundwater elevations.

4.1.3 Summary of Laboratory Test Results

We performed laboratory testing on two grab samples to further assess the engineering index properties of the subsurface soils. The laboratory soil index test results are presented in Appendix III and are summarized in the following table.

Table 4-1: Summary of Laboratory Soil Index Testing Results

Boring/ (Sample No.)	Sample Depth Range (ft.-ft.)	Natural Moisture Content (%)	Silt/Clay Fines Content (%)	Atterberg Plasticity Limits			USCS Classification
				LL	PL	PI	
B-1/(S-9)	33.5' – 35'	27.2	7.8	---	NP*	---	SP-SM
B-2/(S-13)	53.5' – 55'	24.3	27.9	---	NP*	---	SM

*NP = Non-Plastic

5.0 Seismic Site Class and Design Parameters

There are no known, mapped faults in the area of the site. The historic earthquake event which influences the design seismicity of the site the most is the 1886 Charleston, South Carolina earthquake with a magnitude of approximately 7.3.

We analyzed the liquefaction potential of the site in general accordance with the 2018 North Carolina Building Code. The initial step in site class definition is to check for the four conditions described for Site Class F, which would require a site-specific evaluation to determine site coefficients F_A and F_V. Soils vulnerable to potential failure include the following: 1) quick and highly sensitive clays or collapsible weakly cemented soils, 2) peats and highly organic clays, 3) very high plasticity clays, and 4) very thick soft/medium stiff clays. These soils were not evident in the soundings.

One other determining characteristic, liquefaction potential under seismic conditions, was assessed. Soils were assessed qualitatively for liquefaction susceptibility based on their age, stratum, mode of deposition, degree of cementation, and size composition. This assessment considered observed liquefaction behavior in various soils in areas of previous seismic activity.

Our analysis, which is more fully described below, indicates that liquefaction of subsoils appears unlikely to occur on a widespread basis at this site in the event of the design magnitude.

5.1.1 Liquefaction Analysis

An age correction factor, which increases the liquefaction resistance of older sand deposits of the type that were encountered at this site, was applied. To help evaluate the consequences of liquefaction, we have computed the Liquefaction Potential Index (LPI), which is an empirical tool used to evaluate the potential for liquefaction to cause damage. The LPI considers the factor of safety against liquefaction, the depth to the liquefiable soils, and the thickness of the liquefiable soils to compute an index that ranges from 0 to 100. An LPI of 0 means there is no risk of liquefaction; an LPI of 100 means the entire profile is expected to liquefy. The level of risk is generally defined as:

- **LPI < 5** – surface manifestation and liquefaction-induced damage not expected.
- **5 ≤ LPI ≤ 15** – moderate liquefaction with some surface manifestation possible.
- **LPI > 15** – severe liquefaction and foundation damage is likely.

The average LPI for this site was less than 1 using both the ASCE 7-10 and ASCE 7-16 site modified peak ground accelerations, which indicates that the risk of surface damage due to liquefaction is low, and liquefaction-related surface damage is not expected to occur. Significant ground settlements during an earthquake caused by the volumetric compression of the saturated sands are not expected. Therefore, Site Class F does not apply to this site.

5.1.2 *Seismic Spectral Design Values for Site Class D*

The current North Carolina Building Code (NCBC) references the 2015 International Building Code and ASCE 7-10 for determining the design spectral accelerations and liquefaction potential; however, Seismic Ground Motion Maps were updated in 2014 and are incorporated into ASCE 7-16, which is referenced by the 2018 version of the International Building Code (IBC). The updated seismic maps, which result in lower spectral accelerations, represent the latest understanding of the seismic hazards and will presumably eventually be incorporated into the next edition of the NCBC, which is based on the IBC. Listed in the table below are the ground motion parameters from both resources, ASCE 7-10 and ASCE 7-16. Use of the newer, more up to date seismic parameters may require the authorization of the local Building Official.

Table 5-1: Ground Motion Parameters

Method	Site Class	S_S	S_1	S_{DS}	S_{D1}	PGA_M
2018 North Carolina Building Code (ASCE 7-10)	D	0.283	0.111	0.297	0.175	0.224g
2018 International Building Code* (ASCE 7-16)	D	0.201	0.082	0.215	0.131	0.166g

*not currently in effect in North Carolina, but may be adopted in the next NCBC version.

5.1.3 *Seismic Design Category*

For a structure having a Risk Category classification of I, II, or III, the S_{DS} and S_{D1} values obtained are consistent with "Seismic Design Category C" as defined by the 2018 North Carolina Building Code and ASCE 7-10.

For a structure having a Risk Category classification of I, II, or III, the S_{DS} and S_{D1} values obtained are consistent with "Seismic Design Category B" as defined by the 2018 International Building Code and ASCE 7-16.

6.0 Conclusions and Recommendations

The conclusions and recommendations included in this section are based on the project information outlined previously and the data obtained during our exploration. If the construction scope is altered, the proposed layout is changed, or if conditions are encountered during construction that differ from those encountered in the SPT borings, then S&ME, Inc. should be retained to review the following recommendations based upon the new information and make any necessary changes.

6.1 Driven Timber Pile Foundations

The following section details the size, depth, axial and uplift capacity for the proposed timber piles.

6.1.1 Axial Capacity of Timber Piles

We estimated static capacity for timber piles using the method outlined in the NAVFAC Design Manual 7.2 (1984), based upon information obtained from the soil test borings performed at the referenced site. Our pile calculations were modeled to a bearing depth of 30 feet below the existing ground surface considering boring B-2 for the pier, and to a depth of 12 feet considering boring B-1 for the pedestrian beach access.

Normally, several index (test) piles are advanced prior to ordering the production piles to determine the depth at which the production piles are expected to terminate driving and to confirm that our assumptions about the required tip depths are correct. A reasonably safe pile length for the testing may be piles long enough to accommodate up to about 40 feet of subsurface penetration, adjusted to account for any grade design elevation changes, water depths, and stickup above grade.

Based on our exploration and analysis, individual 8-inch (minimum) tip and 10-inch tip diameter naturally tapered timber piles jetted to a depth of 20 feet and then driven to a depth of 30 feet or refusal, considering a low tide elevation datum, are anticipated to provide an allowable axial compressive capacity ranging from 15 to 21 tons for the pier. Jetting to 20 feet is recommended due to the N=26 bpf medium dense sands encountered between depths of about 8 and 18 feet in boring B-2, and has been considered during our axial capacity calculations and lateral deflection response analyses.

Individual 8-inch (minimum) tip diameter naturally tapered timber piles pre-augered to a depth of 5 feet and then driven to a depth of 12 feet or refusal is anticipated to provide an allowable axial compressive capacity of 2.1 tons for the pedestrian beach access.

The estimated *allowable* (design) axial compressive and uplift resistance capacity values are provided in Table 6-1 below. These values assume a factor of safety of 3 against the ultimate capacity for this embedment depth under static conditions.

Table 6-1: Timber Pile Vertical Capacities

Pile Type & Size	Single Pile Allowable Axial Capacity[A] (tons)	Single Pile Allowable Uplift Capacity[B] (tons)	Modeled Embedment Depth (feet)
8-inch Tip Diameter Naturally Tapered Timber Pile **(Pier)**	15	5	30[C]
10-inch Tip Diameter Naturally Tapered Timber Pile **(Pier)**	21	6.5	30[C]
8-inch Tip Diameter Naturally Tapered Timber Pile **(Pedestrian Beach Access)**	2.1	1	12[D]

A. Allowable compressive capacity assumes a factor of safety of 3 applied to the ultimate axial compressive capacity.
B. Allowable uplift capacity assumes a factor of safety of 3 applied to the estimated ultimate skin friction capacity.
C. Assumes pile is advanced from the ground surface elevation that was existing at boring B-2 at the time of this exploration using the proper impact (non-vibratory) hammer. Adjust pile lengths to consider grade changes, water depths, and stick up.
D. Assumes pile is advanced from the ground surface elevation that was existing at boring B-1 at the time of this exploration using the proper impact (non-vibratory) hammer. Adjust pile lengths to consider grade changes and stick up.

For the purpose of developing our axial capacity recommendations, the upper 5 feet of existing soils surrounding the piles was not considered to contribute to the skin friction support of the piles. The maximum pre-augering depth should be set at 5 feet. We also assumed that the piles would not be installed using vibratory hammer techniques. Vibratory installation methods should be prohibited unless otherwise approved by the engineer. The ultimate pile capacity values are for a single, isolated foundation, and assume a spacing of at least 3 feet between piles, center-to-center. A pile spacing of less than 3 feet is not recommended; a greater spacing may be used.

If the capacities used in Table 6-1 are used for design, then a static load test is not required. If it is desired to increase the design axial (download) capacity above the values given in Table 6-1, then an axial static load test or dynamic testing would be required to be performed under the observation of the Geotechnical Engineer, unless the pile size (diameter) is increased sufficiently to maintain a minimum factor of safety of 3 against the ultimate capacity. Please contact us for more information if this alternative is desired.

6.1.2 *Lateral Stability of Piles*

We analyzed the geotechnical response of a laterally loaded, 8-inch and 10-inch tip diameter, naturally tapered timber pile using L-PILE 2019.11.05 and a generalized subsurface profile based upon the soil conditions observed at borings B-1 and B-2. The L-PILE program performs a beam-column analysis of single piles subjected to given lateral and axial loading and assuming a non-linear soil response. The piles were modeled using fixed head pile top boundary conditions under the assumption that sufficient cross-bracing of the piles will be used to generate a fixed head condition, with a modeled embedment depths of 30 feet below soil grade for the pier and 12 feet below soil grade for the pedestrian beach access. The stick-up on the pier piles was modeled as 15 feet, with the mid-point of the cross-bracing modeled at 7.5 feet. The stick-up on the pedestrian beach access piles was modeled as 10 feet, with the mid-point of the cross-bracing modeled at 5 feet. Only static loading conditions were considered for this analysis; please contact us to analyze lateral reactions under seismic loading conditions if needed.

At the top of the pile, axial loads ranging from 15 to 20 tons were applied for the pier piles and 2 tons of axial load was applied for the pedestrian beach access. Lateral loads were applied under a fixed head conditions to result in horizontal deflections ranging from ¼ inch to 1 inch. Lateral loads and bending moments for the piles can be found in tables 6-2 through 6-4. The resulting graphic plots of pile deflection, shear, and bending moment as a function of depth along the pile are attached in Appendix IV for your review.

The structural capacity and integrity of the piles under the applied shear forces and moment at each structural connection has not been considered in our analysis and must be evaluated by the Structural Engineer. The Structural Engineer should also review the boundary condition assumptions to confirm that these assumptions are compatible with the foundation design.

Table 6-2: Lateral Response for Fixed Head under Static Loading, 8 inch tip dia. Tapered Timber Pile jetted to 20 ft. and then driven to 30 ft.

Applied Axial Load (tons)	Embedment Depth[A] (feet)	Head Deflection (inches)	Applied Lateral Load (kips)	Minimum/Maximum Bending Moments (in-kips)
15	30	¼	0.56	-46 / 22
15	30	½	0.98	-84 / 40
15	30	¾	1.4	-119 / 57
15	30	1	1.7	-154 / 73

[A]As measured from the original existing ground surface at B-2; adjust for grade changes.

Table 6-3: Lateral Response for Fixed Head under Static Loading, 10 inch tip dia. Tapered Timber Pile jetted to 20 ft. and then driven to 30 ft.

Applied Axial Load (tons)	Embedment Depth[A] (feet)	Head Deflection (inches)	Applied Lateral Load (kips)	Minimum/Maximum Bending Moments (in-kips)
20	30	¼	0.6	-49 / 25
20	30	½	1.0	-86 / 42
20	30	¾	1.4	-122 / 59
20	30	1	1.7	-157 / 75

[A]As measured from the original existing ground surface at B-2; adjust for grade changes.

Table 6-4: Lateral Response for Fixed Head under Static Loading, 8 inch tip dia. Tapered Timber Pile pre-augered to 5 ft. and then driven to 12 ft.

Applied Axial Load (tons)	Embedment Depth[A] (feet)	Head Deflection (inches)	Applied Lateral Load (kips)	Minimum/Maximum Bending Moments (in-kips)
2	12	¼	1.1	-66 / 24
2	12	½	1.8	-118 / 44
2	12	¾	2.5	-168 / 63
2	12	1	3.2	-215 / 81

[A]As measured from the original existing ground surface at B-1; adjust for grade changes.

6.1.3 Pile Settlement

Settlements of pile supported foundations are anticipated to be ½-inch or less under static loading due to elastic shortening of the piles. Settlements contributed by consolidation of the bearing layer under the axial loads applied are anticipated to be insignificant for a single pile bearing in the dense soil conditions observed at these depths.

Settlement of pile groups may be greater than for individual piles. Group settlements may be estimated using the equivalent footing method, assuming the enclosed area by the group to act similar to a spread footing that bears at an elevation equal to two-thirds the pile length below the surface. To use this method requires that the size of the pile group, number and spacing of piles, and axial load on the group be known. We may be retained to estimate the total group settlements as well as check the differential settlement between adjacent dissimilar groups (if applicable) once the actual pile loads and the configurations of the pile groups have been finally determined.

6.1.4 Installation Depth of Piles

Foundation piles for the pier should be driven to a depth of 30 feet below the original ground surface elevation based on the subsurface soil conditions at boring B-2, and foundation piles for the pedestrian bridge should be driven to a depth of 12 feet below the ground surface elevation based on the subsurface soil conditions at boring B-1.

- **Important:** The required embedment depth (or design tip elevation) for the pier piles may vary as the pier advances out into the Atlantic Ocean. Subsurface conditions may differ from what was observed at boring B 2, which could affect pile installation or target tip depth, axial capacity, and lateral response. To reduce the risk of variability and allow better anticipation of necessary pile lengths along the entire pier, additional soil borings could be performed in the Atlantic Ocean along the future pier alignment. Please contact us if you would like a proposal from S&ME to perform this additional work. Any assumptions or extrapolations made by the design or construction teams regarding the subsurface conditions along the pier alignment at locations other than at our boring B-2 location are at the risk of the assuming party.

The piles should be driven using the driving criteria that are established at the time of construction based upon the energy of the hammer being used, or to refusal.

In areas where piles refuse at depths less than recommended, the full allowable capacity may or may not be available depending upon the conditions at termination of driving, and extra piles may become necessary to accommodate the axial, lateral, or uplift loads of the structure. The anticipated pile embedment depths may also need to be adjusted if any grade changes occur due to removal of soils or if new fill placement is performed prior to pile driving operations, and to accommodate pile caps and stick up.

6.1.5 *Pile Driving Equipment*

Timber piles should be driven with an impact hammer delivering at least 5,000 foot-pounds of driving energy per stroke and not more than 20,000 foot-pounds of energy per stroke. Ram weight should not exceed 5,000 pounds, and a minimum ram weight of 2,000 pounds is recommended. A project-specific driving criteria should be developed prior to construction based upon the contractor’s proposed hammer specifications and observations made during driving of indicator (index) piles.

Do not use vibratory hammers to advance the piles unless otherwise approved by the engineer. Driving hammers may be diesel, steam, or air operated. The use of a gravity-drop hammer to drive piles is discouraged, since this type of hammer can produce excessively high and damaging stresses and may not be capable of advancing the pile to the designed depth.

If any individual pile achieves the driving criteria that indicates the desired capacity has been achieved prior to reaching the recommended embedment depths, then that pile may be terminated early; however, in no case shall termination above an embedment depth of at least 10 feet below the soil surface grade be accepted, because these are the minimum depths to lateral tip fixity (defined as zero deflection at the tip when lateral load is applied at the head).

Timber piles should be driven with the aid of a metal casting that is designed to securely hold the piles in position during driving, and will distribute the load on the head of the pile to reduce splitting or brooming. All timber piles should be clean peeled and pressure treated in accordance with the requirements of AWPA C3. Timber pile design stresses should be established in accordance with ASTM D-2899.

6.1.6 *Pile Installation Observations during Production*

Due to the relatively light loads (the Building Code only requires static load testing when piles support loads of 40 tons or more), load testing is not required, provided that the recommendations presented in this report are followed and the allowable design capacity values (or lower) provided in Table 6-1 are used for design; however, it is strongly recommended that the Geotechnical Engineer, or a qualified representative under his direction, observe the pile driving operations during production. This allows us to maintain driving records, detect variations in pile installation if they occur, and assess the pile driving operations for variability from the design assumptions so that adjustments can be made in the field at the time of construction, if appropriate.

6.2 Grade Slab Support and Construction

The following recommendations are given for the support and construction of soil-supported grade slabs:

1. Soils similar to those recommended as fill material or the native near surface materials should provide adequate support to proposed soil-supported grade slabs, assuming preparation and compaction of the subgrade as recommended above and that any scour risk is properly considered during design. A modulus of subgrade reaction (k) of 175 lbs/in^3 may be used for reinforcing design considering reworked and stable native soils.
2. Structural design should incorporate installation of a vapor barrier prior to placing concrete for grade slab systems, to limit moisture-infiltration into finished spaces, where appropriate.
3. Below the floor slab, place a layer of at least 4 inches of compacted clean granular materials to provide a capillary break between the native soils and the floor slab in finished spaces.

   A. Granular materials used may consist of a clean sand, classifying as USCS type SP or SW and having less than 5 percent silt/clay fines by weight passing the No. 200 sieve when tested by ASTM D1140, or may consist of a crushed, well-graded gravel blend meeting the requirements of NCDOT Aggregate Base Course (ABC), or an open-graded, manufactured washed gravel such as NCDOT No. 57 or No. 67 stone.
   B. If sand is used, this underslab layer should be compacted to at least 98 percent of the standard Proctor maximum dry density (ASTM D 698).
   C. If an ABC blend is used, this underslab layer should be compacted to at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557).

4. Have the Geotechnical Engineer observe a proofroll of all slab subgrades prior to concrete placement. Softened soils may need to be undercut or stabilized before concrete placement.

6.3 Lateral Earth Pressures for Below Grade Earth Retaining Structures

Earth-retaining structures must be capable of resisting any lateral earth pressures that will be imposed on them. If the walls are relatively rigid and structurally braced against rotation, they should be designed for a condition approaching the “at-rest” lateral earth pressure.

In the event that the wall is free to deflect, such as for walls that are not restrained or rigidly braced, the “active” earth pressure conditions would be applicable for design. Cantilevered retaining walls or sheet piles are normally designed to yield (rotate outward) under the influence of this pressure, which is termed the “active” case.

The lateral earth pressure coefficients in Table 6-5 are recommended for use during the design of earth-retaining systems at this site that are constructed neat against the upper fill soils of Stratum I. These recommended earth pressure coefficients would also apply to subsurface structures that are backfilled with new sandy fill material that is compacted to at least 95 percent of the soil’s standard Proctor maximum dry density (ASTM D698).

The given earth pressure coefficients (K_o, K_a, and K_p) in Table 6-5 assume level backfill, a frictionless wall, and no hydrostatic pressure (drained condition). Permanent drainage should be maintained behind the walls to prevent build-up of hydrostatic pressure along the wall, or else the wall should be designed to withstand hydrostatic pressures. Structures below the water table *must consider* hydrostatic pressures. We note that at the time of our exploration, the water level ranged from 1 to 7 feet below the existing ground surface. However, this water level may fluctuate based on seasonal factors and construction modifications made to the site, which must also be considered.

Table 6-5: Lateral Earth Pressure Coefficients

Support Condition	Angle of Internal Friction (φ')	Effective Cohesion (lbs./sq.ft.)	Moist Unit Weight (γ)	Drained Static Earth Pressure Coefficient (K)	Drained Seismic Earth Pressure Coefficient (K)	
					PGA_M=0.224g ASCE 7-10	PGA_M=0.166g ASCE 7-16
Active (K_a)	30	0	120	0.33	0.39	0.37
At-Rest (K_o)	30	0	120	0.50	0.59	0.56
Passive (K_p)	30	0	120	3.0	2.8	2.9

A. The above values represent a fully-drained soil condition at or near the optimum moisture content. Where backfill soils are not fully drained, the lateral soil pressure must consider hydrostatic forces below the water level, and submerged soil unit weight.
B. A coefficient of sliding friction (tan δ) of 0.36 may be used in computation of the lateral sliding resistance.

Drainage systems can be constructed of open-graded washed stone isolated from the soil backfill with geosynthetic filter fabric and drained by perforated pipe, or several wall drainage products are made specifically for this application. Additionally, below grade walls should be designed to support any applied surcharge or structural loads, including fill. Lateral earth pressures arising from surcharge loading (including construction equipment) and slopes above the walls should be added to the earth pressures given above in Table 6-5 to determine the total lateral pressure.

We have not been provided details regarding the location or height of any retaining walls. Note that any wall which is backfilled prior to being braced internally by framing must, in addition to being designed as a fully braced wall using the at-rest earth pressure, also be designed to resist the lateral earth pressure for the active case as a fully cantilevered wall.

Inorganic plastic clays or silts (CL, CH, ML, MH) soils should not be used as backfill immediately behind retaining walls, because these soils are not freely draining. Compact the backfill directly behind walls with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within 5 feet of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures. We caution that operating compaction equipment directly behind the retaining structures can create lateral earth pressures far in excess of those recommended for design. Therefore, bracing of the walls may be needed during backfilling operations.

6.4 Soil Strength Parameters

Our proposal stated that we would provide soil strength parameters for use by others in designing helical pier or soil anchors; however, at the time of this writing it is our understanding that timber piles are the preferred method for support; therefore, we have not included soil strength parameters as part of this report. If it is determined that these parameters are needed at a later date, we can provide them in an addendum to this report once notified.

7.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

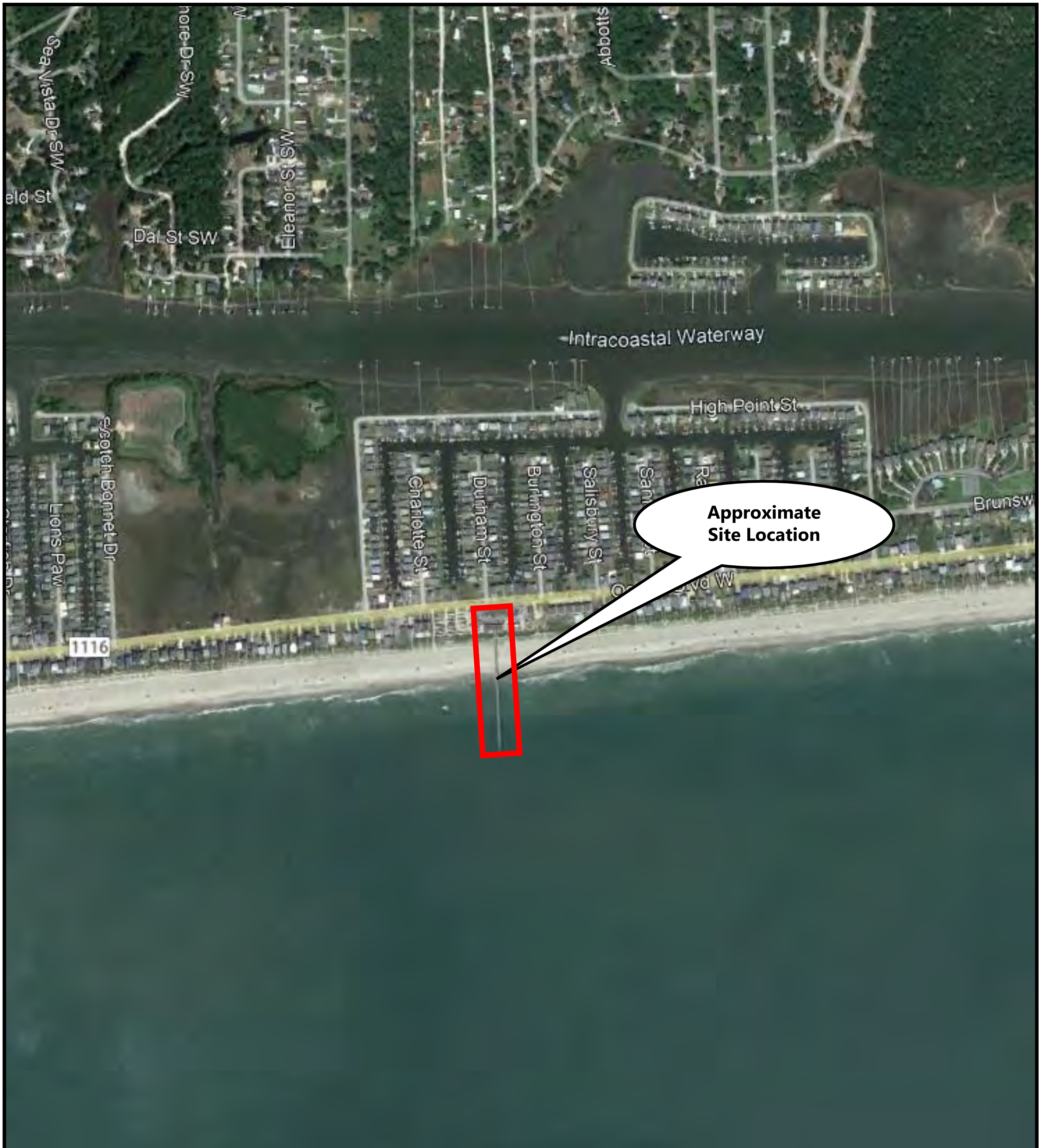
Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction. If conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria). If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, foundation, and other recommendations are properly interpreted and implemented. The recommendations in this report are contingent on S&ME's review of final plans and specifications followed by our observation and testing of earthwork and foundation construction activities.

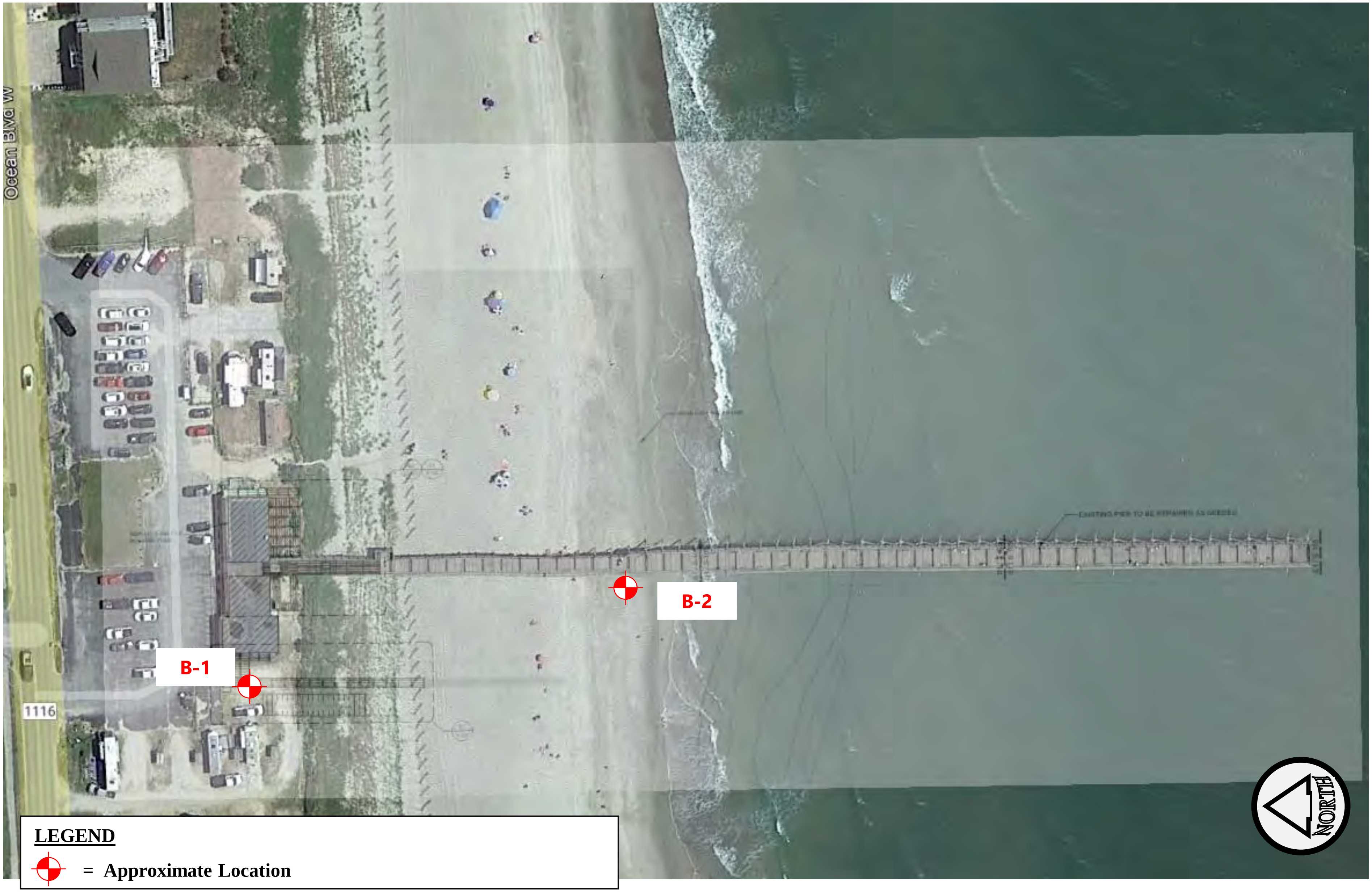
Appendices

Appendix I - Figures



REFERENCE:
Image Courtesy of Google Earth

	Site Vicinity Map	SCALE: AS SHOWN	FIGURE NO.
	Holden Beach Pier and Pier House Holden Beach, North Carolina	DATE: 7/7/23	1
		PROJECT NUMBER 23060076	



	Test Location Sketch	SCALE: Not to Scale	FIGURE NO. 2
	Holden Beach Pier and Pier House Holden Beach, North Carolina	DATE: 7/12/23 PROJECT NUMBER 23060076	

Appendix II – Exploration Procedures and Data

Summary of Exploration Procedures

The American Society for Testing and Materials (ASTM) publishes standard methods to explore soil, rock and ground water conditions in Practice D-420-18, "*Standard Guide for Site Characterization for Engineering Design and Construction Purposes*." The boring and sampling plan must consider the geologic or topographic setting. It must consider the proposed construction. It must also allow for the background, training, and experience of the geotechnical engineer. While the scope and extent of the exploration may vary with the objectives of the client, each exploration includes the following key tasks:

- Reconnaissance of the Project Area
- Preparation of Exploration Plan
- Layout and Access to Field Sampling Locations
- Field Sampling and Testing of Earth Materials
- Laboratory Evaluation of Recovered Field Samples
- Evaluation of Subsurface Conditions

The standard methods do not apply to all conditions or to every site. Nor do they replace education and experience, which together make up engineering judgment. Finally, ASTM D 420 does not apply to environmental investigations.

Boring and Sampling

Soil Test Boring with Mud-Rotary Drilling

Soil sampling and penetration testing were performed in general accordance with ASTM D1586, "Standard Test Method for Penetration Test and Split Barrel Sampling of Soils. Mud-rotary drilling methods were used to advance the borings. Soil samples were obtained with a standard 1.4 inch I. D., two-inch O. D., split barrel sampler. The sampler was first seated six inches to penetrate any loose cuttings, then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler through the two final six inch increments was recorded as the penetration resistance (SPT N) value. The N-value, when properly interpreted by qualified professional staff, is an index of the soil strength and foundation support capability.

Water Level Determination

Subsurface water levels in the soundings were measured at the end of the drilling by measuring depths from the existing grade to the current water level using a measuring tape.

Backfilling of Borings

Boring spoils were backfilled into the open bore holes to the existing ground surface.

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS

SOIL TYPES

(Shown in Graphic Log)

- Fill
- Asphalt
- Concrete
- Topsoil
- Gravel
- Sand
- Silt
- Clay
- Organic
- Silty Sand
- Clayey Sand
- Sandy Silt
- Clayey Silt
- Sandy Clay
- Silty Clay
- Partially Weathered Rock
- Cored Rock

WATER LEVELS

(Shown in Water Level Column)

▽ = Water Level At Termination of Boring
▼ = Water Level Taken After 24 Hours
◄ = Loss of Drilling Water
HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Soft	0 to 2
Soft	3 to 4
Firm	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	31 to 50
Very Hard	Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY	STD. PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Over 50

SAMPLER TYPES

(Shown in Samples Column)

- Shelby Tube
- Split Spoon
- Rock Core
- No Recovery

TERMS

Standard Penetration Resistance - The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D-1586.

REC - Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD - Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks excluded) Divided by the Total Length of the Core Run Times 100%.

Holden Beach Pier & Pier House
Holden Beach, North Carolina
S&ME Project No.

BORING LOG B-1

DATE DRILLED: **6/16/23**	ELEVATION:	NOTES: **Elevation Unknown.**
DRILL RIG: **CME 45**	BORING DEPTH: **60.0 ft**	
DRILLER: **Mid-Atlantic/Matt**	WATER LEVEL: **7' ATD**	
HAMMER TYPE: **Auto**	LOGGED BY: **J. Prevatte**	
SAMPLING METHOD: **Split-Spoon**		NORTHING: / EASTING:
DRILLING METHOD: **Mud Rotary**		

DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION | WATER LEVEL | ELEVATION (feet)

Depth (feet)	MATERIAL DESCRIPTION
0–7	**POORLY GRADED SAND (SP)** - Medium dense tan fine to medium sand, trace fines, some shell, moist - - - Loose
7–18	**POORLY GRADED SAND WITH SILT (SP-SM)** - Loose tan and brown, fine sand, few low plasticity to non-plastic fines, some shell, moist - - - Medium dense
18–23	**POORLY GRADED SAND (SP)** - Medium dense tan fine to medium sand, trace fines, some shell, wet
23–28	**SANDY FAT CLAY (CH)** - Firm, dark blue gray, some fine sand, mostly medium to high plasticity fines, some shell, wet
28–38	**POORLY GRADED SAND WITH SILT (SP-SM)** - Medium dense dark gray, fine sand,few low plasticity to non-plastic fines, few shell,wet - - - Loose
38–60	**POORLY GRADED SAND WITH SILT (SP-SM)** - Dense gray, fine to coarse sand, few low plasticity to non-plastic fines, some weathered limestone, wet - - - Medium dense - - - Loose - - - Medium dense
60	Boring terminated at 60 ft Target Depth

Water level: ∇ at 7 ft

SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA: 1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	N VALUE
1	⧗	3	5	6	11
2	⧗	3	4	5	9
3	⧗	2	5	5	10
4	⧗	2	3	5	8
5	⧗	6	9	9	18
6	⧗	8	13	14	27
7	⧗	WOH	4	1	5
8	⧗	4	7	10	17
9	⧗	5	5	2	7
10	⧗	7	13	21	34
11	⧗	5	5	6	11
12	⧗	4	4	5	9
13	⧗	6	10	5	15
14	⧗	5	6	13	19

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS
10 20 30 6080

NOTES:

1. ***THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.***
2. ***BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.***
3. ***STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.***
4. ***WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.***

Holden Beach Pier & Pier House
Holden Beach, North Carolina
S&ME Project No.

BORING LOG B-2

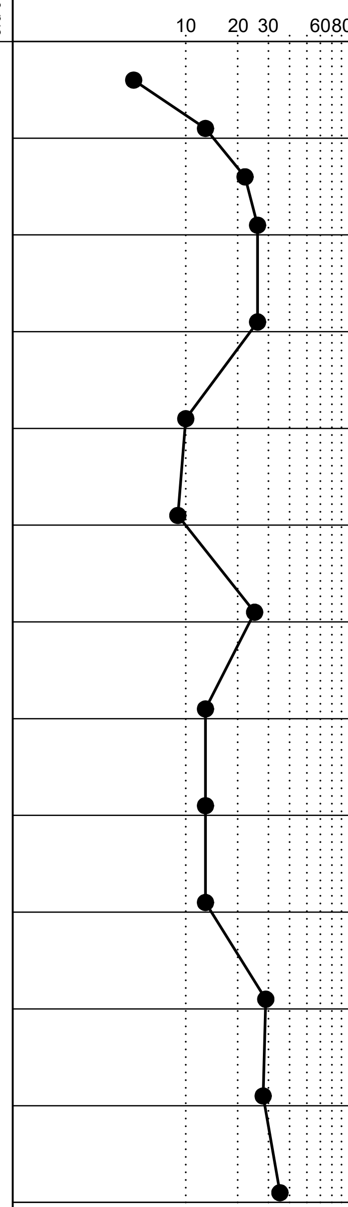
DATE DRILLED: **6/16/23**	ELEVATION:
DRILL RIG: **CME 45**	BORING DEPTH: **60.0 ft**
DRILLER: **Mid-Atlantic/Matt**	WATER LEVEL: **1' ATD**
HAMMER TYPE: **Auto**	LOGGED BY: **J. Prevatte**
SAMPLING METHOD: **Split-Spoon**	
DRILLING METHOD: **Mud Rotary**	

NOTES: **Elevation Unknown.**

NORTHING: EASTING:

DEPTH (feet)	MATERIAL DESCRIPTION	SAMPLE NO.	1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	N VALUE
0–18	**POORLY GRADED SAND (SP)** - Loose tan fine to medium sand, trace fines, ome shell, wet	1	2	3	2	5
	- - - Medium dense	2	3	6	7	13
		3	7	10	12	22
		4	8	12	14	26
		5	3	10	16	26
18–53	**POORLY GRADED SAND WITH SILT (SP-SM)** - Loose tan, fine sand, few low plasticity to non-plastic fines, some marine shell, wet	6	6	5	5	10
		7	3	4	5	9
	- - - Medium dense blue gray sand	8	5	11	14	25
	- - - Fine to medium sand	9	3	7	6	13
	- - - Tan and gray fine sand, weathered limestone	10	5	7	6	13
		11	3	7	6	13
		12	28	19	10	29
53–60	**SILTY SAND (SM)** - Medium dense tan, fine sand, some low plasticity to non-plactic fines, some marine shell, wet	13	10	13	15	28
	- - - Dense	14	5	13	22	35
60	Boring terminated at 60 ft Target Depth					

STANDARD PENETRATION TEST DATA (blows/ft) / REMARKS



S&ME BORING LOG \ HOLDEN BEACH SPT LOGS.GPJ \ LIBRARY 2011_06_28.GDT \ 7/13/23

NOTES:

1. *THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.*
2. *BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.*
3. *STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.*
4. *WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.*

Appendix III – Laboratory Procedures and Data

♦ Summary of Laboratory Test Procedures

Moisture Content Testing of Soil Samples by Oven Drying

Moisture content was determined in general conformance with the methods outlined in ASTM D 2216, "*Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil or Rock by Mass*." This method is limited in scope to Group B, C, or D samples of earth materials which do not contain appreciable amounts of organic material, soluble solids such as salt or reactive solids such as cement. This method is also limited to samples which do not contain contamination.

A representative portion of the soil was divided from the sample using one of the methods described in Section 9 of ASTM D 2216. The split portion was then placed in a drying oven and heated to approximately 110 degrees C overnight or until a constant mass was achieved after repetitive weighing. The moisture content of the soil was then computed as the mass of water removed from the sample by drying, divided by the mass of the sample dry, times 100 percent. No attempt was made to exclude any particular particle size from the portion split from the sample.

Grain Size Analysis of Samples (with Wash No. 200 Sieve)

The distribution of particle sizes greater than 75 mm was determined in general accordance with the procedures described by ASTM D 421, "*Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants*", and D 6913, *"Standard Test Method for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis*,".

A selected specimen of soils was washed over a No. 200 sieve after being thoroughly mixed and dried. This test was conducted in general accordance with ASTM D 1140, "*Standard Test Method for Amount of Material Finer Than the No. 200 Sieve*." Method B, using a hexametaphosphate solution to pre-soak the specimen for at least 2 hours, was used to prepare the sample. The sample is then washed through the No. 200 sieve the percentage by weight of material washed through the sieve was deemed the "percent fines" or percent clay and silt fraction.

The results of the D6913 and D1140 tests are shown on the same form.

Liquid and Plastic Limits Testing

Atterberg limits of the soils was determined generally following the methods described by ASTM D 4318, "*Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils."* Albert Atterberg originally defined "limits of consistency" of fine-grained soils in terms of their relative ease of deformation at various moisture contents. In current engineering usage, the *liquid lim*it of a soil is defined as the moisture content, in percent, marking the upper limit of viscous flow and the boundary with a semi-liquid state. The *plastic limit* defines the lower limit of plastic behavior, above which a soil behaves plastically below which it retains its shape upon drying. The *plasticity index* (PI) is the range of water content over which a soil behaves plastically. Numerically, the PI is the difference between liquid limit and plastic limit values.

Representative portions of fine-grained Group A, B, C, or D samples were prepared using the wet method described in Section 11.1 of ASTM D 4318. Unless otherwise noted on the report form, the liquid limit of each sample was determined using the multipoint method (Method A) described in Section 12. The liquid limit is, by definition, the moisture content where 25 drops of a hand operated liquid limit device are required to close a standard width groove cut in a soil sample placed in the device. After each test, the moisture content of the sample was adjusted and the sample replaced in the device. The test was repeated to provide a minimum of three widely spaced combinations of N versus moisture content. When plotted on semi-log paper, the liquid limit moisture content was determined by straight line interpolation between the data points at N equals 25 blows.

The plastic limit was determined using the procedure described in Section 17 of ASTM D 4318. A selected portion of the soil used in the liquid limit test was kneaded and rolled by hand until it could no longer be rolled to a 3.2 mm thread on a glass plate. This procedure was repeated until at least 6 grams of material was accumulated, at which point the moisture content was determined using the methods described in ASTM D 2216.

Form No: TR-D2216-T265-2
Revision No. 1
Revision Date: 08/16/17

LABORATORY DETERMINATION OF WATER CONTENT

ASTM D 2216 ☑ *AASHTO T 265* ☐

S&ME, Inc. - Wilmington: 3006 Hall Waters Drive, Suite 100, Wilmington, NC 28405

Project #:	23060076	Report Date:	7/10/23
Project Name:	Holden Beach Pier	Test Date(s):	7/8-7/10/23
Client Name:	Town of Holden Beach		
Client Address:	110 Rothschild St., Holden Beach, NC 28462		
Sample by:	J.Prevatte	Sample Dates:	6/16/23
Sampling Method:	Split Spoon	Drill Rig :	CME-45

Method: **A** **(1%)** ☐ **B** **(0.1%)** ☑

Balance ID.	14862	Calibration Date:	7/1/23
Oven ID.	14603	Calibration Date:	7/20/22

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture
		ft. or m.		grams	grams	grams	grams	%
B-1	S-9	33.5'-35.0'	N	0.00	255.41	200.74	54.67	**27.2%**
B-2	S-13	53.5'-55.0'	G	0.00	196.33	157.92	38.41	**24.3%**

Notes / Deviations / References

Tests Performed By: J.FAUCETTE

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Jason Faucette	*Jason Faucette*	Laboratory Supervisor	7/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Results shown in this report, relate only to the samples noted above.

Form No: TR-D1140-1
Revision No. 1
Revision Date: 8/2/17

MATERIAL FINER THAN THE #200 SIEVE

ASTM D1140

S&ME, Inc. - Wilmington: 3006 Hall Waters Drive, Suite 100, Wilmington, NC 28405

Project #:	23060076	Report Date:	7/10/23
Project Name:	Holden Beach Pier	Test Date(s):	7/8-7/10/23
Client Name:	Town of Holden Beach		
Client Address:	110 Rothschild St., Holden Beach, NC 28462		
Sample by:	J.Prevatte	Sample Dates:	6/16/23
Sampling Method:	Split Spoon	Drill Rig :	CME-45

Method; A ☐ **B** ☑ Soaked ☑ Soak Time **3.5 hrs**

Boring #	Sample #	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Tare Wt. + Dry Wt. after Wash	% Passing #200
				grams	grams	grams	grams	%
B-1	S-9	33.5'-35.0'	N	0.00	255.41	200.74	185.06	**7.8%**
B-2	S-13	53.5'-55.0'	G	0.00	196.33	157.92	113.92	**27.9%**

Balance ID. *14862* *Calibration Date:* *7/1/22* *#200 Sieve* *14977* *Calibration Date:* *1/26/23*

Notes / Deviations / References: ASTM D1140: Amount of Material in Soil Finer Than the No. 200 (75-um)) Sieve

Tests Performed By: J.FAUCETTE

Jason Faucette	*Jason Faucette*	Laboratory Supervisor	7/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Results shown in this report, relate only to the samples noted above.

Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

ASTM D 4318 ☒ AASHTO T 89 ☐ AASHTO T 90 ☐

S&ME, Inc. - Wilmington: 3006 Hall Waters Drive, Suite 100, Wilmington, NC 28405

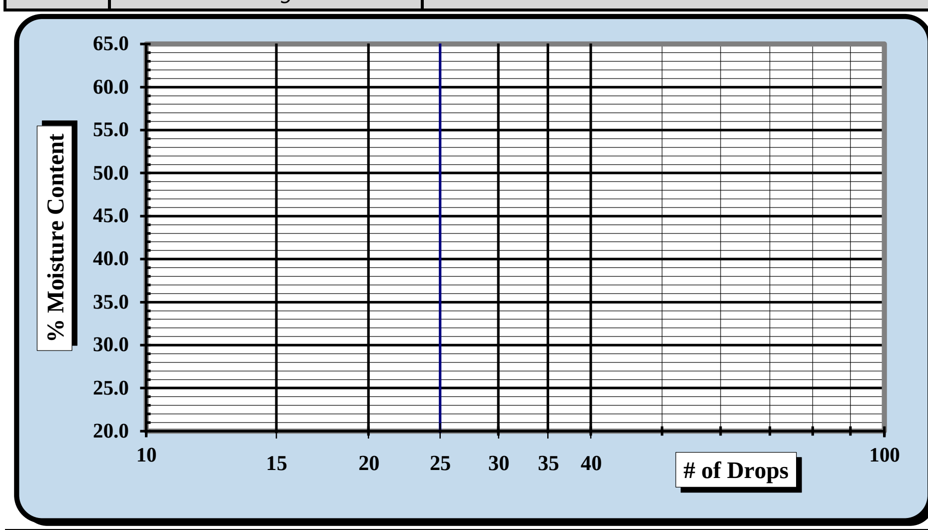
Project #:	23060076	Report Date:	7/10/23
Project Name:	Holden Beach Peir	Test Date(s)	7/8-7/10/23
Client Name:	Town of Holden Beach		
Client Address:	110 Rothschild St., Holden Beach, NC 28462		

Sample Id: 113	Type: Site Material	Sample Date: 6/16/23
Location: Soil Boring	Source Loc.: B-1/S-9	Depth(ft): 33.5'-35.0'

Sample Description: Gray Poorly Graded SAND with Silt (SP-SM)

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	14862	7/1/2023	Grooving tool	14947(A)	7/11/2022
LL Apparatus	14958	7/11/2022	Grooving tool		
Oven	14993	7/20/2022	Grooving tool		

Pan #		Liquid Limit						Plastic Limit		
	Tare #:	1	2	3				4	5	
A	Tare Weight									
B	Wet Soil Weight + A									
C	Dry Soil Weight + A									
D	Water Weight (B-C)									
E	Dry Soil Weight (C-A)									
F	% Moisture (D/E)*100									
N	# OF DROPS							*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR									
Ave.	*Average*									



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒

Liquid Limit	
Plastic Limit	**NP**
Plastic Index	
Group Symbol	**SP-SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation Dry Preparation Air Dried *Estimate the % Retained on the #40 Sie* 17%

Notes / Deviations / References: *ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils*

Tests Performed By: J.FAUCETTE

Jason Faucette	Jason Faucette	Laboratory Supervisor	7/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Results shown in this report, relate only to the sample noted above

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Form No. TR-D4318-T89-90
Revision No. 1
Revision Date: 7/26/17

LIQUID LIMIT, PLASTIC LIMIT, & PLASTIC INDEX

ASTM D 4318 ☒ AASHTO T 89 ☐ AASHTO T 90 ☐

S&ME, Inc. - Wilmington: 3006 Hall Waters Drive, Suite 100, Wilmington, NC 28405

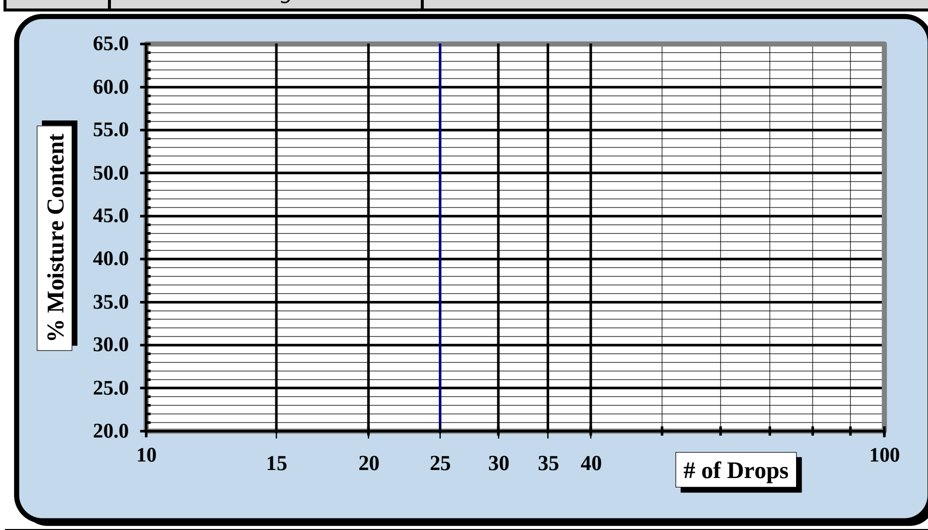
Project #:	23060076	Report Date:	7/10/23
Project Name:	Holden Beach Peir	Test Date(s)	7/8-7/10/23
Client Name:	Town of Holden Beach		
Client Address:	110 Rothschild St., Holden Beach, NC 28462		

Sample Id: 113	Type: Site Material	Sample Date: 6/16/23
Location: Soil Boring	Source Loc.: B-2/S-13	Depth(ft): 53.5'-55.0'

Sample Description: Gray Silty SAND (SM)

Type and Specification	*S&ME ID #*	*Cal Date:*	*Type and Specification*	*S&ME ID #*	*Cal Date:*
Balance (0.01 g)	14862	7/1/2023	Grooving tool	14947(A)	7/11/2022
LL Apparatus	14958	7/11/2022	Grooving tool		
Oven	14993	7/20/2022	Grooving tool		

Pan #			Liquid Limit						Plastic Limit		
		Tare #:	1	2	3				4	5	
A	Tare Weight										
B	Wet Soil Weight + A										
C	Dry Soil Weight + A										
D	Water Weight (B-C)										
E	Dry Soil Weight (C-A)										
F	% Moisture (D/E)*100										
N	# OF DROPS								*Moisture Contents determined by ASTM D 2216*		
LL	LL = **F** * FACTOR										
Ave.	*Average*										



One Point Liquid Limit

N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic ☒

Liquid Limit	
Plastic Limit	**NP**
Plastic Index	
Group Symbol	**SM**

Multipoint Method ☑
One-point Method ☐

Wet Preparation Dry Preparation Air Dried *Estimate the % Retained on the #40 Sieve* 17%

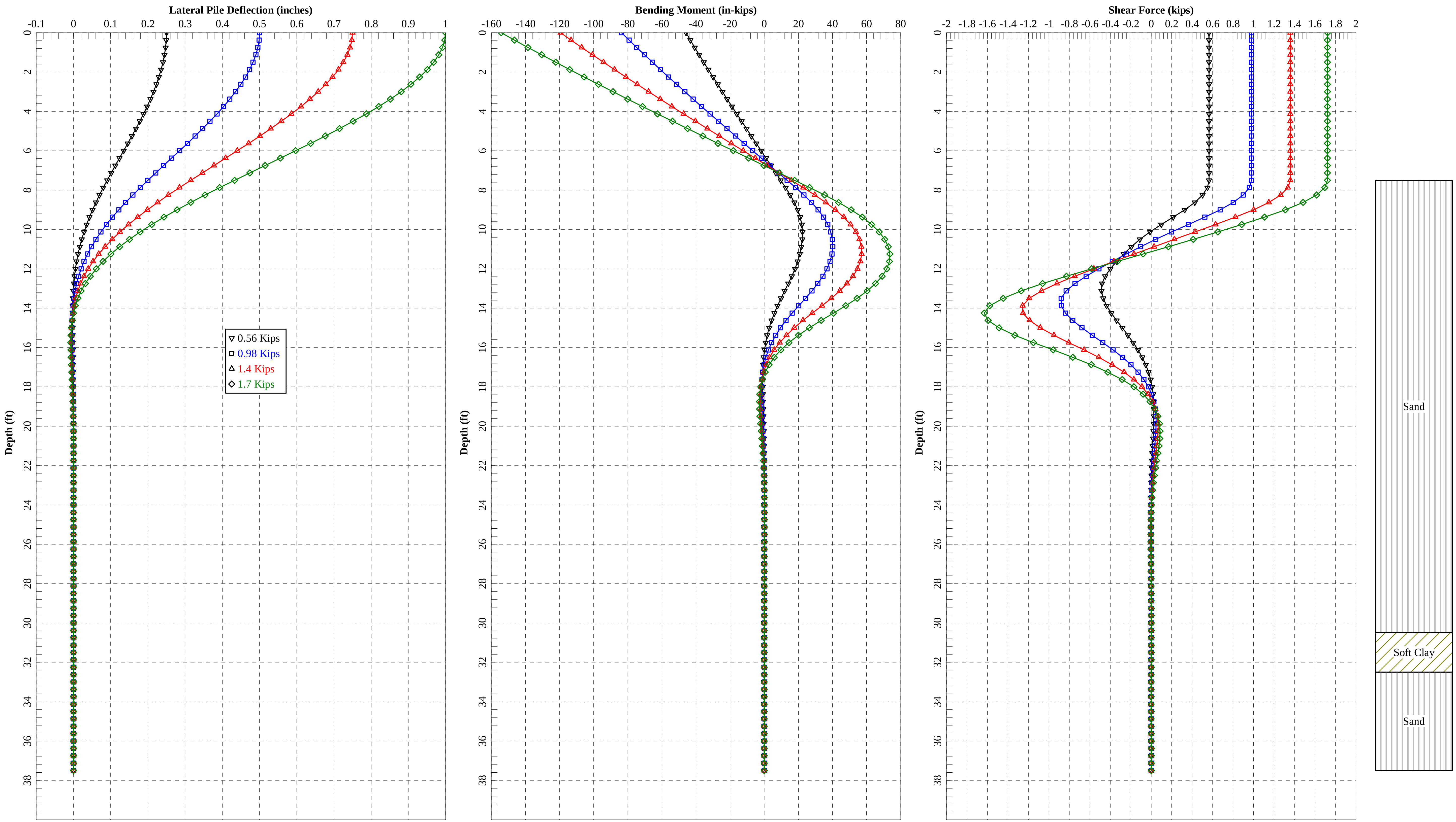
Notes / Deviations / References: *ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils*

Tests Performed By: J.FAUCETTE

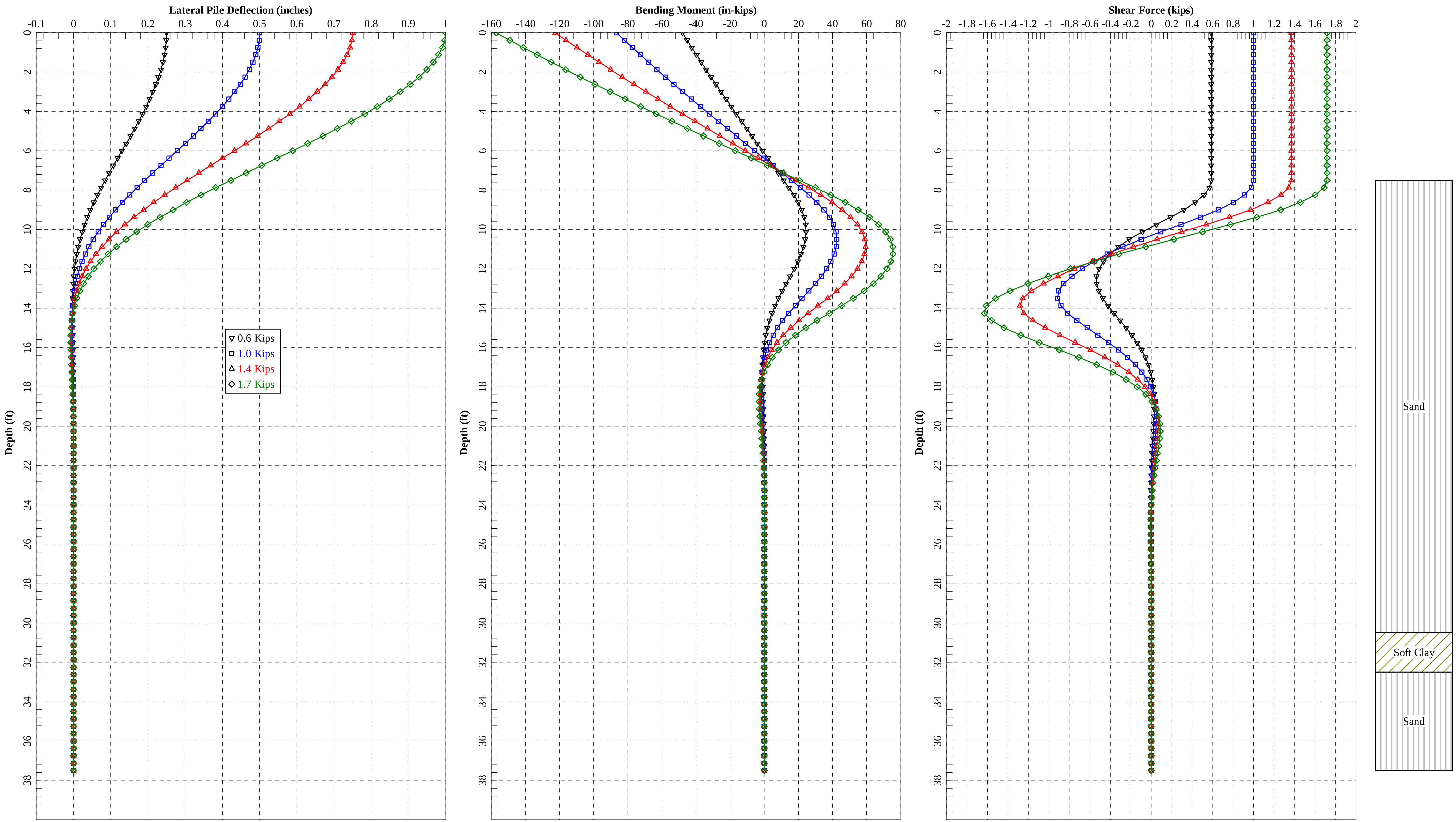
Jason Faucette	*Jason Faucette*	Laboratory Supervisor	7/10/2023
Technical Responsibility	*Signature*	*Position*	*Date*

Results shown in this report, relate only to the sample noted above

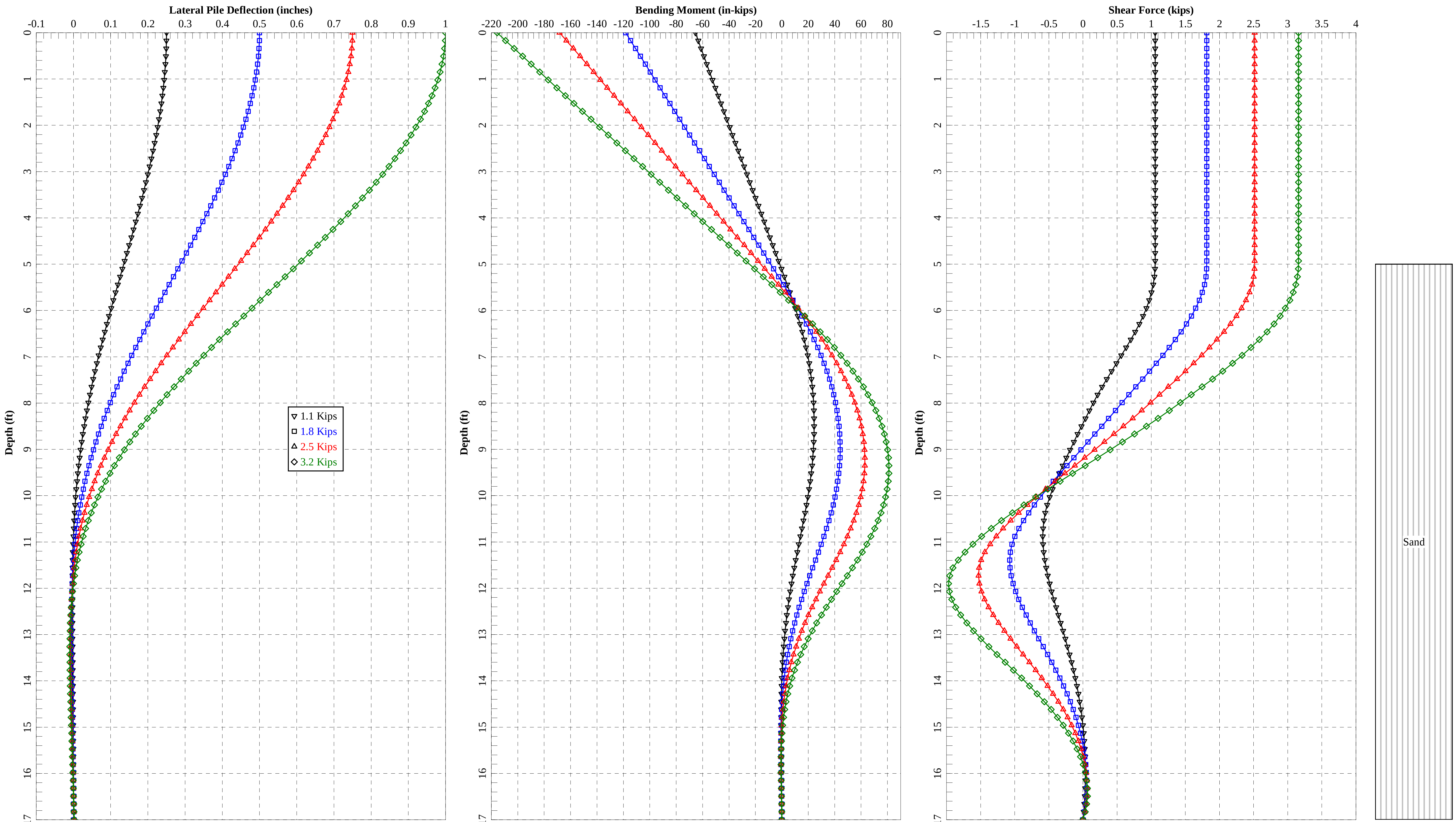
Appendix IV– L-Pile Deflection Model Results



8 Inch Tip Tapered Timber Pile to 30 feet Fixed Head Conditions



10 Inch Tip Tapered Timber Pile to 30 feet Fixed Head Conditions



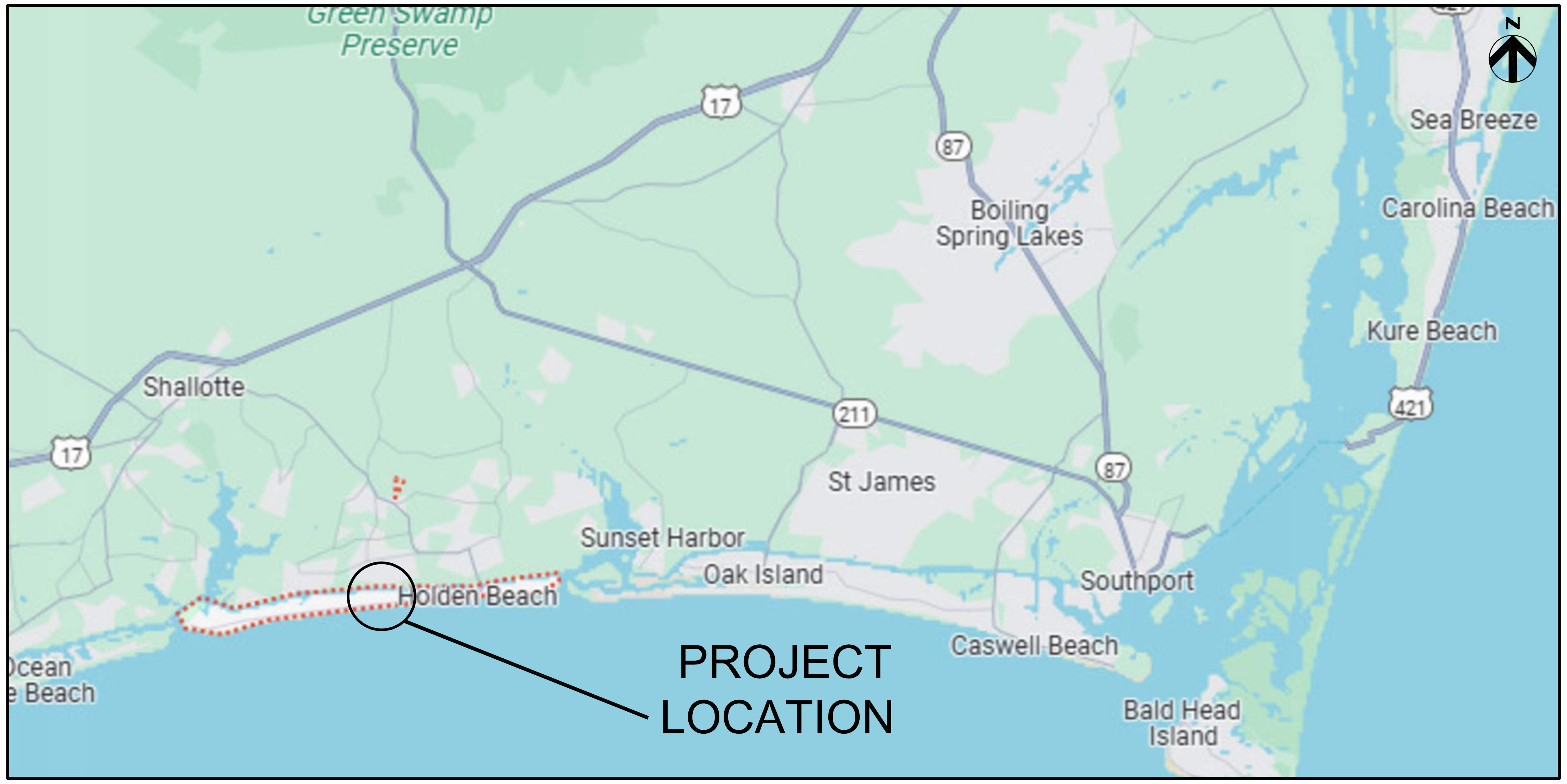
8 Inch Tip Tapered Timber Pile to 12 feet Fixed Head Conditions (Pedestrian Beach Access)

Appendix F

30% Plan Set

hdrinc.com

HDR Engineering, Inc.
101 North 3rd Street, Suite 201, Wilmington, NC 28401-4034
(910) 398-9020



VICINITY MAP

NTS

LOCATION MAP

NTS

Preliminary Drawings For

Town of Holden Beach Pier Replacement

General/Civil/Structural

Project No.
10426190

Holden Beach, North Carolina
July, 2025

INDEX OF DRAWINGS

HDR Engineering, INC
101 North 3rd St. Suite 201
Wilmington, NC28401
(904) 398-9020
N.C.B.E.L.S. License# F-0116

ISSUE	DATE	DESCRIPTION
A	07/02/2025	PRELIMINARY 30% DRAFT SUBMITTAL

PROJECT MANAGER	WILL FULLER
DESIGNED BY	LUKE R. CRESSMAN
DRAWN BY	PHILIP MCINTIRE
CHECKED BY	SCOTT MCCOY
PROJECT NUMBER	10426190

30% SUBMITTAL PRELIMINARY

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW AND IS NOT INTENDED TO BE USED FOR CONSTRUCTION, BIDDING OR PERMIT PURPOSES.

ENGINEER: LUKE CRESSMAN
LICENSE NO.: 055975
DATE: 07/02/2025

OFFICIAL SEAL Town Of Holden Beach, NC

TOWN OF HOLDEN BEACH PIER REPLACEMENT

PROJECT COVER SHEET & VICINITY MAP

FILENAME	G-00.dwg
SCALE	AS NOTED
SHEET	G-00

GENERAL REQUIREMENTS

1. CONTRACTOR SHALL FIELD CHECK AND VERIFY ALL ELEVATIONS, COORDINATES, DIMENSIONS, EXISTING CONDITIONS, AND INFORMATION INDICATED ON THE CONTRACT DOCUMENTS PRIOR TO COMMENCEMENT OF SITE WORK. THE OWNER SHALL BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES FOUND ON THE CONTRACT DOCUMENTS OR FOUND TO EXIST BETWEEN THE FIELD CONDITIONS AND THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL TAKE CORRECTIVE ACTION AS DIRECTED BY THE OWNER.

2. THE CONTRACTOR SHALL COMPLY WITH ALL PROVISIONS OF THE COASTAL AREA MANAGEMENT ACT (CAMA) PERMIT OBTAINED BY THE OWNER FOR THIS PROJECT.

3. CONTRACTOR SHALL SUBMIT STORM WATER POLLUTION PREVENTION PLAN (SW3P) TO OWNER. CONSTRUCTION ACTIVITY MAY NOT COMMENCE UNIT SW3P IS APPROVED BY OWNER. REFER TO SPECIFICATION SECTION XX XX XX – TEMPORARY STORMWATER POLLUTION CONTROL FOR ADDITIONAL REQUIREMENTS.

4. CONTRACTOR SHALL CONDUCT HIS OPERATIONS SO AS TO NOT INTERFERE WITH, OR BE DETRIMENTAL TO VESSEL AND VEHICULAR TRAFFIC AND THE DAILY OPERATION OF THE OWNER DURING THE COURSE OF THE WORK.

5. CONTRACTOR SHALL PROVIDE AND MAINTAIN ALL TRAFFIC CONTROL DEVICES DURING THE COURSE OF THE CONSTRUCTION PERIOD.

6. ALL EXISTING ROADWAYS AND OTHER FEATURES WHICH ARE DAMAGED BY THE CONTRACTOR SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE TO THE SATISFACTION OF THE OWNER.

7. FENCING WHICH IS REMOVED TO FACILITATE CONSTRUCTION SHALL BE REPLACED TO ORIGINAL OR BETTER CONDITION.

8. CONTRACTOR SHALL MAINTAIN ALL REGULATORY AND WARNING SIGNS DURING THE CONSTRUCTION PERIOD.

9. CONTRACTOR SHALL SUBMIT TO OWNER ALL MATERIAL CERTIFICATES PRIOR TO FABRICATION.

10. THE CONTRACTOR SHALL PERFORM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH OSHA AND CONTRACT DOCUMENTS.

SOIL BORINGS

1. THE SOIL INVESTIGATION REPORT IS AVAILABLE FOR REVIEW BASED ON WRITTEN APPROVAL BY THE OWNER. THE REPORT INCLUDES ADDITIONAL GEOTECHNICAL INFORMATION SUCH AS HISTORICAL BORINGS AND LABORATORY TEST DATA. SOIL INVESTIGATION REPORT IS NOT A PART OF THE CONSTRUCTION CONTRACT DOCUMENTS.

2. GEOTECHNICAL INVESTIGATION DATA AND REPORT REFERENCES:

a. 2023 SOIL BORING LOGS ARE AVAILABLE IN GEOTECHNICAL REPORT TITLED: "REPORT OF GEOTECHNICAL EXPLORATION – HOLDEN BEACH PIER AND PIER HOUSE" (S&ME JOB NO. 23060076) DATED JULY 24, 2023; PREPARED BY S&ME, INC.

HORIZONTAL AND VERTICAL CONTROL

1. HYDROGRAPHIC SURVEY WAS PERFORMED BY MCKIM & CREED DATED MARCH 19, 2025.

2. HORIZONTAL COORDINATES SHOWN ARE STATE PLANE GRID, NORTH CAROLINA ZONE (NC-3200) US FEET.

3. VERTICAL DATUM SHOWN ON THESE DRAWINGS REFERS TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88) GEOID 18 EPOCH 2001 IN U.S. FEET

4. DATUM CORRELATION TABLE:

	MLLW	NAVD '88
MEAN HIGHER HIGH WATER (MHHW)	+5.60'	+2.44'
MEAN HIGH WATER (MHW)	+5.21'	+2.05'
NORTH AMERICAN VERTICAL DATUM 1988 (NAVD'88)	+3.16'	+0.00'
MEAN SEA LEVEL (MSL)	+2.71'	-0.45'
MEAN TIDE LEVEL (MTL)	+2.70'	-0.46'
MEAN LOW WATER (MLW)	+0.19'	-2.97'
MEAN LOWER LOW WATER (MLLW)	+0.00'	-3.16

THE TIDAL INFORMATION SHOWN ABOVE IS BASED ON HISTORIC TIDAL GAGE MEASUREMENT AT NOAA STATION: SPRINGMAID PIER (#8661070); LOCATED IN MYRTLE BEACH, SC. WATER SURFACE RANGE BETWEEN MLLW AND MHHW REPRESENTS A NORMAL STATISTICAL WATER SURFACE RANGE. THE WATER SURFACE WILL ON OCCASION BE HIGHER OR LOWER THAN THIS RANGE.

DEMOLITION AND SALVAGE

1. THE CONTRACTOR SHALL REMOVE ALL EXISTING ABOVE SURFACE AND BURIED STRUCTURES ON THE SITE WHICH ARE REQUIRED TO ALLOW THE NEW CONSTRUCTION AS SHOWN. THE APPROXIMATE LOCATION AND EXTENT OF THESE STRUCTURES HAVE BEEN SHOWN ON THIS DRAWING.

2. DEMOLITION OF EXISTING FACILITIES UNLESS NOTED OTHERWISE SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF LEGALLY AND PROPERLY.

3. ALL TIMBER, CONCRETE, STEEL AND OTHER DEBRIS SHALL BE HAULED OFF SITE AND DISPOSED OF AT THE CONTRACTOR'S EXPENSE.

4. MATERIALS TO BE SALVAGED FOR THE OWNER'S USE ARE AS FOLLOWS:
   A.XXXX
   B.XXXX
   C.XXXX

5. MATERIALS TO BE SALVAGED SHALL BE STOCKPILED IN THE AREA AS DIRECTED BY OWNER. STOCKPILED MATERIALS SHALL BE PLACED ON TIMBER SLEEPERS A MINIMUM OF 4-INCH ABOVE GROUND SURFACE AND SHALL BE ADEQUATELY SUPPORTED UNLESS OTHER STORAGE METHOD IS PRE-APPROVED BY OWNER.

6. TIMBER PILING SHALL BE REMOVED BY JETTING AND PULLING. PILING MAY NOT BE BROKEN OFF EXCEPT WITH SPECIFIC WRITTEN PERMISSION OF THE OWNER.

STRUCTURAL TIMBER

1. ALL TIMBER SHALL BE NEW, SOUTHERN YELLOW PINE, GRADE NO. 2 OR BETTER, AND CROMATED COPPER ARSENATE (CCA) TREATED TO RETENTION OF 2.5-LB/CU-FT.

2. THE RETAINING WALL TIMBER PILES AND PLANKS SHALL BE INSTALLED TO THE FOLLOWING TOLERANCES:

•VARIANCE FROM HORIZONTAL ALIGNMENT	½-INCH IN 20-FT
•VARIANCE FROM PLUMB (FRONT TO BACK)	½-INCH IN 10-FT
•VARIANCE FROM PLUMB (SIDE TO SIDE)	¼-INCH IN 10-FT
•VARIANCE IN ELEVATION	1-INCH

3. ALL TIMBER PILES SHALL BE SOUTHERN YELLOW PINE PILING CLASS B, AND SHALL BE TREATED IN ACCORDANCE WITH AWPA STANDARDS G-77 AND G-78, WITH A 70% - 30% CREOSOTE-COAL TAR MIXTURE TO A MINIMUM FINAL RETENTION OF 12-LB/CU-FT. PILES SHALL MEET THE REQUIREMENTS OF ASTM D-25.

4. TIMBER PILING SHALL HAVE MINIMUM TIP DIAMETERS SHOWN. LENGTH SHALL BE SUFFICIENT TO PROVIDE INSTALLED LENGTH SPECIFIED ON THE DRAWING.

5. ALL PILING SHALL BE DRIVEN TO THE MINIMUM PENETRATION SHOWN IN THE SCHEDULE. IF THE MINIMUM RESISTANCE, AS CALCULATED PER SPECIFICATIONS, IS LESS THAN THE MINIMUM VALUE SHOWN IN THE PILE SCHEDULE, THE ENGINEER SHALL BE CONSULTED IMMEDIATELY.

6. ALL SPLICES FOR THE TIMBER PLANKS SHALL BE STAGGERED AND SHALL BE LOCATED AT THE PILES ONLY. PROVIDE LONGEST MEMBER POSSIBLE TO REDUCE THE NUMBER OF SPLICES.

7. ALL DECKING SHALL BE NAILED TO EACH BEAM WITH (3) 20-D HOT-DIP GALVANIZED NAILS WITH TIMBER HEART SIDE DOWN.

8. ALL OTHER NAILED CONNECTIONS SHALL BE MADE WITH 60-D HOT-DIP GALVANIZED NAILS.

9. ALL BOLTS SHALL BE IN ACCORDANCE WITH ASTM A307, AND HOT-DIP GALVANIZED UNLESS OTHERWISE NOTED.

10. ALL FIELD CUTS MADE TO PILING SHALL BE SWABBED WITH A LIBERAL APPLICATION OF AN APPROVED WOOD PRESERVATIVE.

SHOP DRAWINGS

1. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS AND ELEVATIONS SHOWN ON THE DRAWINGS, PRIOR TO PREPARATION OF SHOP DRAWINGS.

2. SHOP DRAWINGS SHALL BE SUBMITTED TO AND APPROVED BY THE ENGINEER BEFORE PURCHASE OF ANY MATERIALS OR START OF FABRICATION.

3. THE USE OD REPRODUCTION OF THESE CONTRACT DRAWINGS BY ANY CONTRACTOR, SUB CONTRACTOR, ERECTOR, FABRICATOR, OR MATERIAL SUPPLIER IN LIEU OF PREPARATION OF SHOP DRAWINGS IS PROHIBITED.

HDR Engineering, INC
101 North 3rd St. Suite 201
Wilmington, NC28401
(904) 398-9020
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PRELIMINARY

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ENGINEER: LUKE CRESSMAN
LICENSE NO.: 055975
DATE: 07/02/2025

OFFICIAL SEAL
Town Of Holden Beach, NC

TOWN OF HOLDEN BEACH
PIER REPLACEMENT

GENERAL NOTES &
DESIGN CRITERIA

FILENAME G-01.dwg
SCALE AS NOTED
SHEET G-01

A/C	AIR CONDITIONING
A/E	ARCHITECT/ENGINEER
A	AMPERE
AB	ANCHOR BOLT
ABAN	ABANDON
ABC	AGGREGATE BASE COURSE
ABT	ABOUT
AC	ALTERNATING CURRENT
ACK	ACKNOWLEDGE
ACP	ACOUSTIC CEILING PANEL, ASPHALTIC CONCRETE PAVEMENT
ACST	ACOUSTIC
AD	ADDENDUM, AREA DRAIN
ADDL	ADDITIONAL
ADH	ADHESIVE
ADJ	ADJUSTABLE, ADJACENT
AF	AMP FRAME, AMP FUSE
AFF	ABOVE FINISH FLOOR
AFG	ABOVE FINISH GRADE
AGGR	AGGREGATE
AI	AREA INLET, ANALOG INPUT
AIC	AMPS INTERRUPTING CAPACITY
ALIG	ALIGNMENT
ALT	ALTERNATE, ALTITUDE
ALUM	ALUMINUM
AM	ACOUSTICAL MATERIAL
AMB	AMBIENT
ANC	ANCHOR
AO	ANALOG OUTPUT
AP	ACCESS PANEL
APRX	APPROXIMATE
APVD	APPROVED
ARCH	ARCHITECTURAL
ASSY	ASSEMBLY
AT	ACOUSTICAL TILE, AMP TRIP
ATC	ACOUSTICAL TILE CEILING
ATM	ATMOSPHERE
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AVG	AVERAGE
AWG	AMERICAN WIRE GAGE
AWT	ACOUSTICAL WALL TILE
B TO B	BACK TO BACK
BAL	BALANCE
BBD	BULLETIN BOARD
BC	BASE CABINET, BOTTOM CHORD, BOLT CENTER, BOLT CIRCLE
BD	BOARD
BE	BOTH ENDS, BELL END
BF	BOTH FACES, BOTTOM FACE, BLIND FLANGE, BOARD FEET
BITUM	BITUMINOUS
BKG	BACKING
BL	BASE LINE
BLDG	BUILDING
BLK	BLOCK
BLKG	BLOCKING
BM	BENCHMARK, BEAM
BOC	BACK OF CURB
BOD	BOTTOM OF DUCT
BOG	BOTTOM OF GRILLE
BOL	BOTTOM OF LOUVER, BOLLARD
BOP	BOTTOM OF PIPE
BOR	BOTTOM OF REGISTER
BOT	BOTTOM
BOU	BOTTOM OF UNIT
BP	BASE PLATE
BRG	BEARING
BRGP	BEARING PLATE
BRKT	BRACKET
BS	BOTH SIDES
BTU	BRITISH THERMAL UNIT
BTW	BETWEEN
BTWLD	BUTT WELD
BU	BELL UP, BUILT-UP
BUR	BUILT-UP ROOFING
BW	BOTH WAYS
BYP	BYPASS
C TO C	CENTER TO CENTER
C&G	CURB AND GUTTER
C	CHANNEL SHAPE, CENTIGRADE, CONDUIT
CAB	CABINET
CAP	CAPACITY
CAT	CATALOG, CATEGORY
CAV	CAVITY
CB	CATCH BASIN
CCB	CONCRETE BLOCK
CCW	COUNTER CLOCKWISE
CDF	CONTROLLED-DENSITY FILL
CE	CONCRETE EDGE
CER	CERAMIC
CF	CUBIC FEET (FOOT)
CFL	COUNTER FLASHING
CHBD	CHALKBOARD
CHD	CHORD
CHFR	CHAMFER
CHH	COMMUNICATION HANDHOLE
CI	CURB INLET
CIP	CAST-IN-PLACE
CIPB	CONCRETE INTERLOCKING PAVER BALLAST
CIRC	CIRCULATION, CIRCULAR
CJ	CONSTRUCTION JOINT
CKT	CIRCUIT
CL	CENTERLINE, CLASS, CLOSE
CLG	CEILING
CLKG	CAULKING
CLR	CLEAR
CMH	COMMUNICATION MANHOLE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CO	CLEANOUT, CONCRETE OPENING
COL	COLUMN
COM	COMMON
COMB	COMBINATION
COMM	COMMUNICATION
COMP	COMPOSITION, COMPRESSIBLE, COMPOSITE
CON	CONCENTRIC
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS
COOR	COORDINATE
CORR	CORROSIVE, CORRUGATED
CP	CHECKER PLATE, CONTROL POINT
CPLG	COUPLING
CRL	CORROSION-RESISTANT LINING
CSC	COMPRESSION SLEEVE COUPLING
CSK	COUNTERSINK
CSS	CLINIC SERVICE SINK
CT	CERAMIC TILE
CTJ	CONTRACTION JOINT
CTR	CENTER
CTRL	CONTROL
CVT	CULVERT
CU	COPPER, CUBIC
CW	CLOCKWISE
CY	CUBIC YARD
d	PENNY (NAIL MEASURE)
D	DEEP, DIFFUSER, DRAIN
DB	DUCT BANK, DECIBEL, DRY BULB
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DEG C	DEGREE CENTIGRADE
DEG F	DEGREE FAHRENHEIT
DEMO	DEMOLITION
DEP	DEPRESSED
DEPT	DEPARTMENT
DET	DETAIL
DI	DROP INLET, DUCTILE IRON, DIGITAL INPUT
DIA	DIAMETER
DIAG	DIAGONAL, DIAGRAM
DIFF	DIFFERENTIAL, DIFFERENCE
DIM	DIMENSION
DISCH	DISCHARGE
DIST	DISTANCE, DISTRIBUTION
DIV	DIVISION
DL	DEAD LOAD
DMJ	DOUBLE MECHANICAL JOINT
DMPF	DAMP PROOFING
DN	DOWN
DO	DISSOLVED OXYGEN, DIGITAL OUTPUT, DITTO
DP	DEPTH
DPDT	DOUBLE POLE, DOUBLE THROW
DPST	DOUBLE POLE, SINGLE THROW
DS	DOWN SPOUT
DT	DOUBLE TEE, DRIP TRAP ASSEMBLY
DUP	DUPLICATE
DWG	DRAWING
DWL	DOWEL
DWR	DRAWER
E	EAST
EA	EACH, EXHAUST AIR
EC	ELECTRICAL CONTRACTOR
ECC	ECCENTRIC
ED	EQUIPMENT DRAIN
EDB	ELECTRICAL DUCT BANK
EE	EACH END
EF	EACH FACE
EFF	EFFLUENT, EFFICIENCY
EHH	ELECTRICAL HANDHOLE
EIFS	EXTERIOR INSULATION & FINISH SYSTEM
EJ	EXPANSION JOINT
EL	ELBOW, ELEVATION
ELEC	ELECTRICAL
EMBD	EMBEDDED
EMER	EMERGENCY
EMH	ELECTRICAL MANHOLE
ENCL	ENCLOSURE
ENGR	ENGINEER
ENTR	ENTRANCE
EOP	EDGE OF PAVEMENT
EQ	EQUAL
EQUIP	EQUIPMENT
EQUIV	EQUIVALENT
ES	EACH SIDE, EQUAL SPACE, EMERGENCY SHOWER
ESEW	EMERGENCY SHOWER AND EYE WASH
EST	ESTIMATE
EW	EACH WAY, EMERGENCY, EYE/FACE WASH
EWC	ELECTRIC WATER COOLER
EWEF	EACH WAY, EACH FACE
EWTB	EACH WAY, TOP AND BOTTOM
EXC	EXCAVATION
EXH	EXHAUST
EXP	EXPANSION, EXPOSED
EXST	EXISTING
EXT	EXTERIOR, EXTERNAL, EXTENSION
F TO F	FACE TO FACE
F&B	FACE AND BYPASS
FAB	FABRICATE
FB	FLOOR BEAM
FBD	FIBERBOARD
FBG	FIBERGLASS
FBM	BOARD FOOT MEASURE
FBO	FURNISHED BY OWNER
FC	FLUSHING CONNECTION
FCA	FLANGED COUPLING ADAPTER
FD	FLOOR DRAIN
FDC	FLEXIBLE DUCT CONNECTION
FDR	FEEDER
FDTN	FOUNDATION
FE	FLANGED END
FEC	FIRE EXTINGUISHER CABINET
FES	FLARED END SECTION
FEXT	FIRE EXTINGUISHER
FF	FAR FACE, FACTORY FINISH, FLAT FACE
FG	FINISHED GRADE
FH	FIRE HYDRANT
FIG	FIGURE
FIN	FINISH
FJT	FLUSH JOINT
FL	FLOW, FLOW LINE
FLEX	FLEXIBLE
FLG	FLANGE
FLOR	FLUORESCENT
FLR	FLOOR
FLS	FLASHING, FLUSH
FN	FENCE
FO	FINISHED OPENING, FIBER OPTIC
FOB	FLAT ON BOTTOM
FOC	FACE OF CONCRETE, FACE OF CURB
FOF	FACE OF FINISH
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FOT	FLAT ON TOP
FPT	FEMALE PIPE THREAD
FR	FRAME
FRP	FIBERGLASS REINFORCED PLASTIC
FRTM	FIRE RETARDANT TREATED MATERIAL
FS	FLOOR SINK, FAR SIDE
FT	FEET, FOOT
FTG	FOOTING, FITTING
FUR	FURRED, FURRING
FURN	FURNITURE, FURNISH
FUT	FUTURE
FV	FACE VELOCITY
FW	FIELD WELD, FIRE WALL
FWD	FORWARD
FWE	FURNISHED WITH EQUIPMENT
FXTR	FIXTURE
G	GRILLE, GROUND
GA	GAGE (METAL THICKNESS)
GAL	GALLON
GALV	GALVANIZED
GB	GRAB BAR, GRADE BREAK
GC	GROOVED COUPLING
GD	GUARD
GEN	GENERAL
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GFMU	GROUND FACE MASONRY UNIT
GG	GUTTER GRADE
GJ	GROOVED JOINT
GL	GLASS
GLB	GLASS BLOCK, GLULAM BEAM
GND	GROUND
GP	GUY POLE
GR	GRADE
GRTG	GRATING
GSB	GYPSUM SHEATHING BOARD
GT	GREASE TRAP
GVL	GRAVEL
GW	GUY WIRE
GWB	GYPSUM WALLBOARD
GYP	GYPSUM HARDBOARD
H	HIGH
HB	HOSE BIBB
HBD	HARDBOARD
HC	HANDICAPPED, HOLLOW CORE, HORIZONTAL, CURVE, HORIZONTAL CENTERLINE
HD	HEAD, HOT DIP
HDR	HEADER
HDW	HARDWARE
HEX	HEXAGONAL
HGR	HANGER
HH	HANDHOLE
HID	HIGH-INTENSITY DISCHARGE
HM	HOLLOW METAL
HORIZ	HORIZONTAL
HP	HIGH POINT, HORSEPOWER
HPC	HORIZONTAL POINT OF CURVATURE
HPS	HIGH-PRESSURE SODIUM
HPT	HORIZONTAL POINT OF TANGENCY
HR	HOSE REEL, HOUR
HS	HEADED STUD, HIGH STRENGTH
HSS	HOLLOW STRUCTURAL SHAPE
HT	HEIGHT
HTG	HEATING
HV	HIGH VOLTAGE
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HWD	HARDWOOD
HWL	HIGH WATER LEVEL
HYD	HYDRAULIC
HZ	HERTZ, CYCLES PER SECOND
ID	INSIDE DIAMETER, INTERIOR DIMENSION
IE	INVERT ELEVATION, FOR EXAMPLE
IF	INSIDE FACE
IH	INTAKE HOOD
IMP	IMPACT
IN	INCH
INC	INCLUDE, INCANDESCENT
INF	INFLUENT
INSTR	INSTRUMENTATION
INSUL	INSULATION
INT	INTERIOR, INTERSECTION
INTR	INTERMEDIATE, INTERIOR
INV	INVERT
IPS	IRON PIPE SIZE
IPT	INTERNAL PIPE THREAD
IR	INSIDE RADIUS, IRON ROD
IRR	IRRIGATION
ISO	ISOMETRIC
JB	JUNCTION BOX
JCT	JUNCTION
JF	JOINT FILLER
JST	JOIST
JT	JOINT
K	KIP
KB	KNEE BRACE
KCMIL	THOUSAND CIRCULAR MILS
KD	KNOCK DOWN
KO	KNOCK OUT
KSI	KIPS PER SQUARE INCH
KW	KILOWATT
L	ANGLE, LENGTH, LAVATORY, LINTEL
LAD	LADDER
LAM	LAMINATE
LATL	LATERAL
LB	LAG BOLT, POUND
LCTB	LIQUID CHALK AND TACK BOARD
LDG	LANDING
LDR	LEADER
LE	LIFTING EYE
LF	LINEAR FOOT
LG	LONG
LH	LEFT HAND
LIN	LINEAR
LIQ	LIQUID
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LMLU	LIQUID MARKER LECTURE UNIT
LNG	LONGITUDINAL
LOC	LOCATION
LP	LOW POINT
LPS	LOW-PRESSURE SODIUM
LR	LONG RADIUS
LT	LEFT
LTD	LIMITED
LTG	LIGHTING
LTL	LINTEL
LTNG	LIGHTNING
LV	LOW VOLTAGE
LVL	LAMINATED VENEER LUMBER
LVR	LOUVER
LW	LIGHTWEIGHT
LWC	LIGHTWEIGHT CONCRETE
LWL	LOW WATER LEVEL
MA	MIXED AIR
MACH	MACHINED
MAINT	MAINTENANCE
MAN	MANUAL
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MBR	MEMBER
MC	MECHANICAL CONTRACTOR, MECHANICAL COUPLING, MOMENT CONNECTION
MCB	METAL CORNER BEAD
MCJ	MASONRY CONTROL JOINT
MDMJ	MODIFIED DOUBLE MECHANICAL JOINT
MECH	MECHANICAL
MED	MEDIUM
MFR	MANUFACTURER
MH	MANHOLE, METAL HALIDE
MIN	MINIMUM
MIR	MIRROR
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
ML	MASONRY LINTEL
MLO	MAIN LUGS ONLY
MMB	MEMBRANE
MO	MASONRY OPENING
MOD	MODULAR, MODIFY
MON	MONUMENT
MPT	MALE PIPE THREAD
MRGWB	MOISTURE-RESISTANT GYPSUM WALLBOARD
MS	MOP SINK
MSL	MEAN SEA LEVEL
MT	MOUNT
MU	MASONRY UNIT
MULL	MULLION
MV	MEDIUM VOLTAGE
MW	MONITORING WELL
N	NORTH, NEUTRAL
NA	NOT APPLICABLE
NAT	NATURAL, NATIONAL
NC	NORMALLY CLOSED
NEG	NEGATIVE
NF	NEAR FACE, NON-FUSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN, NUMBER
NOM	NOMINAL
NPS	NOMINAL PIPE SIZE
NPT	NATIONAL PIPE THREAD
NS	NEAR SIDE
NTS	NOT TO SCALE
NWL	NORMAL WATER LEVEL
O TO O	OUT TO OUT
OA	OUTSIDE AIR, OVERALL
OC	ON CENTER
OCPD	OVER CURRENT PROTECTION DEVICE
OD	OUTSIDE DIAMETER
OED	OPEN END DUCT
OF	OUTSIDE FACE, OFFICE FURNISHING
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
OFOI	OWNER FURNISHED OWNER INSTALLED
OG	ORIGINAL GROUND
OH	OVERHEAD
OPNG	OPENING
OPP	OPPOSITE
OPT	OPTIONAL
OR	OUTSIDE RADIUS
ORD	OVERFLOW ROOF DRAIN
ORIG	ORIGINAL
OVFL	OVERFLOW
OVHG	OVERHANG
OZ	OUNCE
P	PAINT
PA	PUBLIC ADDRESS
PAR	PARALLEL, PARAPET
PB	PANIC BAR, PULL BOX
PBD	PARTICLE BOARD
PC	POINT OF CURVE, PIECE, PRECAST
PCC	POINT OF COMPOUND CURVATURE
PCF	POUNDS PER CUBIC FOOT
PCT	PERCENT
PE	PLAIN END
PED	PEDESTAL
PEN	PENETRATION
PERF	PERFORATED
PERM	PERMANENT
PERP	PERPENDICULAR
PF	POWER FACTOR
PFMU	PREFACED MASONRY UNIT
PH	PHASE
PI	POINT OF INTERSECTION
PKG	PACKAGE
PL	PLATE, PROPERTY LINE, PRECAST LINTEL
PLAS	PLASTER
PLAT	PLATFORM
PLBG	PLUMBING
PLF	POUNDS PER LINEAR FOOT
PNEU	PNEUMATIC
POL	POLISH
POS	POSITIVE, POSITION
PP	POLYPROPYLENE, POWER POLE
PRC	POINT OF REVERSE CURVATURE
PREF	PREFINISHED
PREFAB	PREFABRICATED
PRELIM	PRELIMINARY
PREP	PREPARE
PRES	PRESSURE
PRI	PRIMARY
PROP	PROPERTY, PROPOSED
PROT	PROTECTION
PS	PIPE SUPPORT
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAGE
PST	PRESTRESSED
PT	POINT, POINT OF TANGENCY
PTN	PARTITION
PVC	POLYVINYL CHLORIDE, POINT OF VERTICAL CURVE
PVC-RGS	PVC COATED RGS
PVMT	PAVEMENT
PWD	PLYWOOD
PWJ	PLYWOOD WEB JOIST
PZ	PIEZOMETER
Q	RATE OF FLOW
QT	QUARRY TILE
QTR	QUARTER
QTY	QUANTITY
QUAL	QUALITY
R&R	REMOVE AND REPLACE
R&S	REMOVE AND SALVAGE
R	RADIUS, REGISTER, RISER
RA	RETURN AIR
RB	RESILIENT BASE, ROCK BERM
RCPT	RECEPTACLE
RD	ROOF DRAIN
REC	RECESS
RECD	RECEIVED
RECT	RECTANGULAR
RED	REDUCER
REF	REFERENCE
REINF	REINFORCING
REM	REMOVE
REQD	REQUIRED
RESIL	RESILIENT
RET	RETAINING, RETURN
REV	REVISION, REVERSE
RF	RESILIENT FLOORING
RFG	ROOFING
RFL	REFLECTED, REFLECTOR
RGH	ROUGH
RGS	RIGID GALVANIZED STEEL
RH	RELIEF HOOD, RIGHT HAND, RELATIVE HUMIDITY
RL	REQUIRED LAP
RLFA	RELIEF AIR
RND	ROUND
RNG	RUNNING
RO	ROUGH OPENING
ROW	RIGHT-OF-WAY
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RSP	ROCK SLOPE PROTECTION
RT	RIGHT
RVT	RESILIENT VINYL TILE
RY	READY
S	SOUTH, SINK
SA	SUPPLY AIR
SAMU	SOUND-ABSORBING MASONRY UNIT
SAN	SANITARY
SB	SPLASH BLOCK
SC	SOLID CORE
SCH	SCHEDULE
SCHEM	SCHEMATIC
SCN	SCREEN
SE	STEEL/ALUMINUM EDGE
SEC	SECONDARY, SECONDS
SECT	SECTION
SEP	SEPARATE
SF	SQUARE FOOT, SILT FENCE
SG	SHEET GLASS, SEALANT GROOVE
SH	SHOWER
SHT	SHEET
SHTG	SHEATHING
SIL	SILENCE
SIM	SIMILAR
SJ	SLAB JOINT
SL	SLOPE, STEEL LINTEL
SLTD	SLOTTED
SLV	SLEEVE
SMLS	SEAMLESS
SOG	SLAB ON GRADE
SP	SOUNDPROOF, STANDPIPE
SPA	SPACING
SPEC	SPECIFICATION
SPLY	SUPPLY
SPST	SINGLE POLE SINGLE THROW
SPT	SET POINT
SQ	SQUARE
SR	SHORT RADIUS
SS	SERVICE SINK
SST	STAINLESS STEEL
ST	STREET
STA	STATION
STD	STANDARD
STIF	STIFFENER
STIR	STIRRUP
STL	STEEL
STOR	STORAGE
STR	STRUCTURAL, STRAIGHT
SUB	SUBSTITUTE
SUC	SUCTION
SUSP	SUSPENDED
SY	SQUARE YARD
SYM	SYMBOL
SYMM	SYMMETRICAL
SYN	SYNTHETIC
SYS	SYSTEM
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
T	TILE, TREAD
TA	TOILET ACCESSORY, TEMPERED AIR
TAN	TANGENT
TBM	TEMPORARY BENCHMARK
TCE	TEMPORARY CONSTRUCTION EASEMENT
TEF	TROWELED EPOXY FLOORING
TEMP	TEMPORARY, TEMPERATURE
THD	THREAD
THK	THICK
THRESH	THRESHOLD
TKBD	TACK BOARD
TOB	TOP OF BOLT, TOP OF BANK, TOP OF BEAM, TOP OF BERM
TOC	TOP OF CURB, TOP OF CONCRETE
TOD	TOP OF DUCT
TOF	TOP OF FOOTING
TOG	TOP OF GRATING
TOL	TOLERANCE, TOP OF LEDGER
TOM	TOP OF MASONRY
TOP	TOP OF PLATE
TOPO	TOPOGRAPHY
TOS	TOP OF SLAB, TOP OF STEEL, TOE OF SLOPE
TOW	TOP OF WALL
TP	TOILET PARTITION, TELEPHONE POLE, TOE PLATE, TRAP PRIMER
TPD	TOILET PAPER DISPENSER
TPG	TOPPING, THROUGH PLATE GIRDER
TR	TRANSOM
TRANS	TRANSITION
TRD	TRENCH DRAIN
TYP	TYPICAL
U	URINAL
UG	UNDERGROUND
ULT	ULTIMATE
UNFN	UNFINISHED
UNO	UNLESS NOTED OTHERWISE
UTIL	UTILITY
V	VENT, VELOCITY, VOLT
VA	VOLT AMPERE
VAC	VACUUM
VAR	VARNISH, VARIABLE, VOLT AMPERES REACTIVE
VB	VAPOR BARRIER, VINYL BASE, VALVE BOX
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VCT	VINYL COMPOSITION TILE, VERTICAL CENTERLINE
VEL	VELOCITY
VENT	VENTILATION
VERT	VERTICAL
VERTS	VERTICAL REINFORCING
VG	VERTICAL GRAIN
VIF	VERIFY IN FIELD
VIN	VINYL
VOL	VOLUME
VPC	VERTICAL POINT OF CURVATURE
VPI	VERTICAL POINT OF INTERSECTION
VPT	VERTICAL POINT OF TANGENCY
VS	VERSUS, VAPOR SEAL
VTR	VENT THROUGH ROOF
VWC	VINYL WALL COVERING
W/	WITH
W/O	WITHOUT
W	WATT, WEST, WIDE, WINDOW, WIRE, WIDE FLANGE BEAM
WB	WOOD BASE
WC	WATER CLOSET, WATER COLUMN
WD	WOOD, WIDTH
WF	WIDE FLANGE, WASH FOUNTAIN
WG	WIRE GLASS, WATER GAGE
WH	WALL HYDRANT, WEEP HOLE
WI	WROUGHT IRON
WL	WATER LEVEL
WLD	WELDED
WM	WIRE MESH
WP	WEATHERPROOF
WS	WATERSTOP, WATER SURFACE
WSCT	WAINSCOT
WT	WEIGHT, WATER TIGHT
WTHP	WATERPROOF, WORKING POINT
WWF	WELDED WIRE FABRIC
XP	EXPLOSION-PROOF
XS	EXTRA STRONG
XSECT	CROSS SECTION
XXS	DOUBLE EXTRA STRONG
YH	YARD HYDRANT
YS	YIELD STRENGTH

GENERAL NOTES:

1. THESE ABBREVIATIONS APPLY TO THE ENTIRE SET OF CONTRACT DRAWINGS.
2. LISTING OF ABBREVIATIONS DOES NOT IMPLY THAT ALL ABBREVIATIONS ARE USED IN THE CONTRACT DRAWINGS.
3. ABBREVIATIONS SHOWN ON THIS SHEET INCLUDE VARIATIONS OF A WORD. FOR EXAMPLE, "MOD" MAY MEAN MODIFY OR MODIFICATION; "INC" MAY MEAN INCLUDED OR INCLUDING AND "REINF" MAY MEAN EITHER REINFORCE OR REINFORCING.
4. SEE INSTRUMENTATION LEGEND SHEET FOR PROJECT-SPECIFIC EQUIPMENT SYMBOLS, EQUIPMENT ABBREVIATIONS, AND PIPING SYSTEM ABBREVIATIONS.

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ISSUE	DATE	DESCRIPTION
A	07/02/2025	PRELIMINARY 30% DRAFT SUBMITTAL

PROJECT MANAGER: WILL FULLER
DESIGNED BY: LUKE R. CRESSMAN
DRAWN BY: PHILIP MCINTIRE
CHECKED BY: SCOTT MCCOY
PROJECT NUMBER: 10426190

30% SUBMITTAL PRELIMINARY

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ENGINEER: LUKE CRESSMAN
LICENSE NO.: 055975
DATE: 07/02/2025

TOWN OF HOLDEN BEACH PIER REPLACEMENT

GENERAL ABBREVIATIONS

FILENAME: G-02.dwg
SCALE: AS NOTED
SHEET: G-02

1 2 3 4 5 6 7 8

MATERIALS IN PLAN/SECTION

- ASPHALT (PLAN OR SMALL-SCALE SECTION)
- ASPHALT (LARGE-SCALE SECTION)
- CHECKERED PLATE (PLAN)
- CONCRETE (PLAN AND/OR SECTION)
- DEMOLITION (PLAN AND/OR SECTION)
- EARTH (SECTION)
- FILTER POINT MAT (PLAN)
- TIMBER (SECTION)
- GRANULAR FILL (SECTION)
- GRATING (SECTION)
- GRATING (PLAN)
- GROUT (SECTION)
- METAL (SECTION)
- PLYWOOD (LARGE-SCALE SECTION)
- PLYWOOD (SMALL-SCALE SECTION)
- PRECAST CONCRETE (PLAN AND/OR SECTION)
- RIPRAP (PLAN AND/OR SECTION)
- SAND (SECTION)
- SOD (SECTION)
- WOOD - CONTINUOUS (SECTION)
- WOOD BLOCKING (SECTION)
- EXISTING WETLANDS

GENERAL SYMBOLOGY

ARROW INDICATES DIRECTION OF PLAN NORTH
N N
NORTH ARROW

PLAN
1/4" = 1'-0"
PLAN TITLE

ARROW INDICATES DIRECTION OF SECTION CUT
SECTION LETTER
X XXX X XXX
SHEET WHERE SECTION IS LOCATED
FULL BUILDING SECTION CUT MARKER

SECTION LETTER
FLAG INDICATES DIRECTION OF SECTION CUT
X XXX
SHEET WHERE SECTION IS LOCATED
SECTION CUT MARKER

SECTION LETTER
X XXX SECTION
3/8" = 1'-0"
SHEET WHERE SECTION VIEW IS FIRST CUT *
SECTION TITLE

DETAIL NUMBER
XXX
SHEET WHERE DETAIL IS LOCATED *
DETAIL MARKER
FOR REFERENCING DETAILS INCLUDED IN DRAWING SET.

XXXXXX
DETAIL MARKER
FOR REFERENCING DETAILS BOUND IN SPECIFICATIONS OR SEPARATE VOLUME.

DETAIL NUMBER
X XXX DETAIL
1/4" = 1'-0"
SHEET WHERE DETAIL IS LOCATED *
DETAIL TITLE

* EXCEPTIONS WHERE THE SHEET NUMBER IS REPLACED BY A DASH (-).
1) FOR COMMON DETAILS, SECTIONS, ELEVATIONS OR DETAILS THAT ARE CUT OR CALLED OUT ON MULTIPLE SHEETS.
2) SECTIONS, ELEVATIONS OR DETAILS THAT ARE LOCATED ON THE SAME SHEET THEY ARE CUT OR CALLED OUT ON.

X XXX X XXX
INTERIOR EXTERIOR
ARROW INDICATES POINT OF VIEW
ELEVATION NUMBER
SHEET WHERE ELEVATION IS LOCATED *
SINGLE ELEVATION OR PHOTO MARKER

X X X X XXX
ELEVATION NUMBER
ARROW INDICATES POINT OF VIEW ELEVATION
INDICATES SHEET WHERE ELEVATION IS LOCATED
MULTIPLE ELEVATION OR PHOTO MARKER

ELEVATION IDENTIFICATION NUMBER
X XXX ELEVATION
3" = 1'-0"
SHEET WHERE POINT OF VIEW MARKER CAN BE FOUND *
ELEVATION TITLE

TARGET ELEVATION

ARCHITECTURAL

- ROOM NAME XX-XX — ROOM NUMBER
- XXX X — DOOR NUMBER
- A — COLUMN GRID LINE
- X — WALL TYPE
- X — WINDOW TYPE
- X — LOUVER
- X — ACCESSORY, FURNITURE, AND MISCELLANEOUS EQUIPMENT IDENTIFIER

KEY NOTE DESIGNATION
\# KEY NOTE NUMBER

GENERAL LINE SYMBOLOGY

- 4-HOUR FIRE RATED WALL
- 3-HOUR FIRE RATED WALL
- 2-HOUR FIRE RATED WALL
- 1-HOUR FIRE RATED WALL
- COLUMN GRID LINE/CENTERLINE

SHEET NAMING CONVENTION

AREA DESIGNATION

TO BE EDITED ON AN A PROJECT BASIS. TO BE DETERMINED BY THE PROJECT MANAGER, THEN ADDED TO THE GENERAL LEGEND.

EXAMPLE:
01 BUILDING OR AREA NAME
02 BUILDING OR AREA NAME
03 BUILDING OR AREA NAME

DISCIPLINE DESIGNATOR & DISCIPLINE ORDER

G	GENERAL
V	SURVEYING/MAPPING
X	DEMOLITION
C	CIVIL
L	LANDSCAPING
U	MULTI-DISCIPLINE
S	STRUCTURAL
A	ARCHITECTURAL
D	PROCESS
M	MECHANICAL (HVAC)
P	PLUMBING
F	FIRE PROTECTION
E	ELECTRICAL
Y	INSTRUMENTATION

DRAWING TYPE DESIGNATOR

0	GENERAL (SYMBOLS, LEGENDS)
1	PLANS
2	ELEVATIONS
3	SECTIONS
4	LARGE SCALE VIEWS
5	DETAILS
6	SCHEDULES AND DIAGRAMS
8	PROFILES
9	3D REPRESENTATIONS

EXAMPLE

GRAVITY THICKENER ARCHITECTURAL SECTION, SHEET 01

0	2					AREA 02
AREA DESIGNATION						
		A				ARCHITECTURAL DISCIPLINE
DISCIPLINE DESIGNATOR						
			3			SECTION SHEET TYPE
SHEET TYPE DESIGNATOR						
				0	1	SHEET NUMBER 01
SHEET NUMBER						
0	2	A	3	0	1	
SAMPLE SHEET NUMBER						

CIVIL MAPPING SYMBOLOGY

- EMBANKMENT SLOPE (CUT)
- EMBANKMENT SLOPE (FILL)
- H:V EMBANKMENT SLOPE RIGHT ARROW RIGHT
- H:V EMBANKMENT SLOPE LEFT ARROW LEFT
- 123 SPOT ELEVATION/POINT #
- SURVEY BENCHMARK
- CP-X SURVEY CONTROL POINT
- HORIZONTAL CONTROL POINT
- VERTICAL CONTROL POINT
- SECTION CORNER MONUMENT
- SECTION CORNER NO MONUMENT
- X IDENTIFICATION AND APPROXIMATE LOCATION OF SOIL TEST HOLE
- X TEST PIT
- X SOIL BORING
- BUOY
- FLOW ARROW
- WATER LEVEL IN SECTION/PROFILE
- TIDE GAUGE
- EXISTING UTILITY POLE
- DOWNGUY
- J X EXTERIOR UTILITY JUNCTION BOX
- XXX STATE HIGHWAY SYMBOL
- HAY BALE SILT CHECK
- TEMPORARY SEDIMENT TRAP
- X PIEZOMETER
- SIGN
- In TIRE TREDDLE
- TRAFFIC ARM WITH CARD READER
- TRAFFIC ARM MECHANICAL SWING

UTILITY/CIVIL LINE SYMBOLOGY

- PIPELINE
- LARGE PIPELINE
- UTILITY BENEATH STRUCTURE
- RAILROAD
- CENTERLINE
- BOTTOM OF DITCH
- PROPERTY LINE
- EASEMENT
- LIMITS OF CONSTRUCTION
- ROW
- EXISTING CONTOUR (MINOR)
- 25 EXISTING CONTOUR W/ELEVATION (MAJOR)
- X X EXISTING FENCE
- EXISTING VEGETATION/BRUSH LINE
- X FENCE - BARB WIRE
- FENCE - CHAIN LINK
- FENCE - FIELD
- X X FENCE - OTHER
- FENCE - WOOD
- XX FENCE - WOVEN WIRE
- FLOOD LIMIT (25 YEAR)
- FLOOD LIMIT (50 YEAR)
- FLOOD LIMIT (100 YEAR)
- FLOOD LIMIT (200 YEAR)
- FLOOD LIMIT (500 YEAR)
- HIGHWAY GUARDRAIL
- LEVEE TOP
- LEVEE TOE
- NEW CONTOUR (MINOR)
- 25 NEW CONTOUR (MAJOR)
- RB ROCK BERM
- SF SILT FENCE
- TOE OF SLOPE
- TOP OF SLOPE

D C B A

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DESIGNED BY	LUKE R. CRESSMAN
DRAWN BY	PHILIP MCINTIRE
CHECKED BY	SCOTT MCCOY
PROJECT NUMBER	10426190

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LICENSE NO.: 055975
DATE: 07/02/2025

OFFICIAL SEAL Town Of Holden Beach, NC

TOWN OF HOLDEN BEACH
PIER REPLACEMENT

LEGEND & SYMBOLOGY

FILENAME	G-03.dwg
SCALE	AS NOTED

SHEET G-03

1
OVERALL EXISTING SITE PLAN
1" = 40'

40' 0 40' 80'
SCALE: 1" = 40'

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TOWN OF HOLDEN BEACH PIER REPLACEMENT

OVERALL EXISTING SITE PLAN

FILENAME C-01.dwg
SCALE AS NOTED
SHEET C-01

TIMBER PIER WORKING POINTS		
POINT ID	NORTHING	EASTING
A	59398.2221	2213201.0059
B	59399.2419	2213216.9733
C	58453.1695	2213277.3961
D	58454.1893	2213293.3635
E	58406.2869	2213296.4229
F	58403.2275	2213248.5205
G	58451.1299	2213245.4611
H	58452.1437	2213261.3353

1 PROPOSED SITE IMPROVEMENT AND DEMOLITION PLAN

1" = 40'

40' 0 40' 80'

SCALE: 1" = 40'

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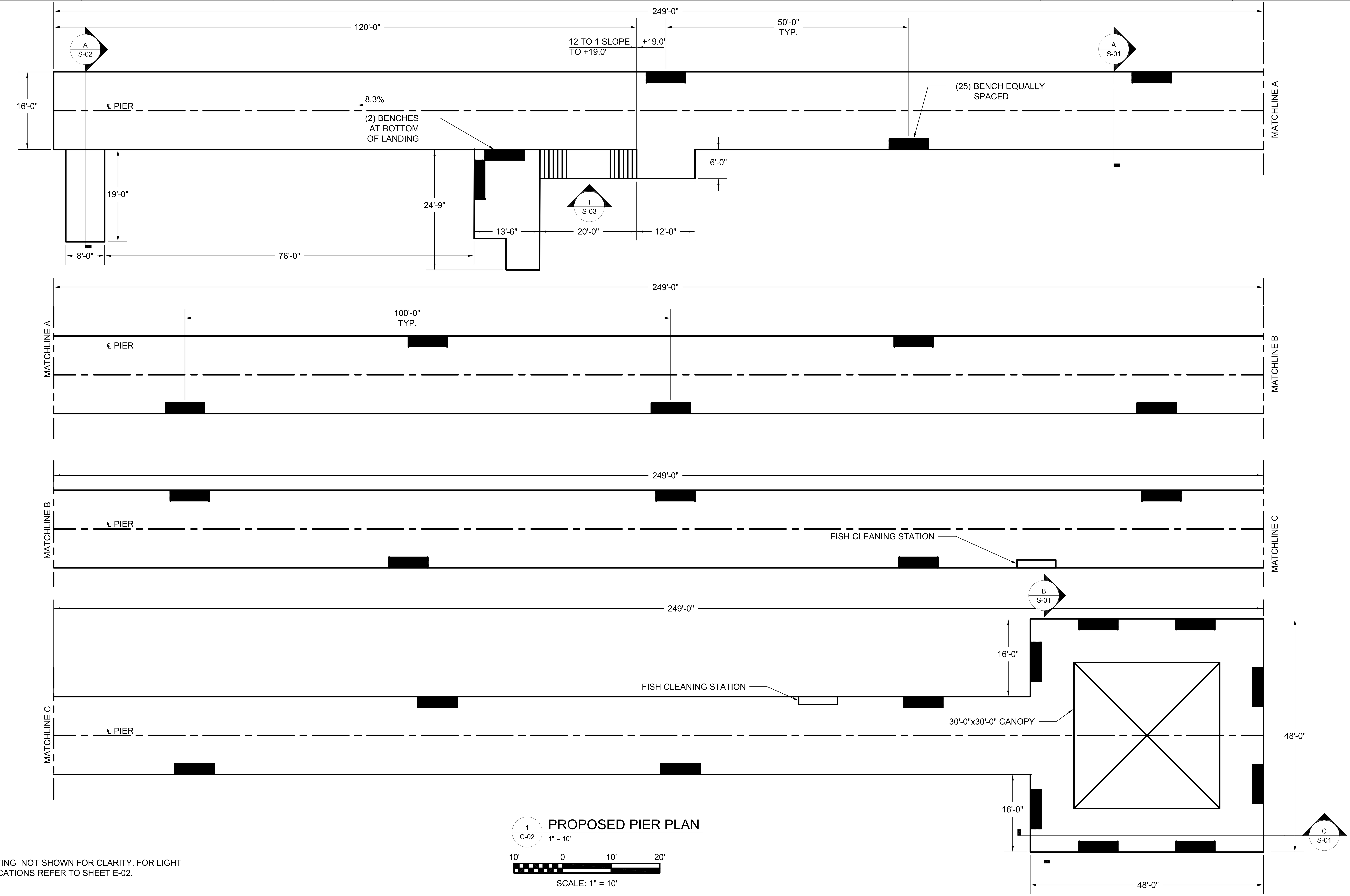
TOWN OF HOLDEN BEACH
PIER REPLACEMENT

PROPOSED SITE IMPROVEMENTS & DEMOLITION PLAN

FILENAME C-02.dwg
SCALE AS NOTED
SHEET C-02



1
C-02
PROPOSED PIER PLAN
1" = 10'

NOTES:
1. ELECTRICAL LIGHTING NOT SHOWN FOR CLARITY. FOR LIGHT FIXTURES AND LOCATIONS REFER TO SHEET E-02.

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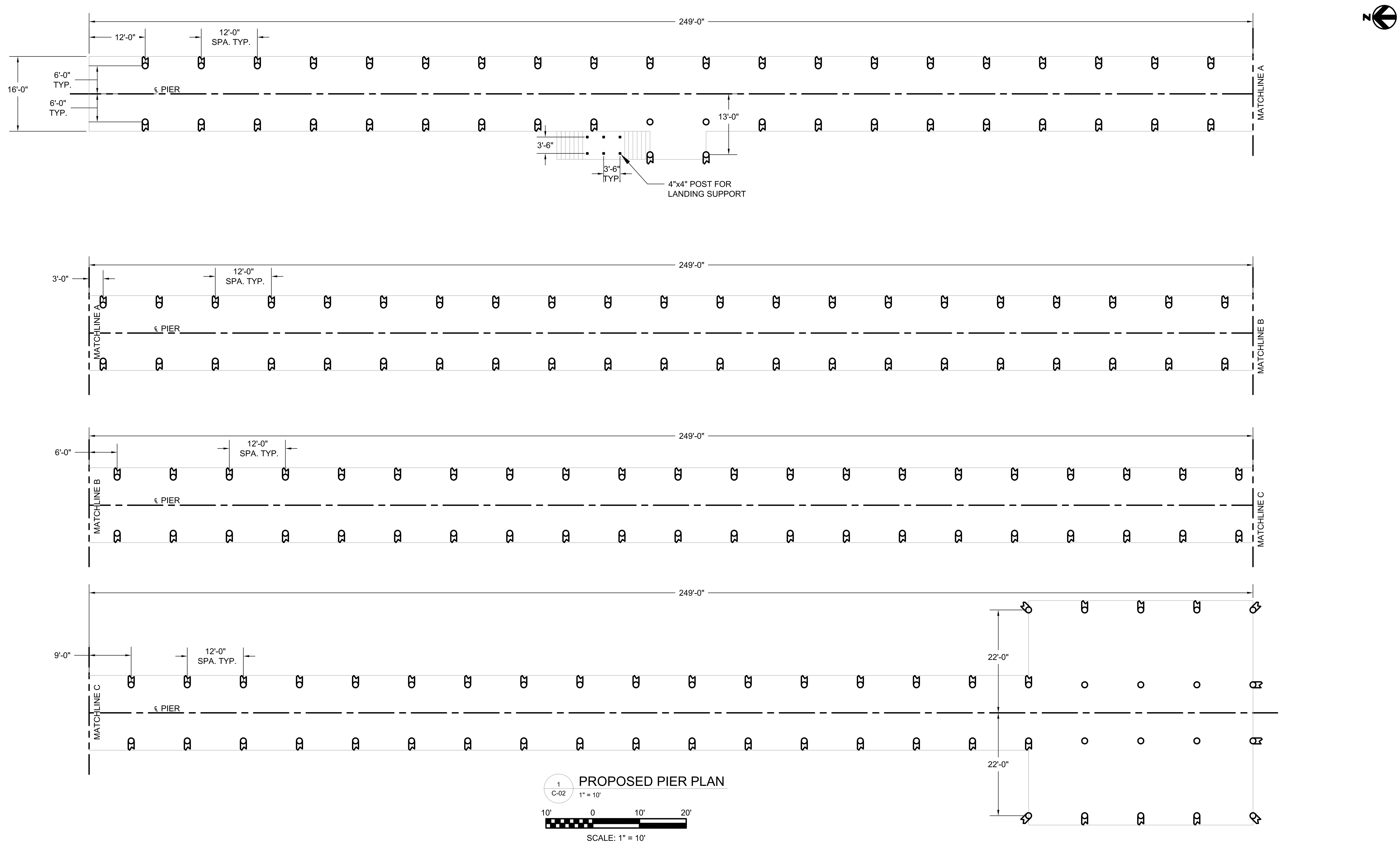
TOWN OF HOLDEN BEACH
PIER REPLACEMENT

PROPOSED PIER PLAN

FILENAME	C-03.dwg
SCALE	AS NOTED
SHEET	C-03



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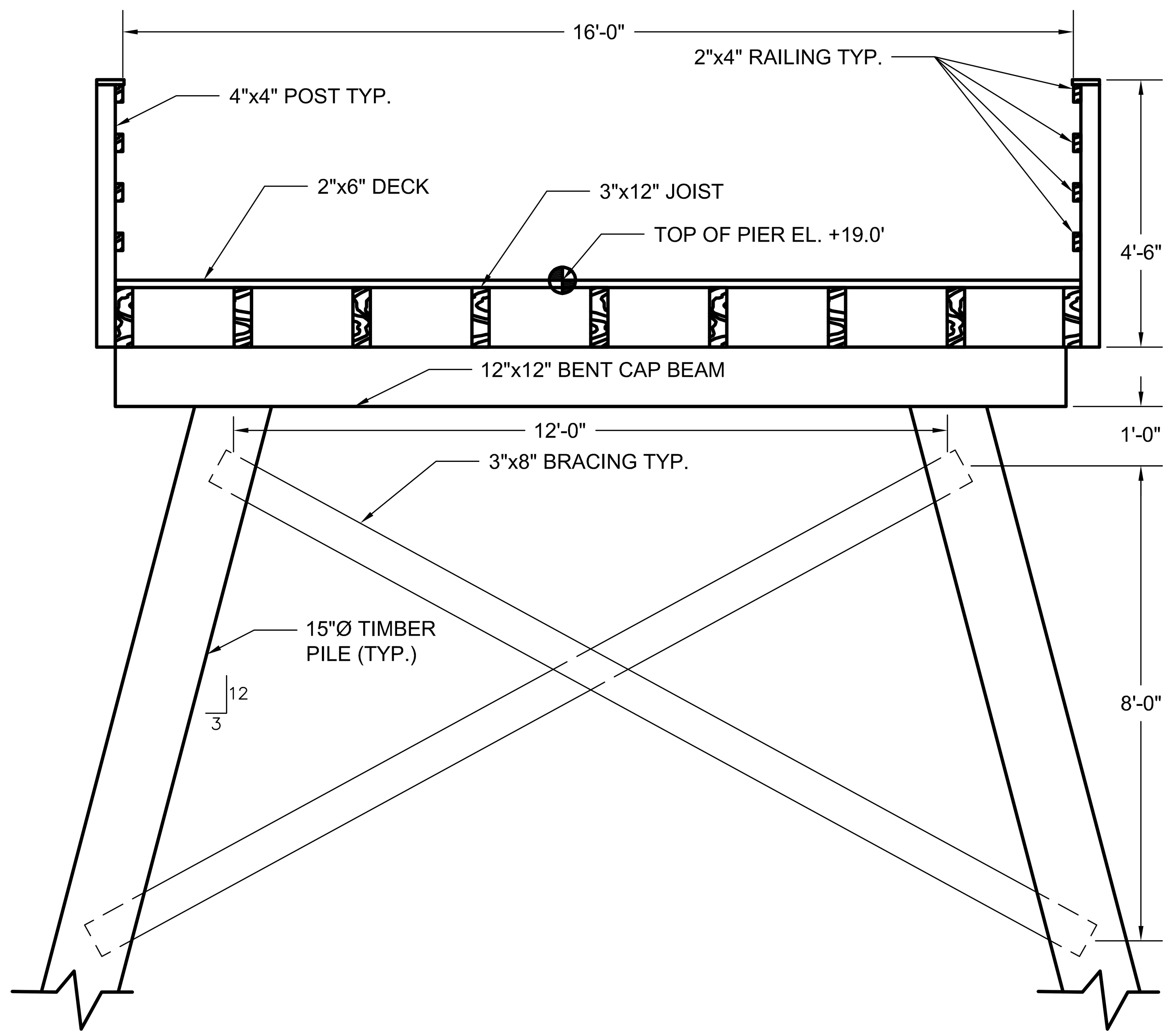
TOWN OF HOLDEN BEACH
PIER REPLACEMENT

PROPOSED PIER PILE PLAN

FILENAME C-04.dwg
SCALE AS NOTED
SHEET C-04

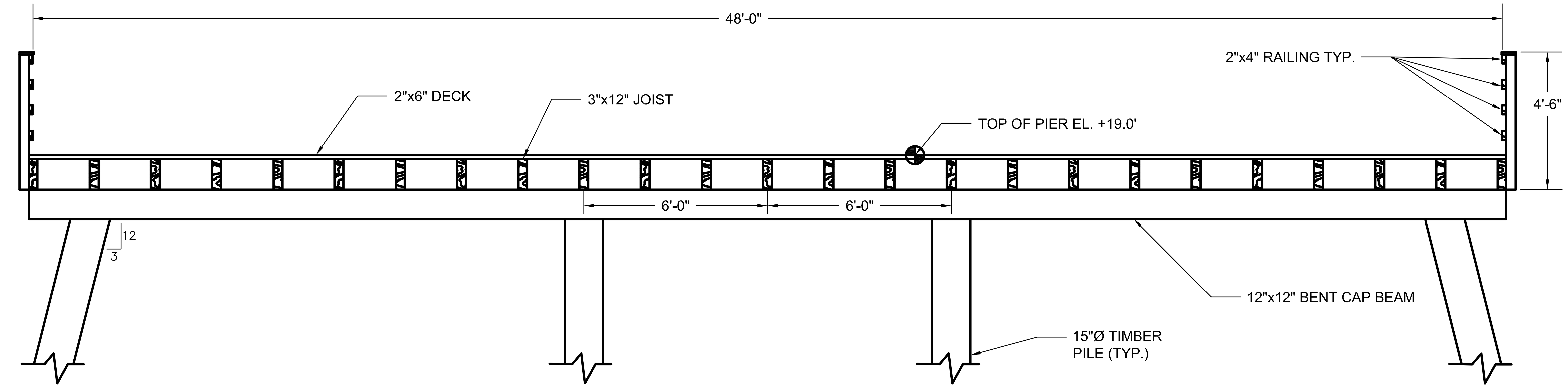


A / C-03 TYPICAL PIER BENT SECTION

1/2" = 1'

0 1' 2' 4'

SCALE: 1/2" = 1'-0"

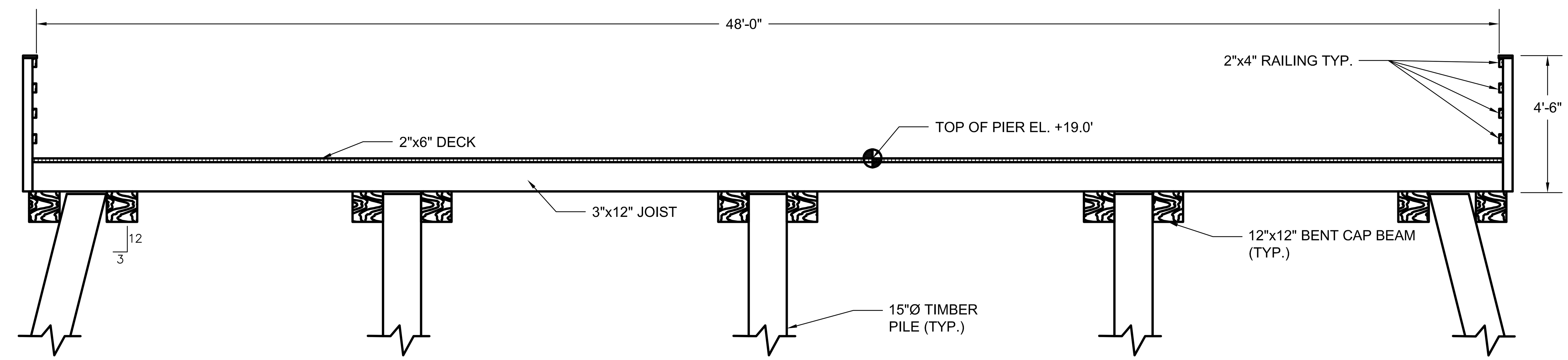


B / C-03 TYPICAL T-HEAD PIER SECTION

3/8" = 1'

0 2' 4' 6'

SCALE: 3/8" = 1'-0"

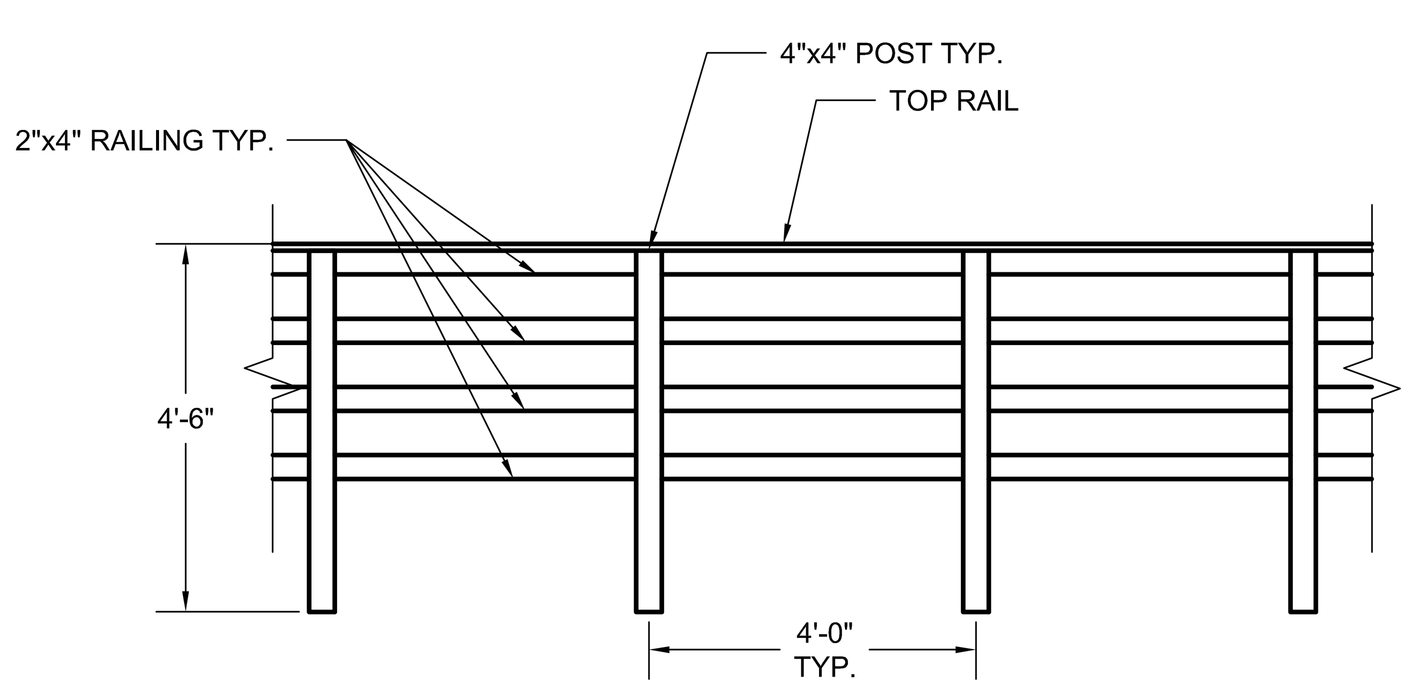


C / C-03 TYPICAL T-HEAD PIER SECTION

3/8" = 1'

0 2' 4' 6'

SCALE: 3/8" = 1'-0"



1 / - TYPICAL PIER RAILING ELEVATION

1/2" = 1'

0 1' 2' 4'

SCALE: 1/2" = 1'-0"

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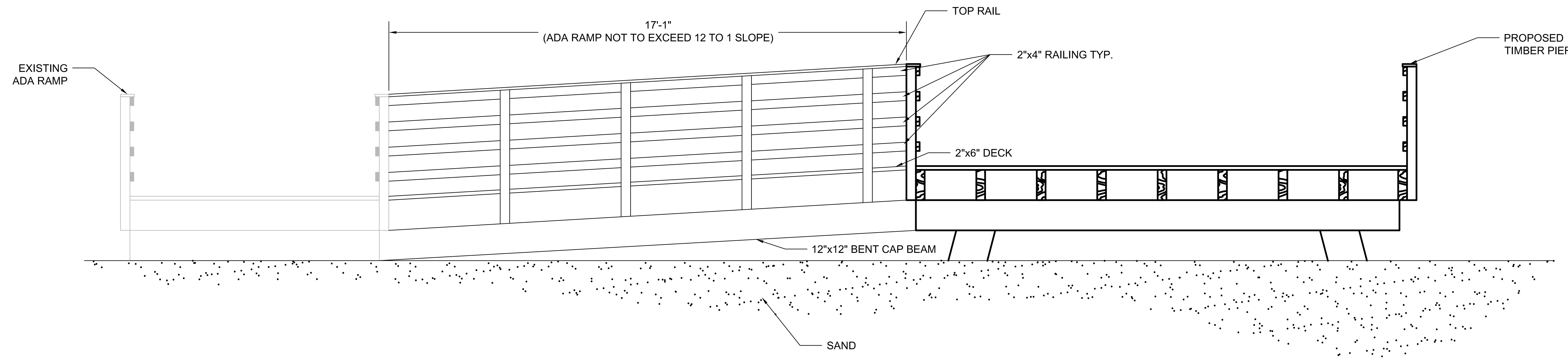
TOWN OF HOLDEN BEACH PIER REPLACEMENT

TYPICAL PIER SECTION

FILENAME S-01.dwg

SCALE AS NOTED

SHEET S-01



A
C-03
ADA RAMP SECTION
1/2" = 1'

0 1' 2' 4'
SCALE: 1/2" = 1'-0"

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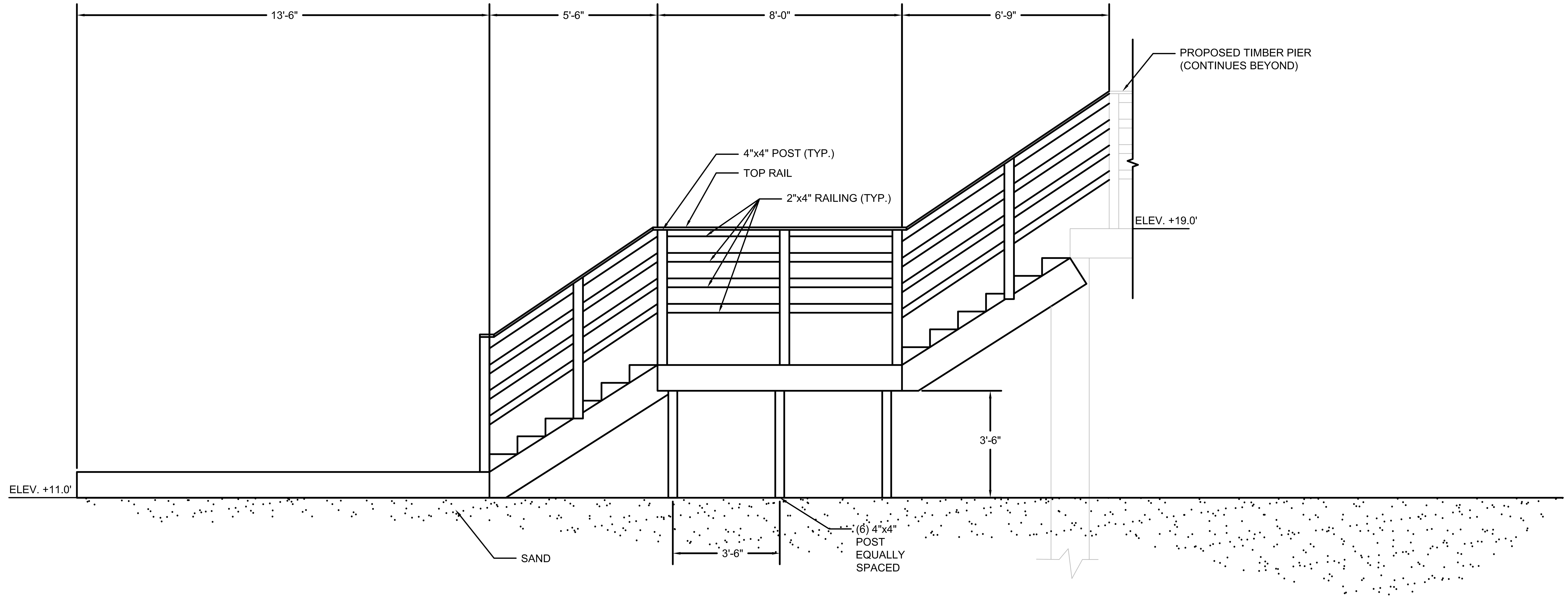
ENGINEER: LUKE CRESSMAN
LICENSE NO.: 055975
DATE: 07/02/2025

OFFICIAL SEAL Town Of Holden Beach, NC

TOWN OF HOLDEN BEACH
PIER REPLACEMENT

ADA RAMP SECTION

FILENAME	S-02.dwg
SCALE	AS NOTED
SHEET	S-02



STAIRCASE WITH LANDING ELEVATION

1 / C-03

1/2" = 1'

0 1' 2' 4'

SCALE: 1/2" = 1'-0"

HDR

HDR Engineering, INC
101 North 3rd St. Suite 201
Wilmington, NC28401
(904) 398-9020
N.C.B.E.L.S. License# F-0116

ISSUE	DATE	DESCRIPTION
A	07/02/2025	PRELIMINARY 30% DRAFT SUBMITTAL

PROJECT MANAGER	WILL FULLER
DESIGNED BY	LUKE R. CRESSMAN
DRAWN BY	PHILIP MCINTIRE
CHECKED BY	SCOTT MCCOY
PROJECT NUMBER	10426190

30% SUBMITTAL
PRELIMINARY

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ENGINEER: LUKE CRESSMAN
LICENSE NO.: 055975
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OFFICIAL SEAL
Town Of Holden Beach, NC

TOWN OF HOLDEN BEACH
PIER REPLACEMENT

STAIRCASE WITH LANDING ELEVATION

FILENAME S-03.dwg
SCALE AS NOTED
SHEET S-03

ONE-LINE, POWER, AND LIGHTING SYMBOLOGY

X 20A 3P — LOW VOLTAGE CIRCUIT BREAKER (CB). RATING AND NO. OF POLES AS SHOWN. WHEN SPECIFIC TYPE, OTHER THAN MCCB, IS REQUIRED, X INDICATES TYPE.

X 100AF 80AT 3P

TYPES
- MCCB - MOLDED CASE
- ICCB - INSULATED CASE
- LVP - LOW VOLTAGE POWER
- MCP - MOTOR CIRCUIT PROTECTOR (RATING PER CONNECTED LOAD)

TRIP UNIT
- L - LONG TIME PICKUP
- S - SHORT TIME PICKUP
- I - INSTANTANEOUS PICKUP
- G - GROUND FAULT PICKUP
- A - ARC ENERGY REDUCTION MODE

X — INTERLOCK: X - INDICATES TYPE

TYPES
- E - ELECTRICAL
- M - MECHANICAL
- K - KEY

GFP — GROUND FAULT PROTECTION

52 — MEDIUM VOLTAGE CIRCUIT BREAKER

FUSE, RATING, AND NUMBER OF FUSES AS NOTED

FUSED CUTOUT, CURRENT RATING, FUSE RATING, AND QUANTITY AS NOTED

FUSIBLE SWITCH, CURRENT RATING, FUSE RATING, AND QUANTITY AS NOTED (3 POLE UON)

NON-FUSED SWITCH, CURRENT RATING, AND NUMBER OF POLES AS NOTED (3 POLE UON)

DISCONNECT OR DRAWOUT CONNECTION

A B — MAGNETIC MOTOR STARTER

A B — SEPARATELY MOUNTED COMBINATION MAGNETIC MOTOR STARTER AND DISCONNECT

D — MOTOR/LOAD CONTROLLER

D — SEPARATELY MOUNTED MOTOR/LOAD CONTROLLER WITH SHORT CIRCUIT PROTECTION AND DISCONNECT

MOTOR STARTER AND CONTROLLER SUBSCRIPTS
- A - MAGNETIC STARTER NEMA SIZE
- B - STARTER TYPE
- NONE - FULL VOLTAGE NON-REVERSING (FVNR)
- FVR - FULL VOLTAGE REVERSING
- 2S - TWO SPEED
- RVAT - REDUCED VOLTAGE AUTO TRANSFORMER
- C - CONTROL DIAGRAM OR CONTROLS SCHEDULE NUMBER (IF REQUIRED)
- D - CONTROLLER TYPE
- VFD - VARIABLE FREQUENCY DRIVE
- SS - SOLID STATE
- CONT - CONTACTOR

SEPARATELY MOUNTED COMBINATION MOTOR STARTER OR CONTROLLER; SEE ELECTRICAL ONE - LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION

SEPARATELY MOUNTED MOTOR STARTER OR CONTROLLER; SEE ELECTRICAL ONE-LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION

X — NON-FUSED SAFETY SWITCH, 30A, 3P, X INDICATES AMP RATING GREATER THAN 30A

X Y — FUSED SAFETY SWITCH, 3P, X INDICATES AMP RATING GREATER THAN 30A, Y INDICATES FUSE SIZE

CB — SEPARATELY MOUNTED CIRCUIT BREAKER; SEE ELECTRICAL ONE - LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION

7 1/2 / HP — MOTOR WITH DESIGN HORSEPOWER (WHEN INDICATED)

G — GENERATOR

ATS — TRANSFER SWITCH, CURRENT RATING, AND NUMBER OF POLES AS NOTED
- ATS - AUTOMATIC
- MTS - MANUAL

TRANSFORMER
- 3-PHASE, 3-WIRE DELTA CONNECTION
- 3-PHASE, 4-WIRE GROUNDED WYE CONNECTION

LP100 208/120V 3Ø, 4W — SWITCHBOARD OR PANELBOARD; NAME, VOLTAGE, PHASE, NUMBER OF WIRES WHEN INDICATED

100 KVA — NON-MOTOR LOAD WITH DESIGN KVA, KW, OR AMP

VOLTAGE TRANSFORMER (VT, PT, OR CPT)

CURRENT TRANSFORMER (CT)

WH — UTILITY WATT-HOUR METER PER UTILITY REQUIREMENTS

DMP — DIGITAL METERING PACKAGE

GROUND

LIGHTNING ARRESTER

SPD — LOW VOLTAGE SURGE PROTECTIVE DEVICE

SS — SELECTOR SWITCH

PB — PUSHBUTTON

IC — INSTRUMENTATION / CONTROL DEVICE

SV — SOLENOID VALVE

CONTROL PANEL INTEGRAL OR PROVIDED WITH ASSOCIATED EQUIPMENT

CONTROL PANEL WITH DISCONNECT SWITCH INTEGRAL OR PROVIDED WITH ASSOCIATED EQUIPMENT

J OR J — JUNCTION OR PULL BOX

PANELBOARD (250V TO 600V)

PANELBOARD (LESS THAN 250V)

X — ELECTRICAL EQUIPMENT ENCLOSURE: SWITCHBOARD, MOTOR CONTROL CENTER, CONTROL PANEL, TRANSFORMER OR OTHER EQUIPMENT AS INDICATED. ESTIMATED SIZE AS INDICATED. WHEN USED X INDICATES EQUIPMENT TYPE.

EQUIPMENT TYPES
- ATS - AUTOMATIC TRANSFER SWITCH
- CP - CONTROL PANEL
- MTS - MANUAL TRANSFER SWITCH
- MCC - MOTOR CONTROL CENTER
- UPS - UNINTERRUPTIBLE POWER SUPPLY
- VFD - VARIABLE FREQUENCY DRIVE
- SB - SWITCHBOARD
- SG - SWITCHGEAR
- T - TRANSFORMER

PLUG-IN RECEPTACLE STRIP, QUANTITY AND SPACING OF RECEPTACLES AS NOTED OR SPECIFIED

X Y — SPECIAL-PURPOSE RECEPTACLE AS DEFINED ON PLANS

X Y — TWO RECEPTACLES IN 2-GANG BOX UNDER COMMON COVER PLATE

X Y — DUPLEX RECEPTACLE

X Y — SIMPLEX RECEPTACLE

X Y — RECESSED FLOOR MOUNTED BOX, QUANTITY AND TYPE OF RECEPTACLES AS INDICATED

SUBSCRIPTS
- X - INDICATES TYPE
  - GFCI - GROUND FAULT CIRCUIT INTERRUPTER
  - IG - ISOLATED GROUND
  - TR - TAMPER RESISTANT
  - PLH - PLUG LOAD HALF CONTROLLED
  - PLD - PLUG LOAD DUAL CONTROLLED
  - USB - USB CHARGING STATION
  - SPD - SURGE PROTECTIVE DEVICE
- Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD

CONDUIT TURNING UP

CONDUIT TURNING DOWN

(#X) — HOMERUN TO SOURCE (E.G. PANELBOARD, MCC) NUMBER IN PARENTHESES REPRESENTS CONDUCTOR SIZE OTHER THAN #12
- SINGLE PHASE: 2#12, 1#12G IN 3/4"C
- THREE PHASE: 3#12, 1#12G IN 3/4"C

UNLESS OTHERWISE NOTED, CONDUCTOR SIZE IS FOR ENTIRE CIRCUIT, SOURCE TO LAST DEVICE. ALSO, SEE ONE LINE DIAGRAM FOR CIRCUIT REQUIREMENTS

CONDUIT CONNECTION TO EQUIPMENT

CIRCUIT RUN BETWEEN DEVICES EXPOSED IN NON-ARCHITECTURALLY FINISHED AREAS; CONCEALED IN ARCHITECTURALLY FINISHED AREAS. CONDUIT AND CONDUCTOR SIZES SHALL BE THE SAME AS THE HOMERUN FOR THE CIRCUIT.

CONDUIT RUN BETWEEN DEVICES CONCEALED IN NON-ARCHITECTURALLY FINISHED AREAS OR UNDER FLOOR SLAB. CONDUIT AND CONDUCTOR SIZES SHALL BE THE SAME AS THE HOMERUN FOR THE CIRCUIT.

(#X) — CIRCUIT HASH MARKS (WHEN INDICATED); LONG, SHORT, SINGLE DOT, AND DOUBLE DOT REPRESENT PHASE, NEUTRAL, EQUIPMENT GROUND, AND ISOLATED GROUND EQUIPMENT GROUND, RESPECTIVELY. X REPRESENTS CONDUCTOR SIZE OTHER THAN #12 IN 3/4" CONDUIT.

CIRCUIT CONTINUATION

CONDUIT STUBBED OUT AND CAPPED

CORD AND PLUG CONNECTION

XXX XXX — CONDUIT TAG OR CIRCUIT NUMBER - WIRE AND CONDUIT SIZE AS SPECIFIED IN CIRCUIT SCHEDULE ON THE SHEETS

GROUND CABLE

GROUND ROD

Z X Y — CEILING/PENDANT/BOLLARD MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — CEILING/PENDANT/BOLLARD MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED, EMERGENCY (INTERNAL OR EXTERNAL POWER SOURCE AS INDICATED)

Z X Y — WALL MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — WALL MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED, EMERGENCY (INTERNAL OR EXTERNAL POWER SOURCE AS INDICATED)

Z X Y — WALL MOUNTED FLOOD LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — POLE/STANCHION MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — POLE/STANCHION MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED, EMERGENCY (INTERNAL OR EXTERNAL POWER SOURCE AS INDICATED

Z X Y — POLE/STANCHION MOUNTED FLOOR LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — CEILING/PENDANT MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — WALL MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED

Z X Y — CEILING/PENDANT MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED, ALL OR PARTIAL EMERGENCY (INTERNAL OR EXTERNAL POWER SOURCE AS INDICATED

Z X Y — WALL MOUNTED LUMINAIRE, LAMP TYPE AS SPECIFIED, ALL OR PARTIAL EMERGENCY (INTERNAL OR EXTERNAL POWER SOURCE AS INDICATED

X Y — EMERGENCY LIGHT, NUMBER OF ATTACHED HEADS AS SHOWN

X Y — EMERGENCY LIGHT, REMOTE MOUNTED HEAD

X Y — DOUBLE-FACED CEILING OR WALL MOUNTED EXIT LIGHT; DIRECTIONAL ARROWS (IF REQUIRED) AS INDICATED ON PLANS

X Y — SINGLE-FACED CEILING OR WALL MOUNTED EXIT LIGHT; DIRECTIONAL ARROWS (IF REQUIRED) AS INDICATED ON PLANS

LIGHTING FIXTURE SUBSCRIPTS
- X - INDICATES LUMINAIRE TYPE PER LUMINAIRE SCHEDULE
- Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD
- Z - INDICATES CONTROLLING SWITCH (IF REQUIRED)
- NL - NIGHT LIGHT UNSWITCHED

X — ROOM/AREA LIGHTING CONTROL TYPE, SEE LIGHTING CONTROL SCHEDULE FOR REQUIREMENTS

2 a — LOW VOLTAGE DIGITAL WALL SWITCH, NUMBER INDICATES QUANTITY OF PUSH BUTTONS PER SINGLE GANG PLATE, LETTER INDICATES CONTROL ZONE WHEN SHOWN

$ Y X — WALL SWITCH

SUBSCRIPTS
- X - INDICATES TYPE
  - NONE - SINGLE POLE
  - 2 - DOUBLE POLE
  - 3 - THREE-WAY
  - 4 - FOUR-WAY
  - K - KEY SWITCH
  - P - PILOT LIGHT
  - L - LIGHTED HANDLE
  - DM - DIMMING
  - MC - MOMENTARY CONTACT
  - T - TIMER
- Y - INDICATES CONTROLLING SWITCH (IF REQUIRED)

$ Y X — MANUAL MOTOR STARTER

SUBSCRIPTS
- X - INDICATES TYPE
  - HP - HORSEPOWER RATED
  - TE - HORSEPOWER RATED WITH
  - FT - THERMAL ELEMENT HORSEPOWER RATED WITH FUSETRON FUSE
- Y - INDICATES SWITCH TYPE
  - NONE - TOGGLE SWITCH TYPE
  - R - ROTARY SWITCH TYPE

PC — PHOTOCELL

TC — TIME CLOCK

$OSX / OSX — LIGHTING CONTROL OCCUPANCY SENSOR, WALL MOUNTED, X INDICATES SPECIFIC TYPE AS SPECIFIED

OSX — LIGHTING CONTROL OCCUPANCY SENSOR, CEILING MOUNTED, X INDICATES SPECIFIC TYPE AS SPECIFIED

COMMUNICATION SYMBOLOGY

- WALL MOUNTED TELEPHONE OUTLET
- WALL MOUNTED DATA OUTLET
- WALL MOUNTED COMBINATION TELEPHONE AND DATA OUTLET
- RECESSED FLOOR MOUNTED TELEPHONE OUTLET
- RECESSED FLOOR MOUNTED DATA OUTLET
- RECESSED FLOOR MOUNTED COMBINATION TELEPHONE AND DATA OUTLET

AUDIO/VISUAL SYMBOLOGY

- TV — TELEVISION OUTLET
- S — CEILING MOUNT SPEAKER
- S X — WALL MOUNT SPEAKER

SPEAKER SUBSCRIPTS
- X - INDICATES HEIGHT

- H — HORN TYPE TRANSDUCER
- VC — VOLUME CONTROL
- PAHE — HEAD END EQUIPMENT
- M — FLOOR MOUNTED MICROPHONE JACK
- M — WALL MOUNTED MICROPHONE JACK

SECURITY SYMBOLOGY

- DOOR POSITION SWITCH
- COMBINATION ELECTRIC DOOR STRIKE AND POSITION SWITCH
- R P — PROXIMITY CARD READER
- R K — PROXIMITY CARD READER WITH KEYPAD
- M — DUAL TECHNOLOGY MOTION DETECTOR
- REQUEST TO EXIT MOTION DETECTOR
- REQUEST TO EXIT PUSH BUTTON
- G — GLASS BREAK DETECTOR
- PTZ — CCTV CAMERA PAN/TILT/ZOOM WHEN INDICATED
- SEC — SECURITY EQUIPMENT CABINET
- R — REMOTE KEYPAD/CONTROL STATION

EMERGENCY ALARM SYMBOLOGY

- E — ALARM BELL
- E — ALARM HORN
- E — ALARM FLASHING LIGHT
- E — ALARM BELL AND FLASHING LIGHT COMBINATION UNIT
- E — ALARM HORN AND FLASHING LIGHT COMBINATION UNIT
- E — PUSHBUTTON OR PULLSTATION

SITE SYMBOLOGY

- EXTERIOR PAD MOUNTED TRANSFORMER
- POLE - MOUNTED TRANSFORMER
- X Y — ELECTRICAL HANDHOLE OR MANHOLE
  - X - INDICATES SEQUENCE NUMBER
  - Y- MHX OR HHX
- X Y — POLE/STANCHION MOUNTED FLOOD LUMINAIRE, LAMP TYPE AS SPECIFIED
- X Y — POLE MOUNTED AREA OR ROADWAY LUMINAIRE, LAMP TYPE AS SPECIFIED
- X Y — HIGH MAST LIGHTING, NUMBER OF LUMINAIRES AS SPECIFIED

LIGHTING FIXTURE SUBSCRIPTS
- X - INDICATES LUMINAIRE TYPE PER LUMINAIRE SCHEDULE
- Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD

- POWER POLE
- DOWNGUY
- E — UNDERGROUND (UNO) ELECTRICAL AND COMMUNICATION SYSTEMS PATHWAY
- OHE — OVERHEAD ELECTRICAL AND COMMUNICATION SYSTEMS PATHWAY

CONTROL SYMBOLOGY

- ELECTRICAL CONNECTION
- or / or — NO ELECTRICAL CONNECTION
- SV or — SOLENOID VALVE
- X Y — CONTROL/RELAY COIL:
  - X-INDICATES TYPE
  - Y-INDICATES LOOP NUMBER, WHEN USED

TYPE
- CR-CONTROL RELAY
- PC-PHOTOCELL
- DP-DEFINITE PURPOSE
- M-MOTOR STARTER
- TC-TIME CLOCK
- LC-LIGHTING CONTACTOR
- TR-TIMING RELAY

- NORMALLY OPEN CONTACT (N.O.)
- NORMALLY CLOSED CONTACT (N.C.)
- MICROPROCESSOR (PLC, RTU, ETC.) OUTPUT
- MICROPROCESSOR (PLC, RTU, ETC.) INPUT
- FIELD WIRING EXTERNAL TO CONTROL PANEL
- NORMALLY OPEN TIME DELAY RELAY CONTACT WITH TIME DELAY ON CLOSING AFTER COIL IS ENERGIZED
- NORMALLY CLOSED TIME DELAY RELAY CONTACT WITH TIME DELAY ON OPENING AFTER COIL IS ENERGIZED
- NORMALLY OPEN TIME DELAY RELAY CONTACT WITH TIME DELAY ON OPENING AFTER COIL IS DE-ENERGIZED
- NORMALLY CLOSED TIME DELAY RELAY CONTACT WITH TIME DELAY ON CLOSING AFTER COIL IS DE-ENERGIZED
- NORMALLY OPEN TEMPERATURE SWITCH; CLOSE ON RISING TEMPERATURE
- NORMALLY CLOSED TEMPERATURE SWITCH; OPEN ON RISING TEMPERATURE
- NORMALLY OPEN FLOW SWITCH; CLOSE ON INCREASING FLOW
- NORMALLY CLOSED FLOW SWITCH; OPEN ON INCREASING FLOW
- NORMALLY OPEN LEVEL SWITCH, CLOSE ON RISING LEVEL
- NORMALLY CLOSED LEVEL SWITCH, OPEN ON RISING LEVEL
- NORMALLY OPEN PRESSURE SWITCH, CLOSE ON INCREASING PRESSURE
- NORMALLY CLOSED PRESSURE SWITCH, OPEN ON INCREASING PRESSURE
- NORMALLY OPEN LIMIT SWITCH, CLOSE ON REACHING LIMIT
- NORMALLY CLOSED LIMIT SWITCH, OPEN ON REACHING LIMIT

CONTROL SYMBOLOGY

- HAND OFF AUTO XOO OOX — 3 POSITION SELECTOR SWITCH, MAINTAINED CONTACTS; UNLESS OTHERWISE NOTED, 2-POSITION SIMILAR
- NORMALLY OPEN PUSHBUTTON, MOMENTARY CONTACT UNLESS OTHERWISE NOTED
- NORMALLY CLOSED PUSHBUTTON, MOMENTARY CONTACT UNLESS OTHERWISE NOTED
- X — INDICATING LIGHT: X INDICATES LENS COLOR
- X — PUSH TO TEST INDICATING LIGHT: X INDICATES LENS COLOR

LENS COLORS
- R - RED / Y - YELLOW
- G - GREEN / W - WHITE
- B - BLUE / A - AMBER

- THERMAL OVERLOAD ELEMENT
- OL (X) — THERMAL OVERLOAD RELAY CONTACT. WHEN SHOWN X INDICATES QUANTITY.
- CPT — CONTROL POWER TRANSFORMER (CPT)
- RTM — RUN TIME METER

GENERAL NOTES

GENERAL NOTES:

1. THIS IS A STANDARD ELECTRICAL SYMBOLOGY SHEET. NOT ALL SYMBOLS MAY BE USED ON THIS PROJECT.
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.
3. SEE P&ID LEGEND SHEET FOR PROJECT SPECIFIC EQUIPMENT SYMBOLS, EQUIPMENT ABBREVIATIONS, AND PIPING SYSTEM ABBREVIATIONS.

HDR

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ISSUE	DATE	DESCRIPTION
A	07/02/2025	PRELIMINARY 30% DRAFT SUBMITTAL

PROJECT MANAGER	WILL FULLER
DESIGNED BY	SCOTT QUIN
DRAWN BY	LOGAN COLONE
CHECKED BY	ARDIT DIMCE
PROJECT NUMBER	10426190

30% SUBMITTAL PRELIMINARY

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ENGINEER: SCOTT QUIN
LICENSE NO.: 24504
DATE: 07/02/2025

OFFICIAL SEAL — Town Of Holden Beach, NC

TOWN OF HOLDEN BEACH PIER REPLACEMENT

UTILITIES - LEGEND AND GENERAL NOTES

FILENAME: E-01.dwg
SCALE: NOT TO SCALE
SHEET: E-01

GENERAL NOTES:

1. HATCHING INDICATES DEMOLITION UNLESS NOTED OTHERWISE.
2. COORDINATE ALL DEMOLITION AND OUTAGES WITH OWNER.

KEYNOTES: #

1. DEMOLISH ALL EXISTING ELECTRICAL DEVICES AND LUMINAIRES ASSOCIATED WITH PIER DEMOLITION.
2. DEMOLISH ALL CONDUIT AND CONDUCTORS BACK TO SOURCE.

1 -

PROPOSED ELECTRICAL SITE IMPROVEMENT AND DEMOLITION PLAN

1" = 40'

40' 0 40' 80'

SCALE: 1" = 40'

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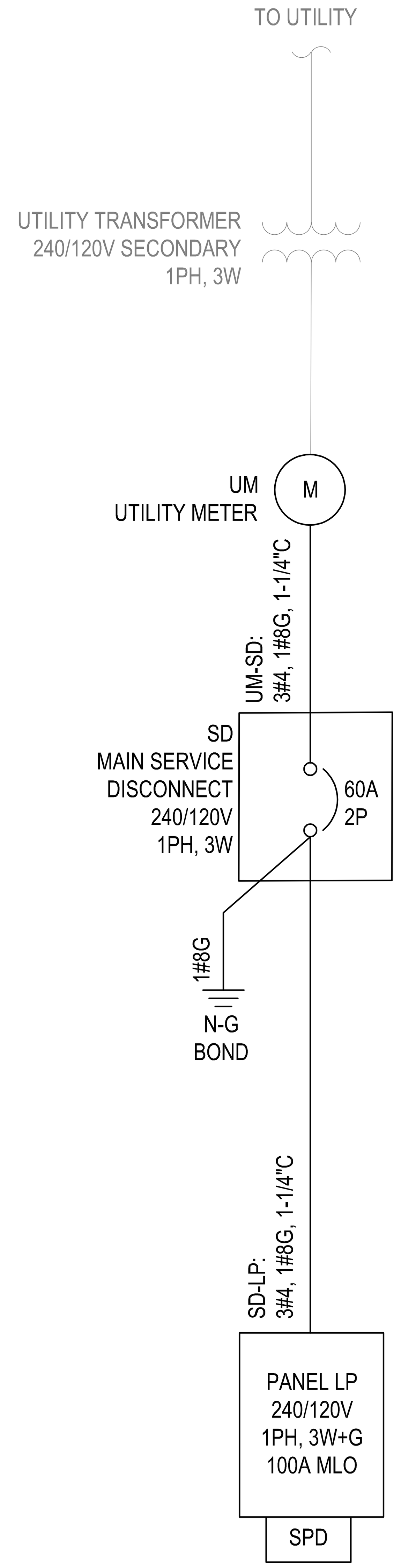
TOWN OF HOLDEN BEACH PIER REPLACEMENT

UTILITIES - PROPOSED SITE IMPROVEMENTS AND DEMOLITION PLAN

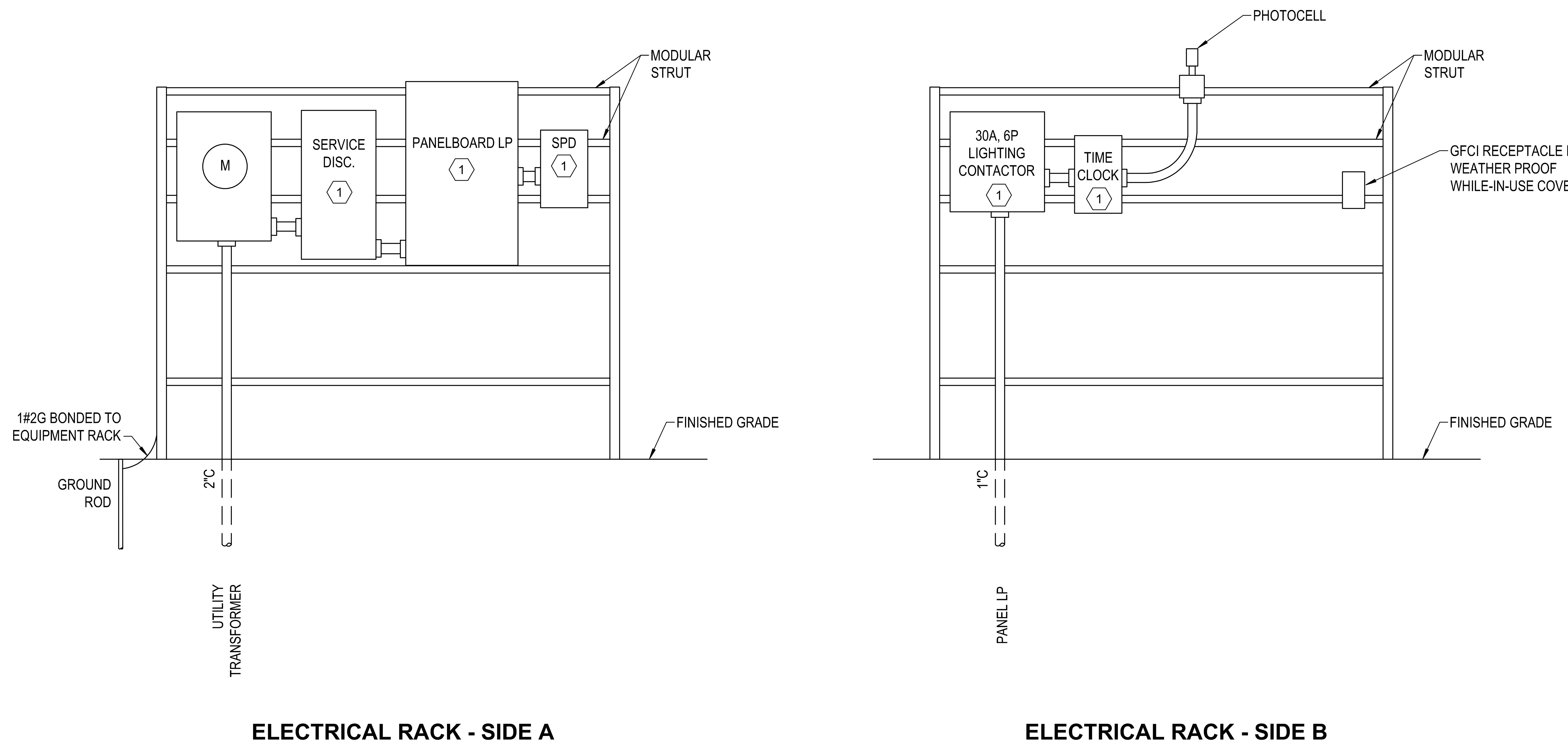
FILENAME: E-02.dwg
SCALE: AS NOTED
SHEET: E-02

KEYNOTES: #

1. PROVIDE NEMA 4X 316 STAINLESS STEEL ENCLOSURE WITH HINGED COVER TO HOUSE EQUIPMENT.



1 UTILITIES - ONE-LINE DIAGRAM
NOT TO SCALE



2 UTILITIES - RACK ELEVATION
NOT TO SCALE

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UTILITIES - ONE-LINE DIAGRAM AND RACK ELEVATION

FILENAME E-06.dwg
SCALE NOT TO SCALE
SHEET E-06

D

LUMINAIRE SCHEDULE

DWG ID	MANUFRACTURER AND LUMINAIRE TYPE	DESCRIPTION	WATTS (MAX)	VOLTAGE	CCT (K)	CRI (MIN)	LUMENS	MOUNTING TYPE	MOUNTING HEIGHT
A1	ACUITY HOLOPHANE EMS H.E. WILLIAMS 96 HUBBELL COLUMBIA LXEM	LED LINEAR ENCLOSED FIXTURE, FIBERGLASS HOUSING, GASKETED HIGH IMPACT FROSTED ACRYLIC LENS, STAINLESS STEEL LATCHES, 48" LENGTH, NEMA 4X AND IP67 RATED.	62W	MVOLT	4000K	80	7,000	CEILING	10'-0" AFG
R1	FC LIGHTING FCSL595 OR APPROVED EQUAL	LED HOODED STEP LIGHT WITH DIE-CAST ALUMINUM HOUSING. MINIMUM IP65 RATED.	6W	MVOLT	4000K	70	400	SURFACE	4'-0" AFG
S1	AMERICAN ELECTRIC LIGHTING ATB0 COOPER LIGHTING VERD OR APPROVED EQUAL	LED AREA LUMINAIRE WITH DIE-CAST ALUMINUM HOUSING AND EXTRUDING ALUMINUM MOUNTING ARM. TYPE II OPTICS WITH SPILL LIGHT CONTROL AND FULL LIGHT CUTOFF. IP66 AND 3G VIBRATION RATING. PROVIDE 3'-0" MAST MOUNTING ARM.	99W	MVOLT	4000K	70	11,000	POLE	15'-0" AFG

LUMINAIRE SCHEDULE NOTES:

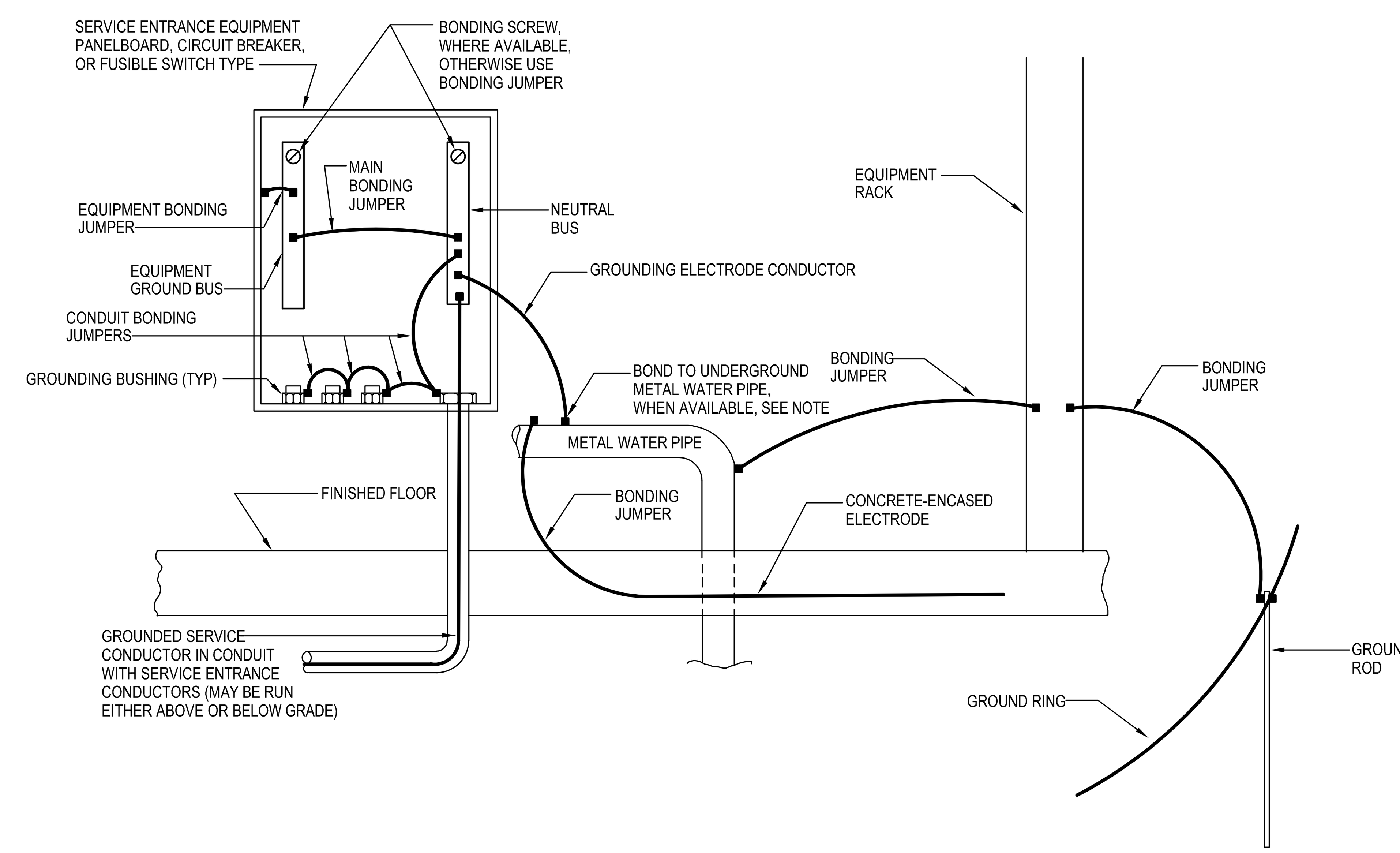
1. COORDINATE WITH ARCHITECTURAL DRAWINGS (REFLECTED CEILING PLANS AND ELEVATIONS) FOR EXACT LUMINAIRE LOCATIONS, CEILING TYPES, AND MOUNTING HEIGHTS.

2. LUMINAIRE SUBMITTALS SHALL INCLUDE LAMP DATA SHEET, DRIVER DATA SHEET,IES (LM-79, LM-80, TM-21) TESTING REPORTS.

3. SUBSTITUTIONS SUBMITTED TO THE ENGINEER PRIOR TO BIDDING SHALL BE EQUAL TO THE LUMINAIRE SPECIFIED IN ALL CHARACTERISTICS.

C

NOTE:
IF UNDERGROUND METAL WATER PIPE IS NOT AVAILABLE, THEN EXTEND THE GROUNDING ELECTRODE CONDUCTOR TO ONE OF THE OTHER GROUNDING ELECTRODES SHOWN. BOND ALL SHOWN ELECTRODES TOGETHER. SIZE OF GROUNDING ELECTRODE CONDUCTOR AND BONDING JUMPERS SHALL BE AS SHOWN ON PLAN DRAWINGS OR AS REQUIRED BY NEC ARTICLE 250.



B

1
-
SERVICE ENTRANCE GROUNDING DETAIL
NOT TO SCALE

A

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TOWN OF HOLDEN BEACH PIER REPLACEMENT

UTILITIES - LUMINAIRE SCHEDULE & DETAILS

FILENAME E-07.dwg
SCALE NOT TO SCALE
SHEET E-07