

MERCER ISLAND PARKS
OVERWATER STRUCTURES ASSESSMENT



DRAFT REPORT

May 30, 2014

OAC No. 2014-001

Prepared for

City of Mercer Island

Parks and Recreation Department

Prepared by

OAC Services, Inc.

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Seattle, Washington 98109



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May 30, 2014

Jason Kintner
Parks Superintendent
Mercer Island Parks and Recreation
2040 84th Avenue SE
Mercer Island, Washington 98040

Re: **Mercer Island Parks – Overwater Structures Assessment**

Mr. Kintner:

Please find enclosed our draft report “Mercer Island Parks – Overwater Structures Assessment”, dated May 30, 2014. The purpose of this report is to summarize our review of specific overwater and shoreline structures at Luther Burbank Park, Clarke Beach Park, and Groveland Park.

Please call with any questions or concerns relative to the contents of the report.

Sincerely,

A handwritten signature in dark ink, appearing to read "Lee Dunham". The signature is fluid and cursive, with a large initial "L" and "D".

Lee Dunham, PE SE
Principal
Forensic Architecture and Engineering Group
OAC Services, Inc.

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1 INTRODUCTION

1.1 Purpose of Report

The purpose of this report is to provide a condition assessment of specific overwater and shoreline (on-grade) structures at three Mercer Island waterfront parks: Luther Burbank Park, Clarke Beach Park, and Groveland Park. The general scope of assessment was directed by Mercer Island Parks.

1.2 Scope of Services

The scope of services for this project included detailed engineering field observations, underwater inspection of piers, bulkheads and other structures by a dive team, preliminary cost analyses and the writing of this summary report.

1.2.1 Consultant Team, Field Work

The consultant team for this assessment was led by OAC Services Inc. (OAC) who provided project management for the assessment under the direction of the Mercer Island Parks Department, as well as all structural engineering review and assessment. Review and assessment of shoreline structures was provided by Associated Earth Sciences, Inc. (AESI). Underwater inspections were carried out by Waterfront Construction, Inc. (Waterfront).

Visual review of overwater and shoreline structures was carried out by the consultant team on the following dates: March 13, 2014 (OAC recon at all three parks with Parks Department); March 18, 2014 (engineering observations and dive inspections at Luther Burbank); March 19 and April 3, 2014 (engineering observations and dive inspections at Clarke Beach and Groveland).

1.2.2 Preliminary Cost Analysis

Based on the data obtained from the fieldwork, preliminary cost estimates were generated and provided to Mercer Island Parks for budgeting purposes on April 22, 2014. These cost estimates are included (and where appropriate expanded upon) in this report.

1.2.3 Report

Findings from engineering field assessments and dive inspections are summarized in this report. Reference Section 2 for general park summaries, Section 3 for a general ranking of remediation priority, and the appendices at the end of the report for detailed observations, structure ratings, short and long term remediation options and associated preliminary cost estimates.

General Note on Overwater Structures

For the purpose of this report, the assessed overwater structures are broken down into two categories: *the superstructure*, which includes the decking and all elements above (decking, concrete slabs, fascia, rails, cleats, etc.) and the *substructure*, which includes all elements below the deck (timber stringers, pile caps / beams, timber piles, bracing, etc.). All wood elements discussed are understood to be pressure-treated, unless otherwise noted. The terms "pier" and "dock" are



typically used interchangeably, however the term “pier” was selected as the predominant default to describe structures extending from the shoreline over the water.

2 PARK SUMMARIES

2.1 Luther Burbank Park

Located at 2040 84th Avenue SE, Luther Burbank Park encompasses approximately 75 acres at the north side of Mercer Island. The assessment did not include review of park structures north of the concrete bulkhead adjacent to the large pier.

2.1.1 Shoreline Structures

From north to south, shoreline structures present at Luther Burbank Park include approximately 200 feet of concrete bulkhead, approximately 975 feet of natural shoreline, and approximately 85 feet of shoreline located along a swimming beach. The concrete bulkhead is in generally good condition with no significant undermining observed. Brick work observed on the ground surface directly behind the bulkhead exhibited some chipped, missing, or uneven brick surfaces, particularly toward the south end of the bulkhead. This presents a tripping hazard as well as an aesthetic problem. The south end of the bulkhead is located near the toe of a hill traversed by a gravel-surfaced maintenance road. The maintenance road is steeply inclined and its surface is subject to erosion by runoff flowing down its length. This has resulted in rilling of the road surface and accumulation of mud and ponded water behind the bulkhead at its south end. The accumulation of mud and standing water presents a problem for area pedestrian traffic and access to the adjacent dock. At least a portion of the runoff flowing down the maintenance road appears to originate as emergent seepage (springs) within the road and adjacent area. Control of the runoff is recommended to mitigate the erosion problem in this area.

Beginning near the south end of the bulkhead, a pedestrian path extends south along the natural shoreline between the south end of the bulkhead and the swimming beach at the south end of the park. A portion of the trail was very muddy at the time of our visit. Placement of filter fabric overlain by cedar chips or crushed rock is recommended in the wet portions of the trail to provide a relatively dry, mud-free surface for pedestrian traffic. The swim beach at the south end of the park appears to be constructed of imported sand. The surface of the beach is rilled due to erosion by runoff. We observed runoff flowing across the beach even though our site visit coincided with a period of dry weather. This suggests that a portion of the runoff originates as spring flow. Control of this runoff is recommended to mitigate beach erosion in this area.

2.1.2 Overwater Structures

From north to south, overwater structures at Luther Burbank Park include a large multi-fingered pier, a small pier, and timber mooring piles (not ‘overwater’ per se but included here). Both the piers are of similar construction, which consists of precast concrete “double T” deck slabs spanning along the main axis of the pier supported by timber cap beams and timber piles. The piles are braced with diagonal timbers and battered piles. The large pier has various finger slips consisting of diagonal wood decking on treated timber beams and piles. Overall, the concrete slabs are in relatively good condition with only minor spalling and cracking. The timber piles supporting the piers appear to be treated with creosote and are in

good overall condition. Structural concerns at these piers relate to the timber cap beams, some of which are exhibiting decay at the exposed beam end. As well, the cap beams are shimmed at the piles with what appears to be untreated plywood, and these shims are exhibiting decay. Wood decking at the smaller fingers is weathered but not generally decayed. The series of mooring piles located south of the small pier have advanced decay at the waterline and require repair if they are to be used in the future.

Detailed descriptions of our observations, recommended mitigation, figures, and photographs showing key features are included in Appendix A.

2.2 Clarke Beach Park

Clarke Beach Park encompasses roughly 8 acres on the south east side of Mercer Island between E. Mercer Way and Lake Washington.

2.2.1 Shoreline Structures

Beginning at the north end of the park, shoreline structures at Clarke Beach include approximately 60 feet of asphalt paved path. The edges of the path adjacent to the water are supported by sheetpiles with a concrete pile cap. A portion of the asphalt pavement along the edge of the path has settled. The area south of this path consists of an enclosed swimming area (“Kids’ Swim Area”). The shoreline within the swimming area consists of concrete stairs that extend down into the water. The stairs appear to be in good condition with no damage observed. The kids’ swimming area is enclosed by a sheetpile wave break that extends out into the lake. The sheetpiles appear to be in generally good condition, but they have exposed sharp edges that could be hazardous to swimmers. They are also constructed with “fish windows”. In addition to potentially sharp edges, the fish windows could present a potential trapping hazard to swimmers. The sheetpile wave break is constructed with a wooden cap that is heavily weathered. South of the swim area is approximately 150 feet of shoreline with a rock bulkhead. This bulkhead, like the other rock bulkheads at this park, is constructed as a riprap rock revetment rather than the more typical stacked rock bulkhead. Large voids are present between the rocks indicating that some shifting has occurred. Some rocks have also toppled into the lake. Asphalt pavement has been placed over a portion of the riprap bulkhead near its south end. This appears to have been placed in an attempt to stabilize the rock.

Another section of concrete stairs extends down into the water along the portion of shoreline south of the rock bulkhead. These stairs have been severely undermined by wave action. This has resulted in some cracking of the concrete. Beginning approximately 85 feet south of the bulkhead, a sheetpile wall has been installed at the toe of the concrete stairs. The sheetpile wall extends south approximately 65 feet to the south end of the stairs. A concrete cap has been placed along the top of the sheetpile wall. The cap is connected to the toe of the concrete stairs by bolts extending through the face of the cap and by steel plates that span between the tread of the lower step and the top of the concrete cap. Most of the bolt holes extending through the face of the pile cap are missing bolts. These open holes provide a conduit for wave action behind the sheetpile wall. In some areas gaps were observed between individual sheetpiles and between the tops of the sheetpile wall and pile cap. These gaps also provide conduits for wave action that could potentially undermine the toe of the adjacent stairs. In some areas, lateral deflection of the sheetpile wall occurred under hand pressure. This suggests poor embedment of the sheetpiles. The portion of the concrete

stairs behind the sheetpile wall exhibited moderately severe cracking. South of the shoreline concrete stairs is approximately 285 feet of additional rock bulkhead/riprap similar to that present north of the stairs. The condition of the rock bulkhead/riprap in this area is similar to that of the bulkhead/riprap north of the stairs.

2.2.2 Overwater Structures

From north to south, overwater structures at Clark Beach Park include a large pier and a small pier. Both the piers are of similar construction, which consists of wood decking, fascia and stringers supported by timber cap beams and piles. With the exception of one pile, the treated timber piles supporting these piers are in good condition. The superstructure of the large pier is in good condition, with the exception of deterioration of the painted wood rail. The wood decking is weathered but in general not decayed. The small pier to the south has sustained fire damage from arson. One of the main stringers has substantial section loss at the abutment and adjacent decking has been removed.

Detailed descriptions of our observations, recommended mitigation, figures, and photographs showing key features are included in Appendix B.

2.3 Groveland Park

Groveland Park encompasses roughly 3 acres at the west side of Mercer Island between W. Mercer Way and Lake Washington, directly opposite Seward Park to the west.

2.3.1 Shoreline Structures

Shoreline structures present at Groveland Park include approximately 250 feet of concrete bulkhead. Vertical cracks extending completely through the bulkhead are present at several locations. Although no widespread undermining of the bulkhead was observed, several large cracks or holes were observed near its toe (below lake level). In addition, what appear to be weep holes were observed near the toe of the bulkhead at approximately 10 foot intervals along its entire length. The area directly behind the bulkhead consists of a beach. Widespread settlement of the beach sand directly behind the bulkhead was observed. More pronounced areas of localized settlement (potholes) were observed in places along the back of the bulkhead. The locations of these potholes coincided with the locations of the larger cracks and voids in the bulkhead. The settlement behind the bulkhead is interpreted to be the result of washout of sediment from behind the wall by wave action. The beach behind the bulkhead appears to be constructed of imported sand. The sand exhibits rilling. This appears to be the result of erosion by runoff from the adjoining upslope area. North of the bulkhead, at the north end of the park, is a small pocket beach. Logs placed at the head of the beach provide grade separation between the beach and the adjacent, higher-lying lawn. The logs have been undermined by wave action and appear at risk of rolling. As this would result in collapse of the edge of the lawn and presents a potential hazard. Anchoring of the logs is recommended.

2.3.2 Overwater Structures

From north to south, overwater structures at Groveland Park include a small pier and a large pier. Typical construction at the large pier consists of precast concrete slab sections supported by treated timber stringers on timber piles; the small pier consists of wood decking

on a similar substructure. Timber piles supporting both structures appear to be untreated and are in poor condition. Advanced decay was documented at the waterline at a good portion of the piles; some have lost bearing at the superstructure interface. Some piles at the large pier have been “canned” (a concrete-infilled steel splice at the waterline). The wood railing and skirt wall / wave break at the large pier is weathered with isolated decay. The relatively thin precast slab elements forming the large pier deck are weathered, have substantial paste erosion, and are cracked; the screws connecting the slabs to the underlying substructure have compromised holding capacity and are loose at some locations. The south return of the large pier is topped with asphalt (unknown substrate). At the north end of the pier, the slabs/stringers are noticeably sagging; this end sways noticeably in the east-west direction. Underwater wood bracing elements at the large pier are loose and some dowel type connectors (bolts / threaded rods) were observed to be substantially corroded. The wood decking at the smaller pier is weathered and decayed in some areas. Various planks have been replaced in the past.

Detailed descriptions of our observations, recommended mitigation, figures, and photographs showing key features are included in Appendix C.

3 PRIORITIZED REMEDIATION

3.1 Short Term Remediation (1 – 2 years)

The decayed piles supporting the two piers at Groveland Park result in diminished load carrying capacity of the structures. These piers should be repaired or replaced in the short-term.

If the area bounded by the sheet pile wave break at Clarke Beach Park is desired to remain in use as a swim area for children, additional work is recommended to improve safety, including covering of any exposed sheet piling edges and limiting swimmer access to fish windows.

3.2 Mid-Range Remediation (3 – 5 years)

The two piers at Luther Burbank Park should be repaired relatively soon (recommended before 2017), and reserves for long-term maintenance should be budgeted for. If they are to be used in the future, the mooring piles at Luther Burbank Park should be spliced at the waterline. In addition to these items, the log bulkhead at Groveland’s pocket beach should be re-anchored.

3.2 Long-Term Remediation (10 + years)

In general, the remaining work contemplated in the summary tables in the appendices should be addressed in the next 10 – 15 years. However, in some cases (such as with the concrete bulkhead at Groveland Park), detrimental effects of continued undermining are expected to increase over time if left unmitigated.

Limitations of Report

This report is based on limited visual observations at specific shoreline and overwater structures at Luther Burbank, Clarke Beach, and Groveland Parks on Mercer Island. The report is for the sole use of the City of Mercer Island. Review and commentary on structures not addressed herein is beyond the scope of this study.

Appendix A

Luther Burbank Park

Summary Tables

A.1 – Shoreline Structures

A.2 – Overwater Structures

Figures

A1 – Park Map

A2 – Large Pier, Plan and Section

A3 – Large Pier, Sections

A4 – Small Pier, Plan and Sections

Representative Photos

1A – 26A

Table A.1: Luther Burbank Park - Shoreline Structures

Loc	OBSERVATION			RATING					MITIGATION			
	Shoreline Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Interim Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
1	Concrete Bulkhead [approx 200 ft of shoreline]	Generally good; minor undermining of toe observed where a drain pipe extends out into lake from under the bulkhead (near the center of the bulkhead); minimal sedimentation observed at base of joints in bulkhead.	Minor washout of sediment around drain pipe by wave action.	10	10	10	10	20+	None recommended at this time.	N/A	None recommended at this time.	N/A
1A	Brick work [behind bulkhead]	Some uneven, chipped, or missing bricks behind bulkhead, mainly near S. end	Likely due to settlement of fill behind bulkhead; chipped or missing bricks likely due to wear/vandalism.	9	9	7	9	Exceeded where damaged	None recommended at this time.	N/A	Removal and replacement of existing bricks.	\$2,000 - \$4,000
1B	Gravel maintenance road/trail	Heavily rilled; erosion of soil from inclined road has resulted in deposition of mud and accumulation of standing water on brick surface behind S. end of bulkhead.	Uncontrolled runoff on inclined surface of maintenance road; a portion of the runoff appears to be due to emergent seepage (springs) in the road.	4	4	2	7	Exceeded	Periodic regrading of the road and frequent removal of the mud from behind the bulkhead.	\$1,000 per event	Construction of check dams/water bars on road; installation of a trench drain at the toe of the slope.	\$10,000 - \$15,000
2	Natural shoreline [approx 975 ft. of shoreline]	Generally good; trail paralleling shoreline very muddy.	Muddy condition of trail due to accumulation of runoff, possibly with some emergent seepage.	7	7	7	9	20+	Build up surface of trail with cedar chips underlain by filter fabric.	\$5,000 - \$10,000	Build up surface of trail with crushed rock underlain by filter fabric.	\$10,000 - \$15,000
3	Swim beach [approx 85 ft. of shoreline]	Beach appears to be constructed of imported sand placed on till. Heavy rilling of surface of beach. Concrete steps/retaining walls at head of beach in good condition.	Rilling on beach due to erosion from runoff. The source of much of the runoff appears to be emergent seepage (springs).	6	6	6	10	N/A	Regrade surface of beach/import additional sand.	\$5,000	Installation of interceptor/finger drains to control seepage.	\$10,000 - \$15,000

Table A.2: Luther Burbank Park - Overwater Structures

Loc	OBSERVATION			RATING					MITIGATION			
	Overwater Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Short-Term Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
4	Large Pier Superstructure	Superstructure consists of precast conc decking units and wood bull rails at main pier; diagonal wood decking at fingers; newer steel gangway and marine grating at floating swim platform. Concrete slabs exhibit minor cracking / spalling but are otherwise in relatively good condition. Wood decking / rails weathered but with exception of some detached bull rail, these are in relatively good condition.	age weathering	7	7	7	8	15+	Allowance for repair of deteriorated concrete and wood rails.	\$15,000 - \$20,000	Provide allowance in budget for additional similar mitigation procedures in 10 - 15 years.	\$20,000
	Large Pier Substructure	Substructure consists of treated timber cap beams (with non-treated wood shims); creosote treated timber piles and timber bracing. Diver reports the following: With exception of one location, piles are in good condition. Problems exist with decayed wood shims between caps and piles, and decayed cap ends. Bracing is loose and connection hardware loose corroded at some locations.	age weathering wood decay steel corrosion wave action	5	5	N/A	7	2 - 4	Pile splice allowance + allowance to repair decayed cap beams, shims and bracing in-place.	\$65,000 - \$85,000	Provide allowance in budget for additional similar mitigation procedures in 10 - 15 years.	\$50,000
5	Small Pier Superstructure	Construction and condition same as large pier - see notes above							Allowance for repair of deteriorated concrete and wood rails.	5,000 - \$10,000	Provide allowance in budget for additional similar mitigation procedures in 10 - 15 years.	\$10,000
	Small Pier Substructure	Construction and condition same as large pier - see notes above							Allowance for repair of deteriorated concrete and wood rails.	\$20,000 - \$25,000	Provide allowance in budget for additional similar mitigation procedures in 10 - 15 years.	\$20,000
6	Mooring Piles	Timber mooring piles south of small dock are deteriorated	age wood decay	3	3	3	7	Exceeded	Splice timber piles	\$12,000 - \$16,000	None recommended at this time.	N/A

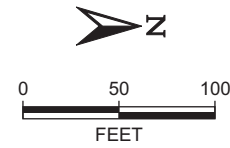


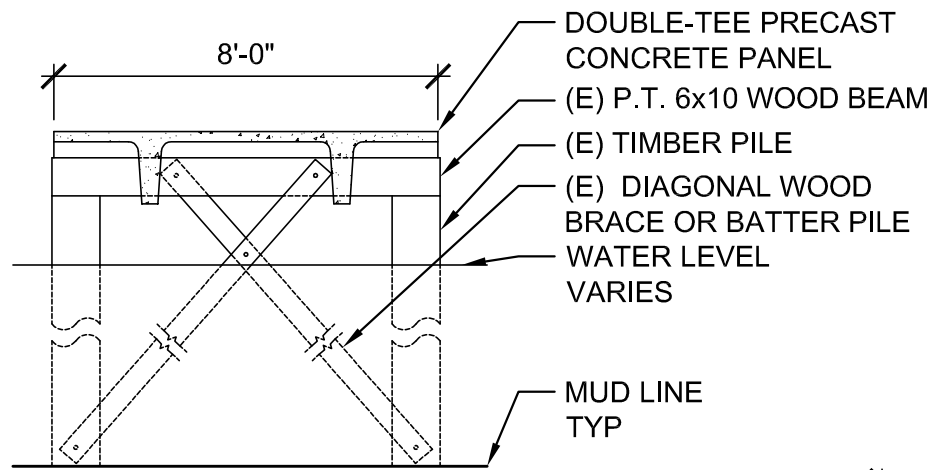
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REFERENCE: GIS - KING CO. / USGS

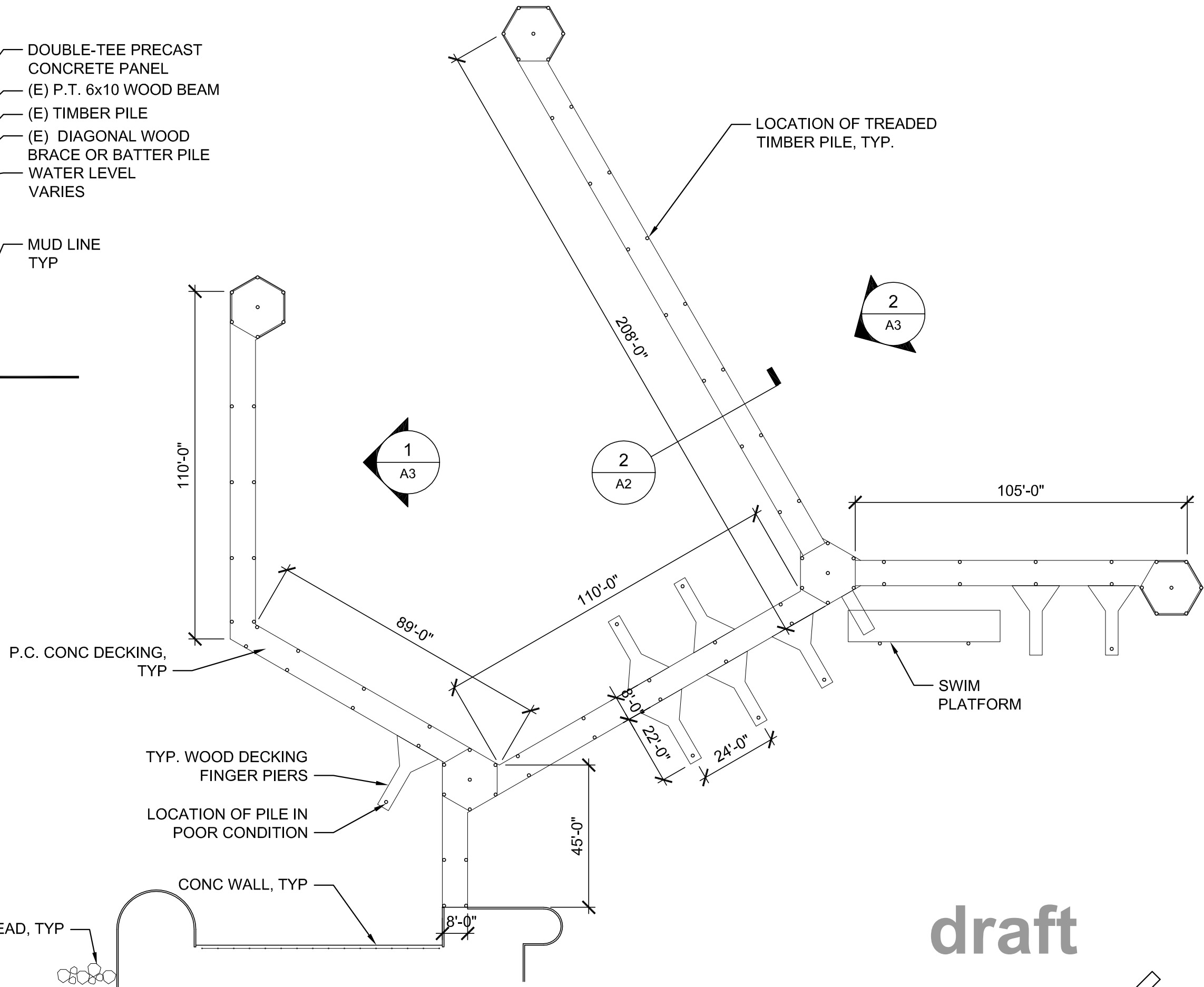
SITE PLAN - LUTHER BURBANK PARK
 MERCER ISLAND PARKS - WATERFRONT STRUCTURES ASSESSMENT
 MERCER ISLAND, WASHINGTON

FIGURE A1
 DATE 4/14
 PROJ. NO. KE140078A





2 TYPICAL PIER SECTION
SCALE: 1/4" = 1'-0"



1 PIER PLAN
SCALE: approx. 1/32" = 1'-0"

draft

FIGURE
A2

LARGE PIER - PLAN
LUTHER BURBANK PARK
CITY OF MERCER ISLAND
SCALE : NTS

DATE	4/2014
DRAWN	PK / MD
CHECK	LD
JOB	2014001

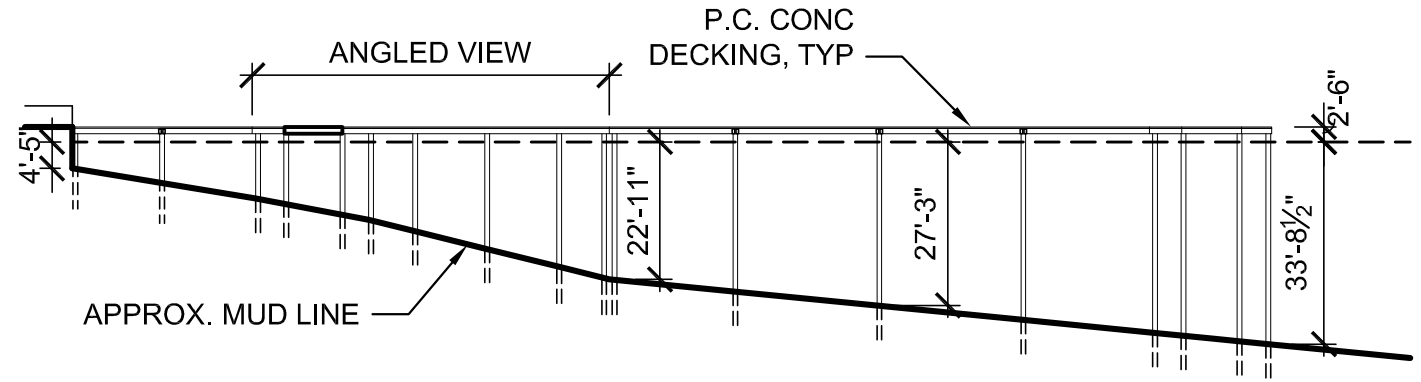
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1

PIER SECTION

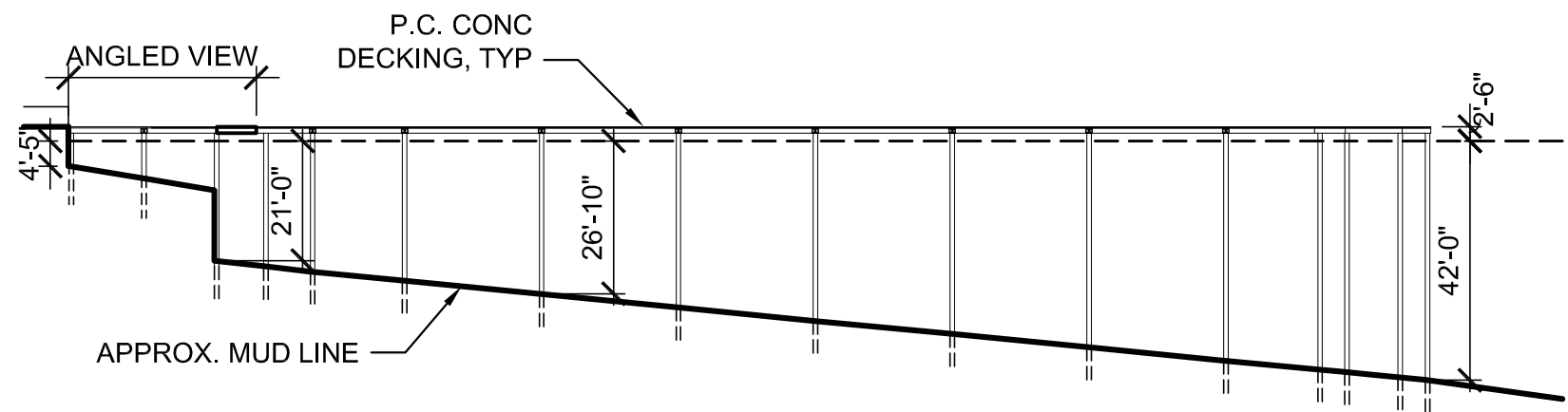
SCALE: approx. 1/32" = 1'-0"



2

PIER SECTION

SCALE: approx. 1/32" = 1'-0"



draft

LARGE PIER - SECTION
 LUTHER BURBANK PARK
 CITY OF MERCER ISLAND
 SCALE: NTS

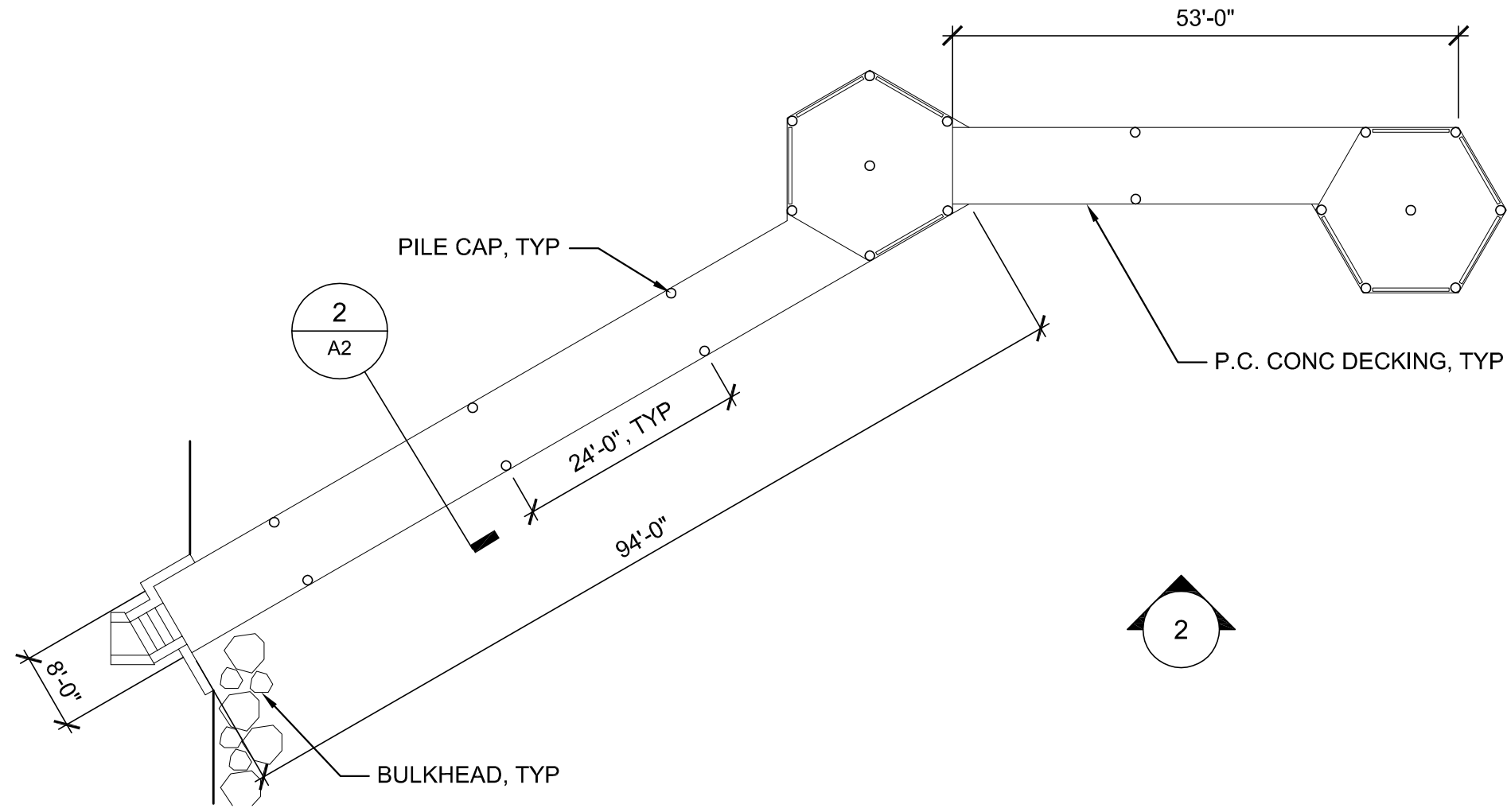
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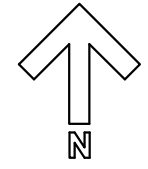
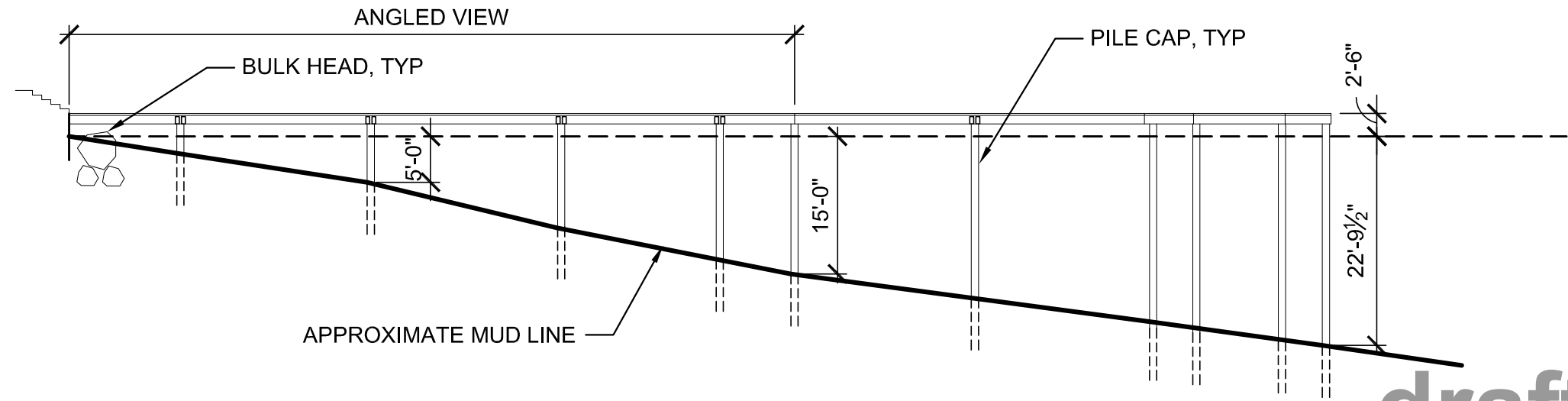
FIGURE
A3

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1 PIER PLAN
SCALE: approx. 1/16" = 1'-0"



2 PIER SECTION
SCALE: approx. 1/16" = 1'-0"



 701 Dexter Avenue North Suite 301 Seattle, WA 98109-4342 T: 206.285.4300 F: 206.285.4371 W: www.oac-engineers.com		DATE	4/2014
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SMALL PIER - PLAN AND SECTION LUTHER BURBANK PARK CITY OF MERCER ISLAND SCALE: NTS		FIGURE A4	

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Photo 1A – Concrete bulkhead



Photo 2A – Brickwork adjacent to bulkhead



Photo 3A – Gravel maintenance road



Photo 4A – Trail along shoreline



Photo 5A – Swim beach



Photo 6A – Large pier



Photo 7A – Pier finger and gangway



Photo 8A – Typical pier construction



Photo 9A – Deteriorated pier slab



Photo 10A – Pier slab over support



Photo 11A – Moss / vegetation at pier edge



Photo 12A – Deteriorated / loose bull rail



Photo 13A – Treated cap beam at pile



Photo 14A – Deteriorated cap beam



Photo 15A – Deteriorated cap beam end



Photo 16A – Spalling at underside of precast "T"



Photo 17A – Precast "T" and timber cap beam



Photo 18A – Plywood shims between cap and pile



Photo 19A – Diagonal bracing



Photo 20A – Loose connector at substructure



Photo 21A – Stripped / corroded connector



Photo 22A – Small pier



Photo 23A – Platform at end of small pier



Photo 24A – Pile cap to pile connection (small pier)



Photo 25A – Deteriorated cap beam (small pier)



Photo 26A – Deteriorated mooring pile

Appendix B

Clarke Beach Park

Summary Tables

B.1 – Shoreline Structures

B.2 – Overwater Structures

Figures

B1 – Park Map

B2 – Large Pier, Plan and Sections

B3 – Small Pier, Plan and Section

Representative Photos

1B – 22B

Table B.1: Clarke Beach Park - Shoreline Structures

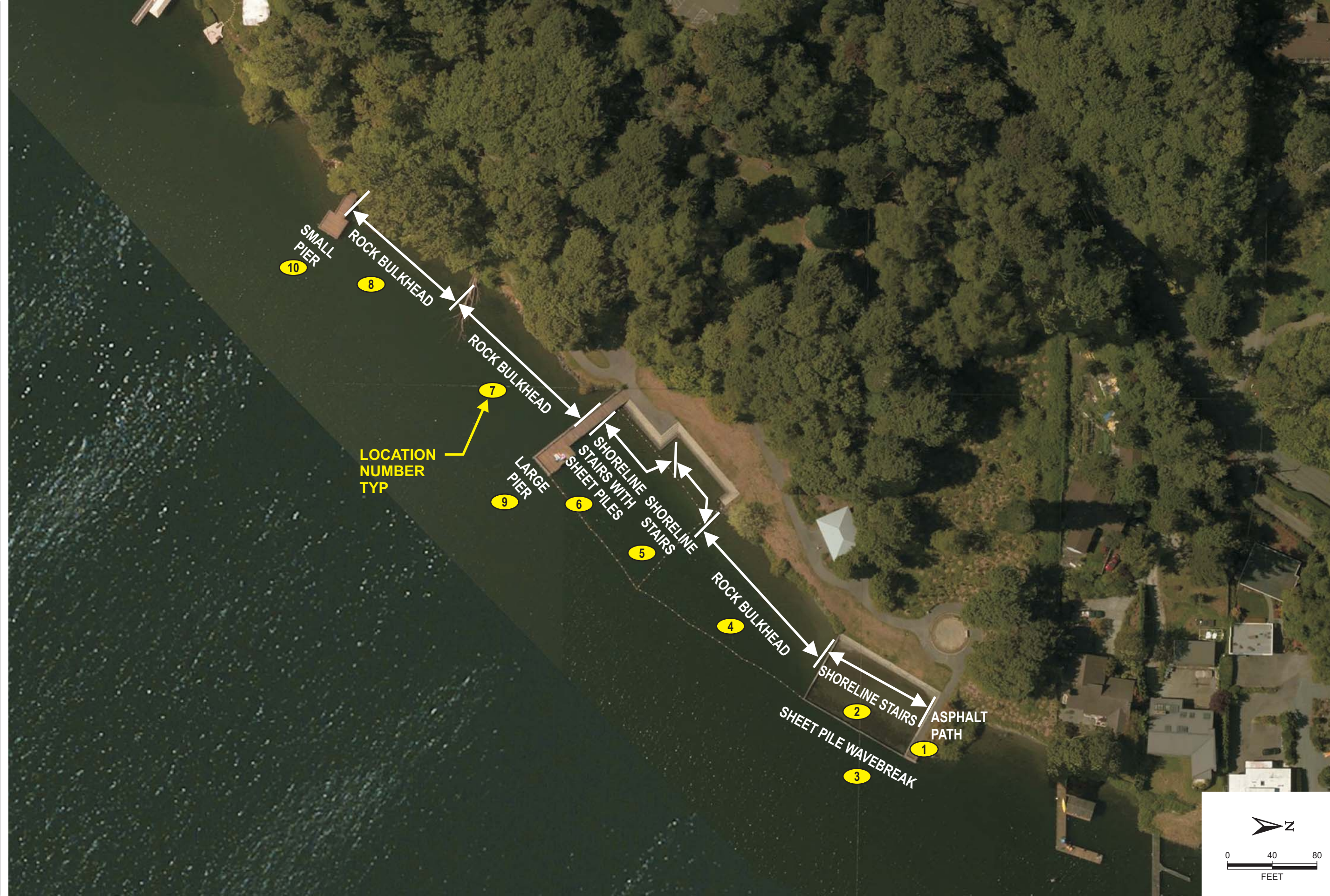
Loc	OBSERVATION			RATING					MITIGATION			
	Shoreline Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Short-Term Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
1	Asphalt Path [approx 60 ft of shoreline]	Path is bounded on edges by sheet piles topped with a concrete cap. Area underlying path not observable but likely consists of fill. Some settlement of asphalt has occurred along south edge of the path.	Pavement settlement likely caused by washout of the fill underlying the pavement by wave action through sheetpile joints or slight lateral deflection of sheet-piles.	7	9	7	9	10-20	Patch asphalt	\$1,000 - \$2,000	Grind out existing asphalt pavement, add additional fill in area of settlement and replace pavement.	\$3,000 - \$5,000
2	Shoreline Stairs [approx 100 ft of shoreline]	Good condition; no damage or deficiencies observed. Some gravel deposited on stairs.	Good toe embedment in gravel lake bed. Area protected from heavy wave action.	10	10	10	10	20+	None recommended at this time.	N/A	None recommended at this time.	N/A
3	Sheetpile Wave Break ("Kids' Swim Area") [approx 160 ft of shoreline]	Sheetpiles appear to be in good structural condition with light scaling observed. Sharp edges on sheetpiles. Wooden cap topping the sheetpile wall is degraded. Fish windows in sheetpiles.	Wooden cap degradation due to weathering. Sharp edges on piles; Fish windows potentially hazardous in swimming area	10	10	7 wooden cap	5 sharp edges, fish windows	20+	Allowance for covering sharp sheet pile edges with treated wood	\$4,000 - \$8,000	Future allowance for modification / maintenance	\$10,000 - \$15,000
4	Rock Bulkhead/ Riprap Bank [approx 150 ft of shoreline]	Large voids present between rocks suggesting some shifting has occurred; subsidence behind bulkhead adjacent to Location 5. Some toppled rocks.	Washout of soil behind bulkhead by wave action; no drain rock or fabric observed behind bulkhead.	7	7	9	10	10-20	Placement of cobble and gravel at toe and addition of rock infill/backfill as needed; annual monitoring.	\$30,000 - \$35,000 plus \$500 per year for annual monitoring	Replacement with a new engineered bulkhead with geosynthetic or rock filter; placement of aggregate at toe; annual monitoring.	\$90,000 - \$100,000 plus \$500 per year for annual monitoring
5	Concrete Shoreline Steps [approx 85 ft of shoreline]	Large void present at NE end next to rock bulkhead; 5" to arm length void below footing at toe of steps along full length; cracks located at bends in steps.	Undermining of stairway footing by wave action.	7	10	8	9	10-20	Placement of cobble and gravel aggregate at toe to prevent undermining; annual monitoring.	\$15,000 - \$20,000 monitoring included under Location 4	Complete demolition and replacement of stairs; placement of aggregate at toe to reduce the potential for undermining; annual monitoring.	\$70,000 - \$90,000 monitoring included under Location 4

Table B.1: Clarke Beach Park - Shoreline Structures, Cont'd

Loc	OBSERVATION			RATING					MITIGATION			
	Shoreline Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Short-Term Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
6	Concrete Shoreline Steps with Sheetpile Wall [approx 65 ft of shoreline]	Concrete pile cap atop sheetpiles connected to lower step by through-bolts and metal plates; approx 1/2 to 2/3 of the through bolts are missing. No pile-pile cap connection in some areas. Some sheetpiles wobbly under hand pressure. Some gaps observed between sheetpiles. Moderately severe cracking of steps observed.	Settlement/cracking likely due to undermining of stairs by wave action through gaps in sheetpiles and vacant bolt holes.	7	10	8	9	10-20	Placement of cobble and gravel aggregate in front of sheetpile wall to reduce potential for further undermining of stairs; annual monitoring and replacement of aggregate as needed.	\$10,000 - \$15,000	Replace sheetpiles and complete demolition and replacement of existing stairs.	Stair replacement \$40,000 - \$50,000 Sheetpile replacement \$70,000 - \$100,000
7	Rock Bulkhead/ Riprap Bank [approx 165 ft of shoreline]	Constructed entirely of large rocks; areas of bank erosion observed behind riprap; visquine visible behind riprap in places; large no. of rocks in water in front of riprap; large voids suggest past shifting of rocks.	Bank erosion by wave action through rocks	7	7	9	10	10-20	Placement of cobble and gravel at toe and addition of rock infill/back-fill as needed; annual monitoring	\$30,000 - \$35,000 Monitoring cost included under Location 4	Replacement with a new engineered bulkhead with geosynthetic or rock filter; placement of aggregate at toe; annual monitoring.	\$100,000 - \$120,000 Monitoring cost included under Location 4
8	Rock Bulkhead/ Riprap Bank [approx 120 ft of shoreline]	Similar to Location 7, but not as readily observed due to heavy brush.	Bank erosion by wave action through rocks	7	7	9	10	10-20	Placement of cobble and gravel at toe and addition of rock infill/back-fill as needed; annual monitoring	\$25,000 - \$30,000 Monitoring cost included under Location 4	Replacement with a new engineered bulkhead with geosynthetic or rock filter; placement of aggregate at toe; annual monitoring.	\$70,000 - \$85,000 Monitoring cost included under Location 4

Table B.2: Clarke Beach Park - Overwater Structures

Loc	OBSERVATION			RATING					MITIGATION			
	Shoreline Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Short-Term Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
9	Large Pier Superstructure	Superstructure consists of pressure treated wood decking, fascia, curbs and rails. Wood decking components are weathered but otherwise in good condition. Painted wood railing is deteriorated and requires replacement.	age weathering	8	8	7	9	15+	Allowance for spot repair of deteriorated wood decking and replacement of wood rail in-kind.	\$15,000 - \$20,000	Replace wood decking with proprietary marine grating system.	\$45,000 - \$60,000
	Large Pier Substructure	Substructure consists of treated timber stringers, cap beams, and piles. Diver reports the following: Substructure, including piles, in good condition with the exception of (1) pile.		10	10	N/A	10	20+	Allowance for isolated substructure repair.	\$10,000 - \$15,000	Provide allowance in budget for isolated pile splicing and in-place repair of stringers / cap beams in 15 - 20 years.	\$10,000 - \$15,000
10	Small Pier Superstructure	Construction similar to large pier. Small pier superstructure has sustained fire damage at stinger(s) bearing at abutment.	arson	3	1	1	1	Exceeded	Repair fire damage in-place	\$20,000 - \$25,000	Demolish	\$20,000 - \$25,000
	Small Pier Substructure	Construction and condition similar to large pier - see notes above							see notes above		see notes above	



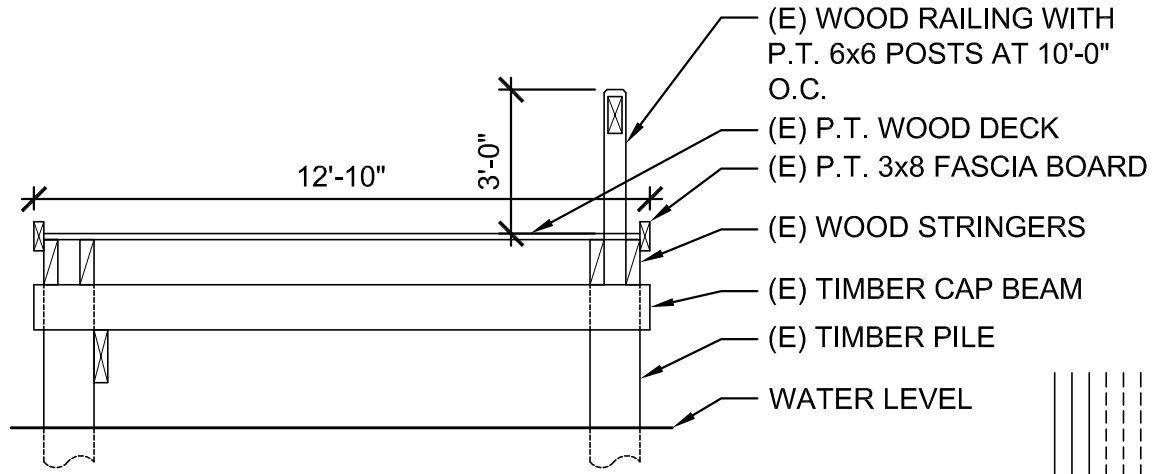
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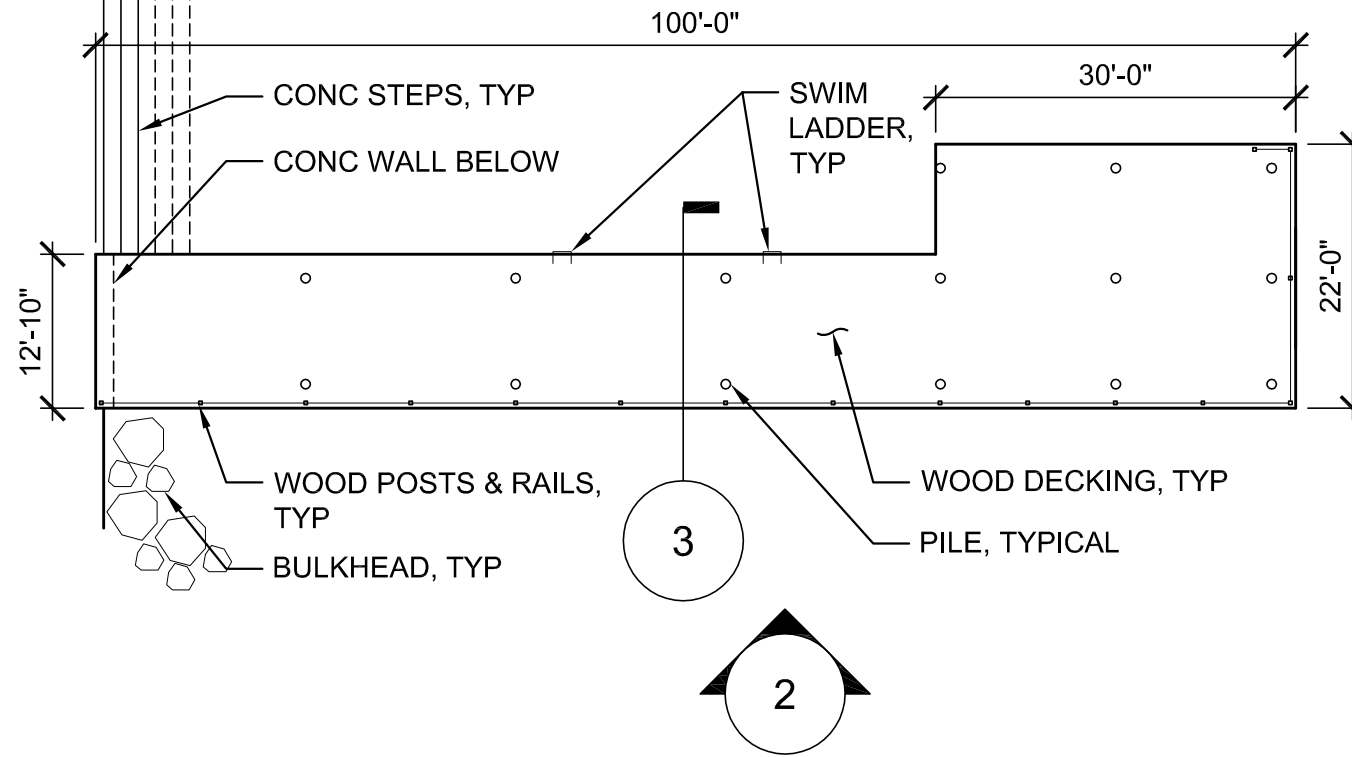
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 MERCER ISLAND PARKS - WATERFRONT STRUCTURES ASSESSMENT
 MERCER ISLAND, WASHINGTON

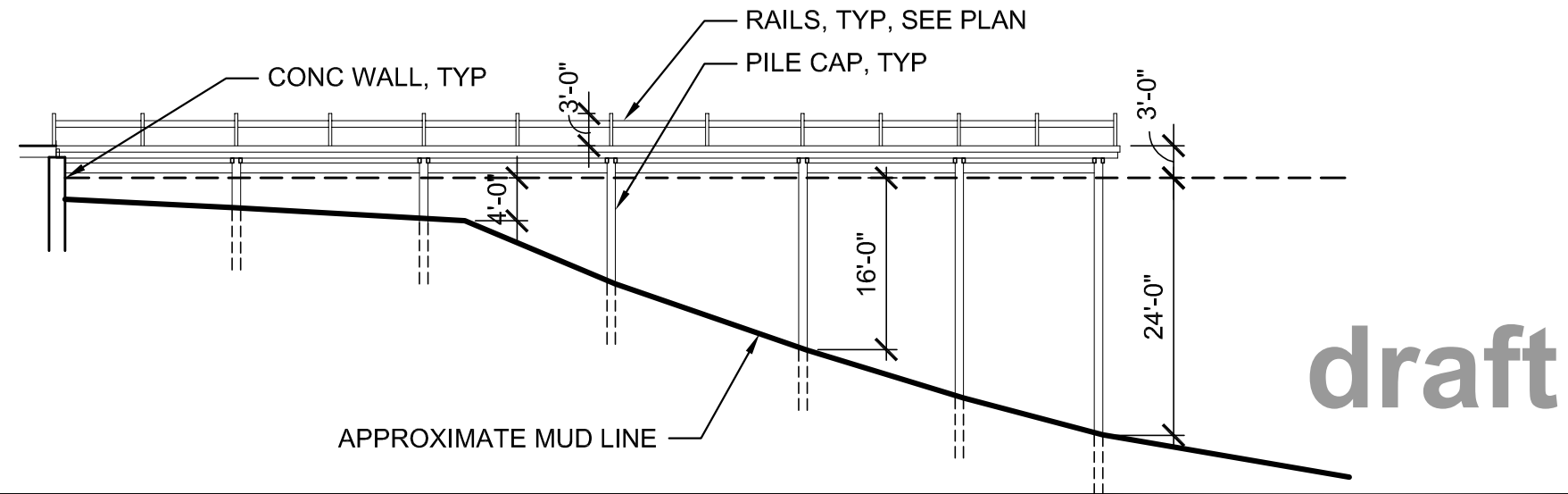
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 DATE 4/14
 PROJ. NO. KE140078A



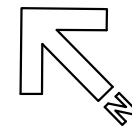
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2 PIER SECTION
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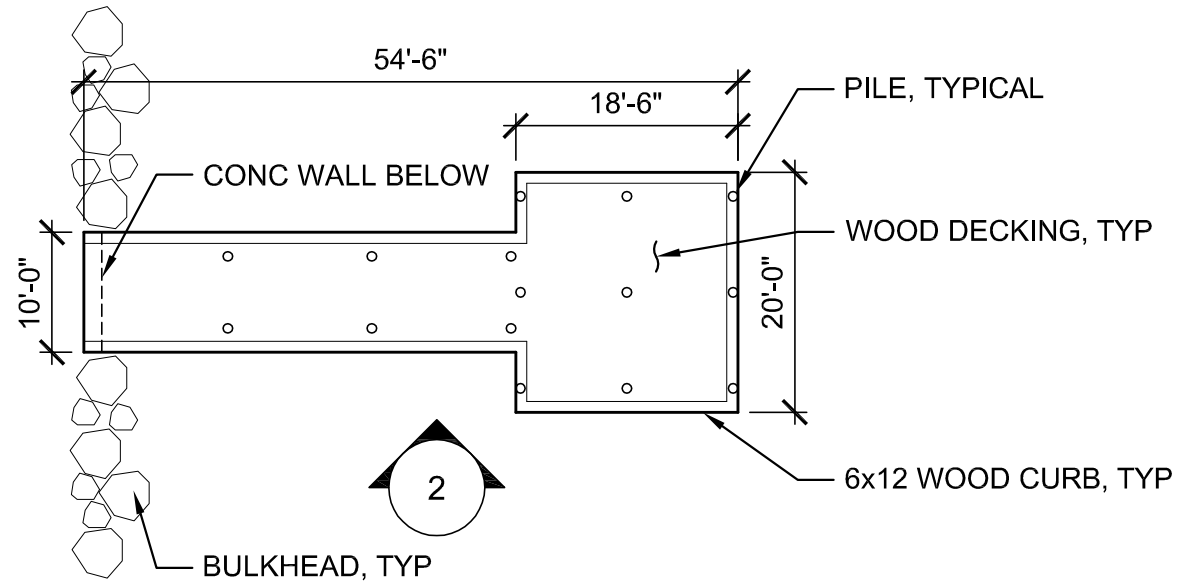
LARGE PIER - PLAN AND SECTION
 CLARKE BEACH PARK
 CITY OF MERCER ISLAND
 SCALE: NTS

DATE	4/2014
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CHECK	LD
JOB	2014001

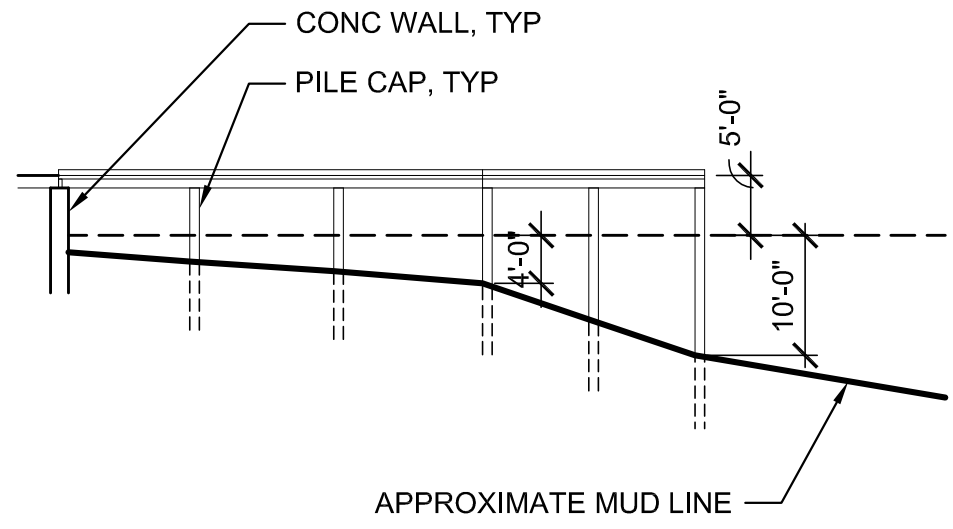
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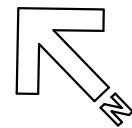
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2 PIER SECTION
SCALE: approx. 1/16" = 1'-0"



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<p>701 Dexter Avenue North Suite 301 Seattle, WA 98109-4342 T: 206.285.4300 F: 206.285.4371 W: WWW.OACENGINEERS.COM</p>	DATE	4/2014	<p>SMALL PIER - PLAN AND SECTION CLARKE BEACH PARK CITY OF MERCER ISLAND</p>		<p>FIGURE B3</p>
	DRAWN	PK	CHECK	LD	
	JOB	2014001	SCALE: NTS		

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Clarke Beach Park – Representative Photos



Photo 1B – Kid's swim area / bulkhead



Photo 2B – Shoreline steps



Photo 3B – Sheet piling with fish windows



Photo 4B – Rock bulkhead / riprap bank



Photo 5B – Shoreline steps



Photo 6B – Shoreline steps / added sheet piling

Clarke Beach Park – Representative Photos



Photo 7B – Cracked shoreline steps



Photo 8B – Rock bulkhead / riprap bank



Photo 9B – Natural shoreline



Photo 10B – Small pier



Photo 11B – Deteriorated wood rail



Photo 12B – Deteriorated wood rail



Photo 13B – Swim ladder



Photo 14B – Weathered wood decking



Photo 15B – Typical pier construction



Photo 16B – Typical pier construction



Photo 17B – Treated timber piles



Photo 18B – Treated timber piles



Photo 19B – Split pile



Photo 20B – Small pier



Photo 21B – Fire damage at small pier



Photo 22B – Looking east along small pier

Appendix C

Groveland Park

Summary Tables

C.1 – Shoreline Structures

C.2 – Overwater Structures

Figures

C1 – Park Map

C2 – Large Pier, Plan and Sections

C3 – Small Pier, Plan and Sections

Representative Photos

1C – 32C

Table C.1: Groveland Park - Shoreline Structures

Loc	OBSERVATION			RATING					MITIGATION			
	Shoreline Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Short-Term Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
1	Concrete Bulkhead [approx 250 ft of shoreline]	Potholes/settlement of sand behind bulkhead; vertical cracks observed in face of bulkhead at several locations; no widespread undermining observed by diver; 16" long piece of concrete missing near toe of bulkhead ~80" N of S end; 18" long crack up to ~2" wide observed near toe ~115' N of S end; ~2.5' x 4" hole in bulkhead at it toe ~45' N of S end; weep holes (form remnants?) at 10' o.c. at top of footing along length of bulkhead - at least some are fully penetrating.	Potholes in beach sand behind bulkhead line up with voids/cracks observed in the bulkhead; potholes/settlement likely caused by washout of sediment by wave action through voids/cracks.	8	8	6 due to settlement of beach sand behind bulkhead	9	10-20	Periodic importation and placement of new beach sand behind wall.	\$2,000 - \$3,000 per event	Remove existing material behind bulkhead and replace with graded aggregate with filter fabric; placement of cobble and gravel aggregate at toe.	\$70,000 - \$85,000 plus \$500/year for annual monitoring
2	Beach 1 [behind bulkhead]	Erosion/rilling of beach sand.	Erosion by surface water runoff from upland area behind beach.	N/A	8	6	10	5-10	Periodic grading of beach surface to remove rills with importation of new sand as needed.	\$3,000 - \$4,000 per event	Installation of an interceptor drain at head of beach.	\$8,000 - \$10,000
3	Beach 2 [north of bulkhead] [approx 60 ft of shoreline]	Logs placed at head of beach have been undermined and have the potential to become unstable and shift resulting in collapse of the overlying bank and possible injury.	Undermining of log by wave action	N/A	5	9	5	0-10	Anchor log to upland area behind beach using deadman anchors.	\$8,000 - \$10,000	Replace log with a "soft" structure consisting of new logs anchored with boulders.	\$30,000 - \$35,000

Table C.2: Groveland Park - Overwater Structures

Loc	OBSERVATION			RATING					MITIGATION			
	Shoreline Structure	Condition	Cause	Rating for Structure (1-10 = poor-good)				Unmitigated Life Expect. (years)	Short-Term Mitigation		Long-Term Mitigation	
				Condition	Function	Aesthetic	Safety		Options	Est. Costs	Options	Est. Costs
4	Large Pier Superstructure	Superstructure consists of precast concrete slabs (typical and main pier). Asphalt topping and small amount of wood decking at south return adjacent to shoreline. Vertical wood plank wall / wave break at inboard side of pier, wood railing at outboard side of pier. Concrete slabs are weathered and cracked; fasteners to wood stringers loose. North end of pier sways noticeably in east-west direction. Wood skirt wall / wavebreak is deteriorated.	age weathering wood decay wave action	4	4	5	5	1 - 2	Remove and replace concrete slabs with marine grating . Replace wood rail and skirting. Assess condition of subgrade at asphalt topping.	\$90,000 - \$120,000	See substructure option below	N/A
	Large Pier Substructure	Substructure consists of treated timber stringers supported by timber piles. Stringers appear to be sagging / deflecting at north end of pier. Diver reports the following: Timber piles appear to be un-treated and many are in very poor condition at the waterline. Some piles have lost bearing at superstructure (17 of 49 piles have advanced decay; remainder have moderate to advanced decay; 6 of 49 piles have been previously repaired (piles have been "canned" with concrete filled steel tubes). Diagonal bracing is loose and connection hardware was observed to be corroded.	age weathering wood decay steel corrosion	2	3	N/A	4	1 - 2	Repair piles in-place with splicing; repair bracing and stringers as necessary. * NOTE: This option leaves untreated but intact piles in place and therefor is assumed to extend the pier's service life by a modest amount (10 - 20 years)	\$110,000 - \$130,000	Replace existing pier and substructure with new steel structure (estimated service life = +50 years)	\$275,000 - \$350,000
5	Small Pier Superstructure	Wood decking and rails. Decking is weathered / decayed in some areas; limited selective replacement has occurred.	age weathering wood decay	6	6	6	7	5 - 10	Continued selective decking replacement and repair allowance.	\$8,000 - \$10,000	Replace wood decking with proprietary marine grating system.	\$30,000 - \$45,000
	Small Pier Substructure	Construction and condition same as large pier - see notes above (3 of 24 piles have advanced decay; remainder have moderate to advanced)							Repair piles in-place with splicing; repair bracing and stringers as necessary.	15,000 - \$25,000	Allowance for future similar repair work in 10 - 15 years.	\$20,000

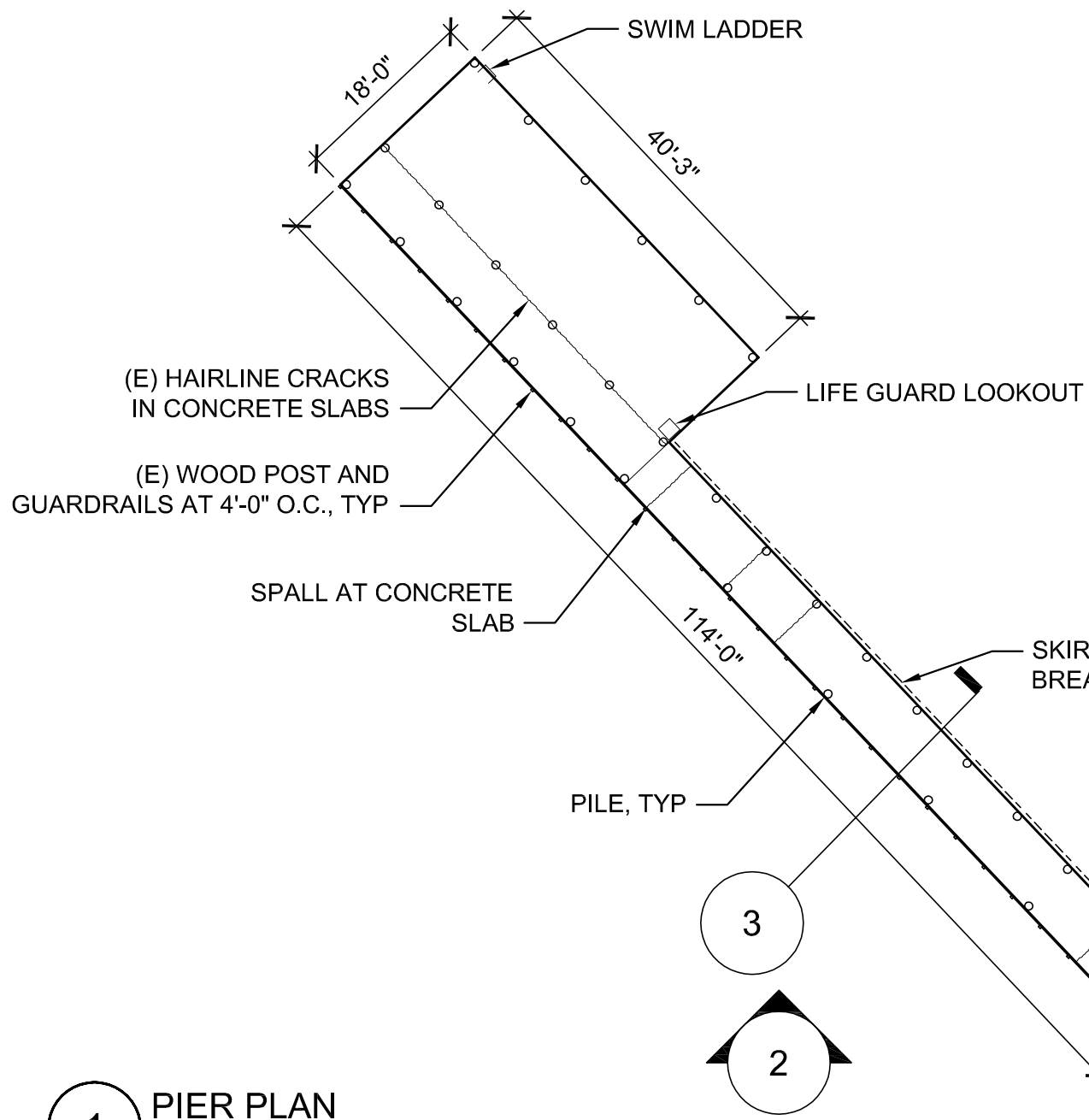


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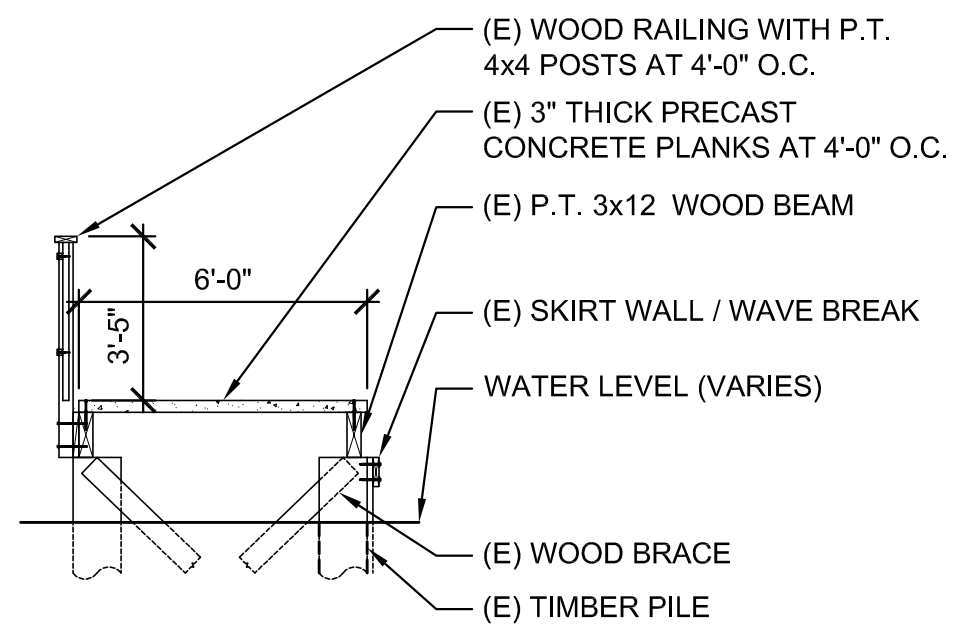
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SITE PLAN - GROVELAND BEACH PARK
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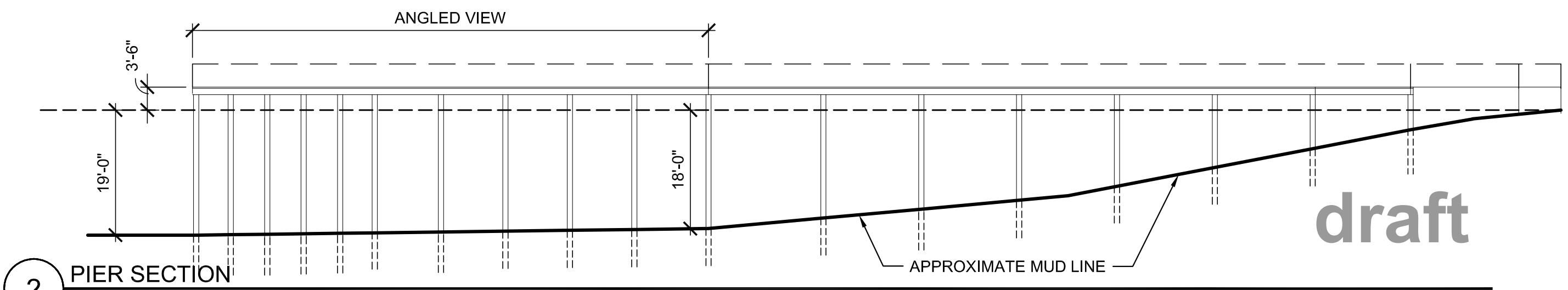
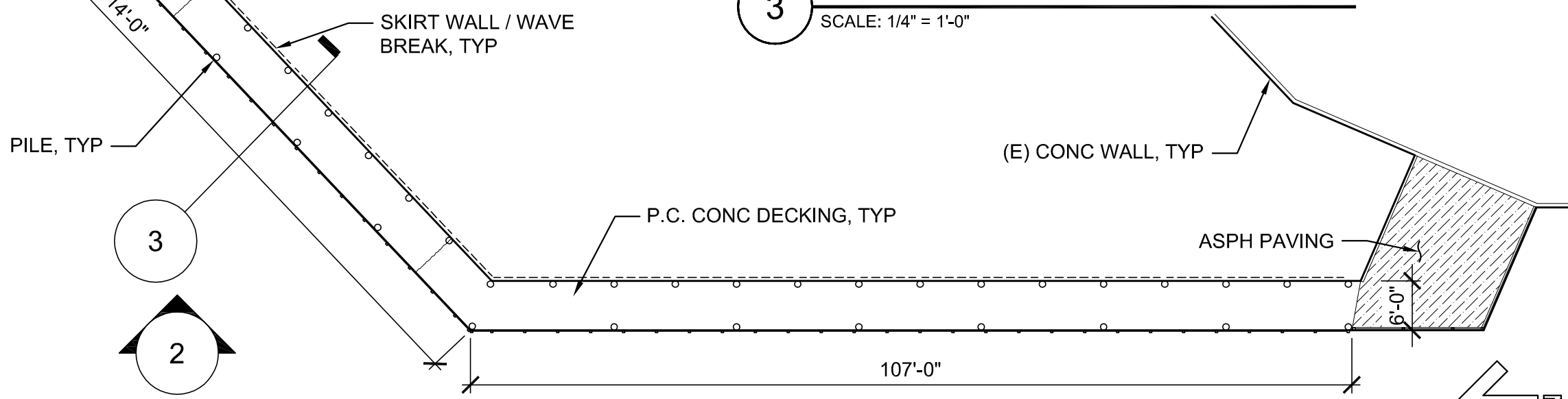
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DATE 4/14
PROJ. NO. KE140078A



1 PIER PLAN
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3 TYPICAL PIER SECTION
SCALE: 1/4" = 1'-0"



2 PIER SECTION
SCALE: approx. 1/16" = 1'-0"

FIGURE C2

LARGE PIER - PLAN AND SECTION
GROVELAND BEACH PARK
CITY OF MERCER ISLAND
SCALE: NTS

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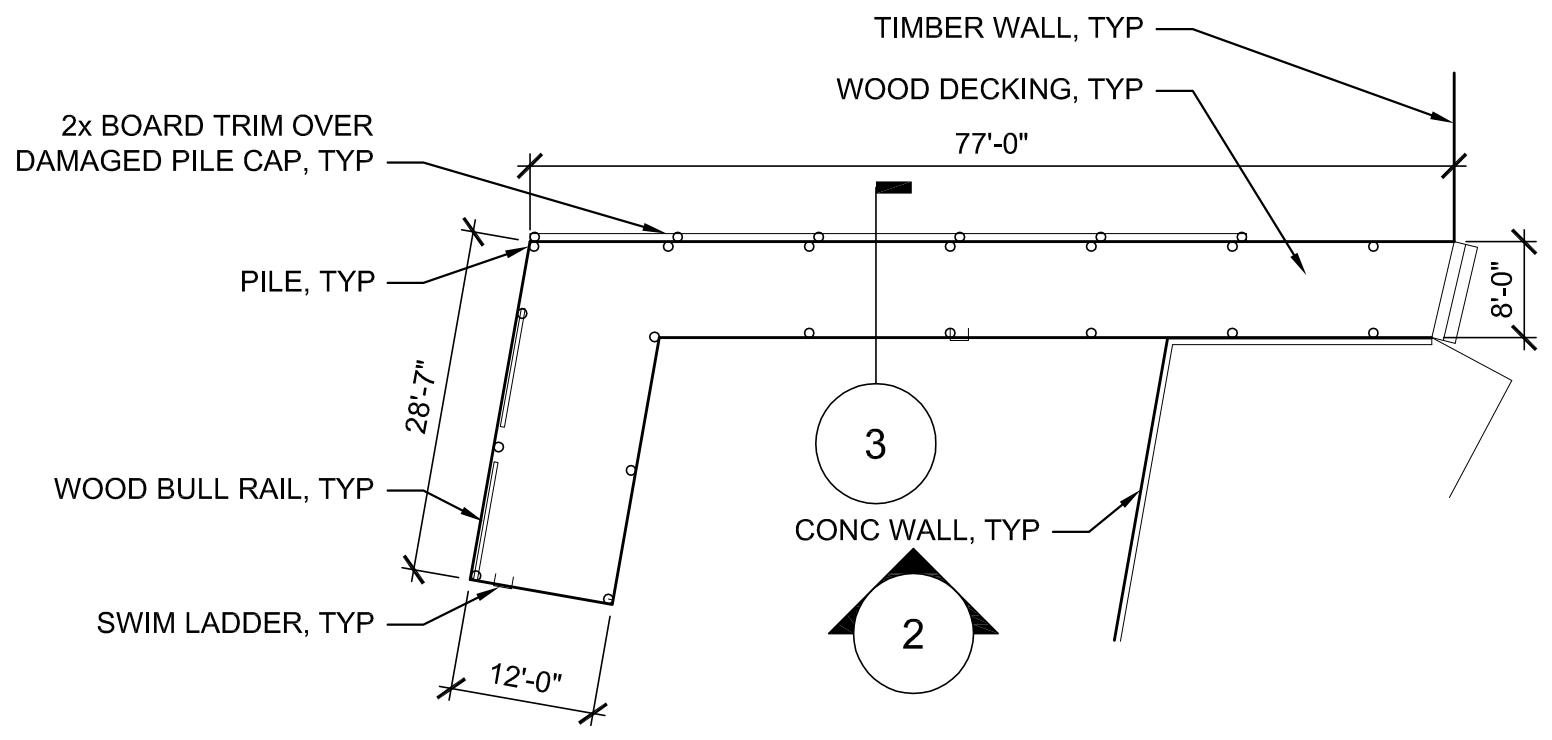
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SMALL PIER - PLAN AND SECTION
GROVELAND BEACH PARK
CITY OF MERCER ISLAND
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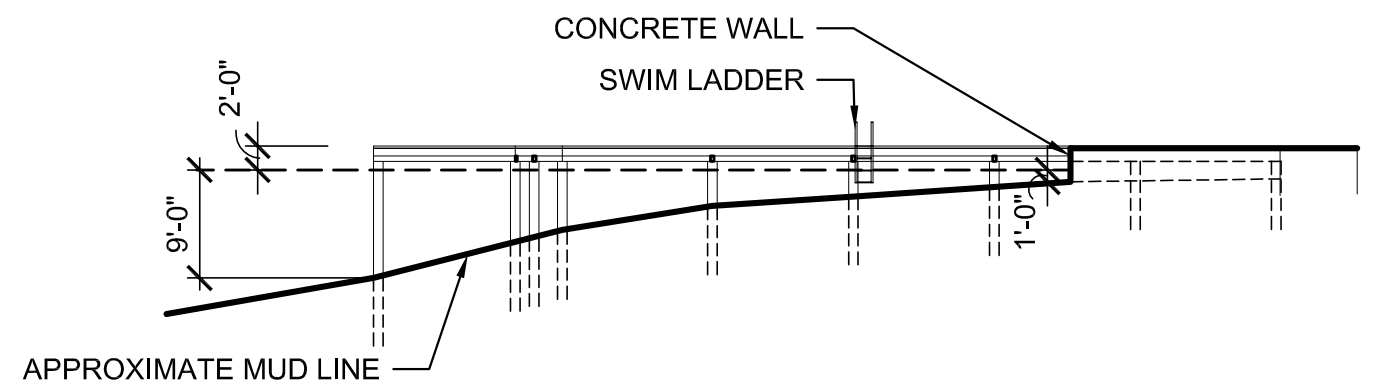
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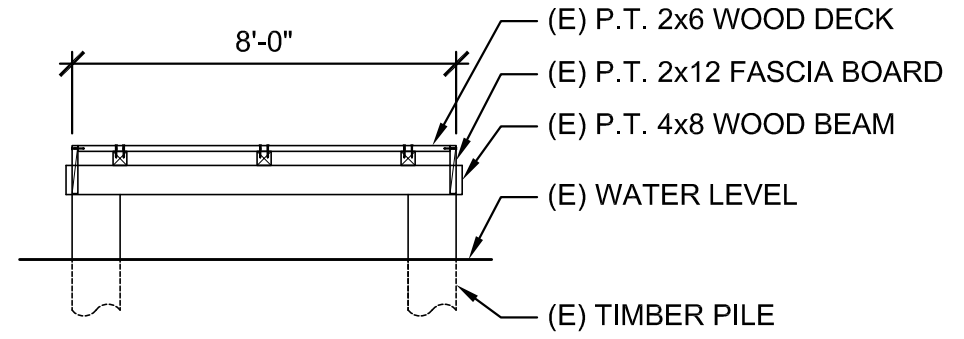
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1 PIER PLAN
SCALE: approx. 1/16" = 1'-0"



2 PIER SECTION
SCALE: approx. 1/16" = 1'-0"



3 TYPICAL PIER SECTION
SCALE: 1/4" = 1'-0"

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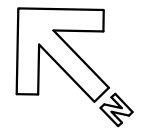




Photo 1C – Groveland Beach 1



Photo 2C – Cracked bulkhead



Photo 3C – Eroded sand, Beach 1



Photo 2C – Rilled sand, Beach 1



Photo 5C – Undermined bulkhead toe



Photo 6C – Undermined bulkhead toe



Photo **7C** – Log bulkhead



Photo **8C** – Large pier, south return



Photo **9C** – Large pier, looking north



Photo **10C** – Large pier, looking south



Photo **11C** – Large pier, north end



Photo **12C** – Missing rail picket



Photo **13C** – Deteriorated skirt wall



Photo **14C** – Cracked concrete pier slab

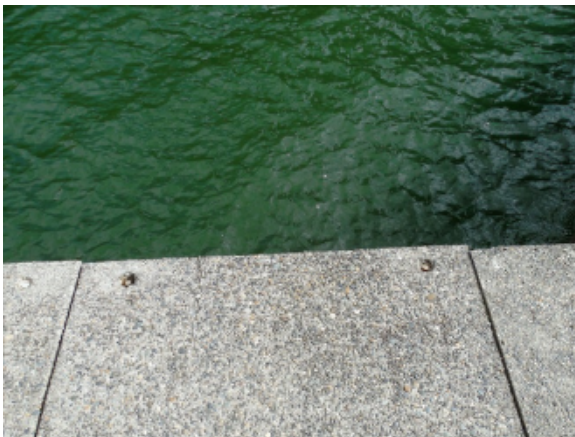


Photo **15C** – Loose slab connections



Photo **16C** – Weathered, spalled slab



Photo **17C** – Decayed top of pile



Photo **18C** – Large pier deck, stringers and pile

Groveland Park – Representative Photos



Photo 19C – Loose bracing connector



Photo 20C – “Canned” pile (previous repair)



Photo 21C – Severely decayed pile



Photo 22C – Severely decayed pile, loss of bearing



Photo 23C – Large pier substructure



Photo 24C – Decayed pile, loose connection hardware



Photo 25C – Decayed pile



Photo 26C – Decayed pile

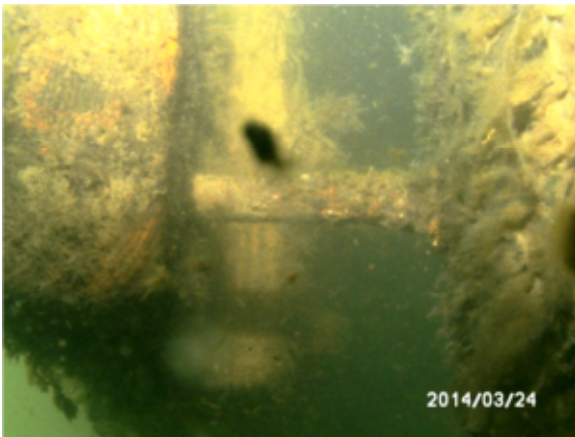


Photo 27C – Corroded fastener

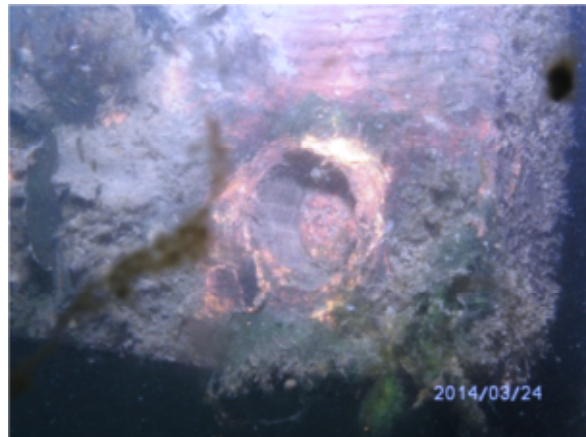


Photo 28C – Corroded fastener



Photo 29C – Small pier



Photo 30C – Small pier decking, past repair



Photo 31C – Decayed decking, small pier



Photo 32C – Decayed pile, small pier