WESTMAR ADVISORS

December 21, 2018

City of White Rock
15322 Buena Vista Avenue,
White Rock, BC V4B 1Y6

Project No.: 1180031

Attention: Rosaline Choy, P.Eng. Manager of Engineering

Reference: White Rock Pier – Emergency Inspection December 20, 2018

1 Introduction

Westmar Advisors Inc. (Westmar) was requested by the City of White Rock (CoWR) to attend White Rock Pier on December 20, 2018 to assess damage caused by a storm event earlier on the same day.

Facility: White Rock Pier, BC

Inspected by: Westmar Advisors Inc. - Daniel Leonard, P.Eng.
Westmar Advisors Inc. - Vignesh Ramadhas, P.Eng.
Foreshore Technologies Inc. - Dominic Gerelle
Vancouver Pile Driving Ltd. - Ian Purvis

Time: December 20, 2018 2100 hr to 2330 hrs

1.1 Scope of Work

The scope of work is as summarized below:

- A high level visual inspection from the shore during the low tide of December 20, 2018 to identify obvious damage caused by the storm event earlier on the same day. The following components of the facility were inspected:
  - Sections of the pier from the shore abutment to edge of the dredge pocket for the marina (approximately Bent No. 92);
  - East float, onshore side of breakwater, limited sections of the shoreline protection on either side of the shore abutment (all viewed from a distance);
- The preparation of a letter presenting the inspection findings and recommendations for repairs. An order of magnitude cost estimate to implement repairs to restore the Pier to its previous condition will also be included. It is noted that CoWR may choose to repair the Pier to an upgraded condition such that it will be more resistant to similar storm events in the future. The upgraded condition will result in a higher cost than just returning the Pier to its previous condition and the design for the upgraded condition is beyond the scope of this assignment at this time.

1.2 Evaluation of Results

The inspection, related findings, and recommendations are based on the following:

- Published recommendations and standards relating to structures of this type have been used as a guide to develop the scope of work for this inspection.
- The inspection, findings, and recommendations are based on our engineering judgment and familiarity with the design, construction, and maintenance requirements of similar structures.
- The inspection findings and recommendations are based on our field data.
- The findings and recommendations are for the use of the CoWR only.
- The findings and recommendations are Westmar's assessment of the condition of the structure at the specific time of the inspection.
- The inspection is based on examining and reporting only on the condition of the structure. It is not intended as a check of the original design.
- As the inspection is based on visual observations, there is a possibility that hidden or latent defects have not been detected during the course of the inspection. Users of the facility should always report any unusual conditions so that they can be evaluated.

1.3 Reference Material

The following reference material was made available prior to the inspection:

- WorleyParsons Report No. 307071-00353-00-MA-REP-0005_Rev 0 - White Rock Pier Load Rating and Light Pole Analysis dated December 16, 2011.

2 Description of the Structure

2.1 Description

The White Rock Municipal Pier is located on the north side of Semaihmoo Bay along the White Rock Beach Promenade and Marine Drive. The timber pier structure is approximately 470 m long and extends, in the north to south direction, from the shore out into the bay. A breakwater and mooring float facilities are located at the southern end of the pier.

The pier originally constructed in 1914/1915 underwent a significant repair and restoration program in 1977. Minor repairs and timber replacement have been implemented since then as part of CoWR's ongoing inspection and maintenance program.

2.2 Geometry

The pier structure is of timber construction and consists of piles, pile caps, stringers and decking. Member geometry as indicated on the reference drawings is outlined below:

- Timber Deck: 38 mm by 285 mm
- Stringers: 100 mm by 300 mm
- Edge Stringers: 150 mm by 300 mm
- Pile Caps: 200 mm by 250 mm
- Piles: 305 mm diameter

2.3 Reference System

Bent numbering starts at the North end of the pier and increases sequentially to the South. The bent located closest to shore is numbered as Bent No. 1. Bayline numbering start at the West end and increases towards East. The west most pile at each bent is numbered "A".

3 Inspection Results

General observations from the inspection are presented in this section. Detailed findings are presented in Appendix 1.

In reviewing results of the inspection, please note the following:

- The term "serviceable condition" is used to describe a structure, or a specific element of a structure, which is considered to still function in the manner in which it was originally intended.
- The term "monitor for further deterioration" is used to describe an element with damage and/or deterioration but does not require immediate remedial action. It is anticipated that repairs will be required in the future.

3.1 Inspection Findings

Damage identified to the White Rock Pier directly attributed to the storm event of December 20, 2018 is summarized as follows. Photos recorded during the inspection are presented in Appendix 2.

The recommended actions noted are to restore the Pier to its previous condition. It is noted that CoWR may choose to repair the Pier to an upgraded condition such that it will be more resistant to similar storm events in the future. Recommendations for the upgraded condition are beyond the scope of this assignment at this time.

- Several pile bents along the pier have sustained impact damage likely from floating debris and/or loose vessels. Typical damage observed during the inspection includes displacement of pile resulting in failure of drift pins, fracturing of piles at connection to pile cap and failure of cross bracing. A detailed list of damage identified during the inspection along with recommended repair is presented in Appendix 1.
- The section of the Pier between Bent No. 33 to Bent No. 43 has failed completely (Photograph Nos. 1 to 3). Most piles and all superstructure at this location are missing. Utilities and power lines at this location have been dislodged from their installed position and have been strewn on the East side. Debris from damaged boats have been lodged along this section of the pier.

Removal of debris from this location, replacement of pile bents and superstructure and installation of removed utilities and power lines is recommended.

- There is severe damage to Bent Nos. 51 and 52 with most piles missing. This has resulted in the superstructure no longer being supported at this location.

Replacement of missing piles and damaged sections of the superstructure is recommended.

- Most sections of the West marina float have been dislodged from their moored position, rotated 90 degrees towards the shoreline and deposited on the beach (Photograph Nos. 4 and 5). The mooring piles have failed but are attached to the side of the float. The west gangway is supported by a small section of float that is still in place.

Replacement of the west marina float is recommended.

- In speaking to marina users that were present during the inspection, Westmar understands that a total of the 34 boats were moored at the marina before the storm. During the inspection, Westmar observed two sets of three boats grounded on the west side of the Pier between Bent No. 60 to 70. Three to four boats were loose and floating near the bottom of the west gangway. It is inferred that the remaining boats were either destroyed due to collision with the piles (Photograph Nos. 6 and 7), dispersed within a few hundred metres east of the Pier, or on the rocks along the shoreline at East Beach. There are several outboard motors that are dispersed in the beach west of the Pier.

Removal of debris is recommended.

- The east float and gangway appear to be in a serviceable condition with no visible signs of major damage from the storm event.
- There is no observable damage to the new services that were installed beneath the shore abutment (Photograph No. 8). The construction fencing that was around this area is strewn around this area of the beach and partially covered with sand with some fence sections destroyed.

Following the inspection, Mr. Daniel Leonard from Westmar visited the Fire Hall in White Rock and discussed Westmar's concerns related to further damage to the Pier due to changing tides with Fire Chief Lemire. Westmar's concerns were as follows:

- There was a high potential for the loose boats and broken west float to cause further damage to the pier with rising tides (high tide was just before 600 hrs). In particular, the two sets of rafted boats with bows under the Pier were of concern;
- Further damage to the remaining section of west float could result in failure of the west gangway.

Fire Chief Lemire first called the Coast Guard but the Coast Guard was unable to confirm their ability to respond prior to high tide. A private company in Steveston that was already rescuing boats in Ladner was contacted and they confirmed that they could respond in short order. Fire Chief Lemire also received approval from Mr. Dan Bottrill, Chief Administrative Officer, City of White Rock for costs associated with the emergency call-out. The following instructions were provided to the private boat rescue company:

- Sail boats to be pulled away from the Pier and tied up to the east float;
- Twisted portion of the west float to be cut to allow the serviceable portion of the west float to continue supporting the gangway; and
- Identify a safe moorage location for the damaged portion of the west float.

4 Summary and Cost Estimate

Based on the findings of our inspection, Westmar considers the White Rock Pier to be no longer in a serviceable condition with several sections of the pier damaged and/or missing. It is recommended that a repair/rehabilitation program be undertaken to restore the facility to a safe and operable condition.

A summary of order of magnitude cost estimates to return the Pier to its previous condition is presented below. It is noted that CoWR may choose to repair the Pier to an upgraded condition such that it will be more resistant to similar storm events in the future. The upgraded condition will result in a higher cost than just returning the Pier to its previous condition and the design for the upgraded condition is beyond the scope of this assignment at this time.

Description	Unit	Rate	Cost
Mobilization / Demobilization	1	$150,000	$150,000
Demolition and Disposal	1	$250,000	$250,000
New Pile Installation	75	$12,000	$900,000
Deck Replacement	520	$1,400	$730,000
Bracing and Pile Cap Replacement	1	$250,000	$250,000
Lighting Replacement	1	$75,000	$75,000
Watermain Repairs	1	$25,000	$25,000
Power and Communications Repairs	1	$75,000	$75,000
Float Replacement	270	$950	$300,000
Contingency (35%)			$1,000,000
Total			**$3,760,000**

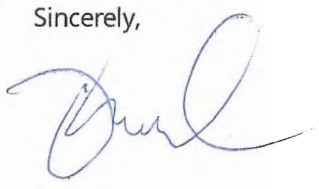
In reviewing the above estimated costs, note the following:

- The estimate is based on in-house experience and budget price quotations from local contractors and suppliers for similar projects.
- The estimate is in Canadian dollars and is based on prices at the fourth quarter (Q4) 2018.
- The estimate assumes a competitive bidding process.
- The estimate is based on replacement of structural elements with those of similar type and size.

- The estimate includes an allowance for mobilization/demobilization. There may be an opportunity for cost savings if the work can be done in conjunction with other work in the vicinity so that mobilization/demobilization costs can be shared.
- The estimate does not include:
  - any applicable taxes;
  - escalation;
  - permitting;
  - owner's costs;
  - and allowances for ongoing future maintenance, upgrades, or further remedial measures unless indicated.
- A contingency of 35% of the total estimated cost is included. The contingency is not a reflection of the accuracy of the estimate, but covers undefined items of work which will have to be performed, and elements of cost which will be incurred, but which are not explicitly detailed or described due to the level of engineering and estimating which has been completed to date.
- The total estimated cost, including contingency, is considered accurate to ±50%.

Please do not hesitate to contact us at 604-562-4797 or via email at dleonard@westmaradvisors.com should you have any questions or require additional information or clarification.

Sincerely,



Daniel Leonard, P.Eng.
Vice President
Westmar Advisors Inc.

cc: Jim Gordon, City of White Rock
Phil Lemire, City of White Rock
Vignesh Ramadhas, Westmar Advisors Inc.

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Appendix 1 – Inspection Findings

Bent No	Pile	Description	Recommendations to Restore the Pier to its Previous Condition
4	C	Pile cap fractured above pile C	Repair pilecap
5	A	Pile has displaced 50 mm to the East	Monitor for further Deterioration
	B	Pile fractured at top 900 mm. Drift pin connection to pile cap has failed	Replace Pile
6	A	Pile to pilecap connection has failed	Replace Pile
	B	Pile to pilecap connection has failed	Replace Pile
8	-	Cross brace is fractured	Replace cross brace
	C	Pile is split in the top 600 mm	Install steel clamps
9	C	Pile is split in the top 900 mm	Install steel clamps
10	A	Pile has displaced 75 mm to the East	Monitor for further Deterioration
11	A	Pile has displaced 125 mm to the East. Pile is split in the top 1500 mm.	Replace Pile
	B	Pile is split in the top 600 mm	Install steel clamps
12	A	Pile has displaced 100 mm to the East.	Monitor for further Deterioration
	-	Cross brace is fractured	Replace cross brace
13	A	Pile has displaced 50 mm to the East.	Monitor for further Deterioration
	B	Pile is split in the top 600 mm	Install steel clamps
14	-	Cross brace is fractured	Replace cross brace
15	A	Pile has displaced 75 mm to the East. Pile is split in the top 900 mm.	Replace Pile
17	A	Pile has displaced 75 mm to the East	Monitor for further Deterioration
20	A	Pile has displaced 75 mm to the East	Monitor for further Deterioration
	-	Cross brace is fractured	Replace cross brace
21	A	Pile fractured at top 1200 mm. Drift pin connection to pile cap has failed. Pile has displaced 100 mm to the east	Replace Pile
	B	Pile fractured at top 900 mm. Drift pin connection to pile cap has failed. Pile has displaced 75 mm to the east	Replace Pile
22	A	Pile has displaced 25 mm to the East	Monitor for further Deterioration
	-	Cross brace is fractured	Replace cross brace
23	A	Drift pin connection to pile cap has failed. Pile has displaced 450 mm to the east.	Realign pile and attach to pilecap with steel straps
25 to 26	-	Boat debris lodged between bents	-
25	A	Pile has displaced 25 mm to the East	Monitor for further Deterioration
	C	Pile has displaced 75 mm to the North	Monitor for further Deterioration

Bent No	Pile	Description	Recommendations to Restore the Pier to its Previous Condition
26	A	Drift pin connection to pile cap has failed. Pile has displaced 300 mm to the east	Replace Pile
	-	Cross brace is fractured	Replace cross brace
27	A	Pile fractured at top 900 mm. Drift pin connection to pile cap has failed. Pile has displaced 100 mm to the east	Replace Pile
28	A	Pile fractured at top 600 mm. Drift pin connection to pile cap has failed. Pile has displaced 150 mm to the east	Replace Pile
29	A	Pile has undergone significant displacement and is no longer supporting the pilecap	Replace Pile
	B	Drift pin connection to pile cap has failed. Pile has displaced 200 mm to the east	Replace Pile
	-	Cross brace is fractured	Replace cross brace
31	A	Pile is missing	Replace Pile
33	A	Pile fractured at top 1500 mm. Drift pin connection to pile cap has failed.	Replace Pile
33 to 44	All	Piles are either missing or have failed	Replace Piles
	-	Super structure is missing	Replace superstructure
45	A	Pile fractured at top 1500 mm. Drift pin connection to pile cap has failed.	Replace Pile
45	A	Pile fractured at top 1200 mm. Drift pin connection to pile cap has failed.	Replace Pile
48 to 49	-	Boat debris lodged between bents	-
50	A	Drift pin connection to pile cap has failed.	Replace Pile
51 to 52	-	Piles damaged or missing	Replace Piles
	-	Superstructure is unsupported or damaged	Replace/repair superstructure
51 to 53	-	Watermain has failed and is missing	Reinstall watermain
54	-	Cross brace is fractured	Replace cross brace
	-	Watermain has failed	Reinstall watermain
55	A	Pile fractured at top 1200 mm. Drift pin connection to pile cap has failed.	Replace Pile
60	A	Pile is missing	Replace Pile
60 to 61	-	Boat debris lodged between bents	-
83 to 85	-	Boat debris lodged between bents	-

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Appendix 2 – Photos

Photo 1: Failed section of Pier between Bent No. 33 to 44

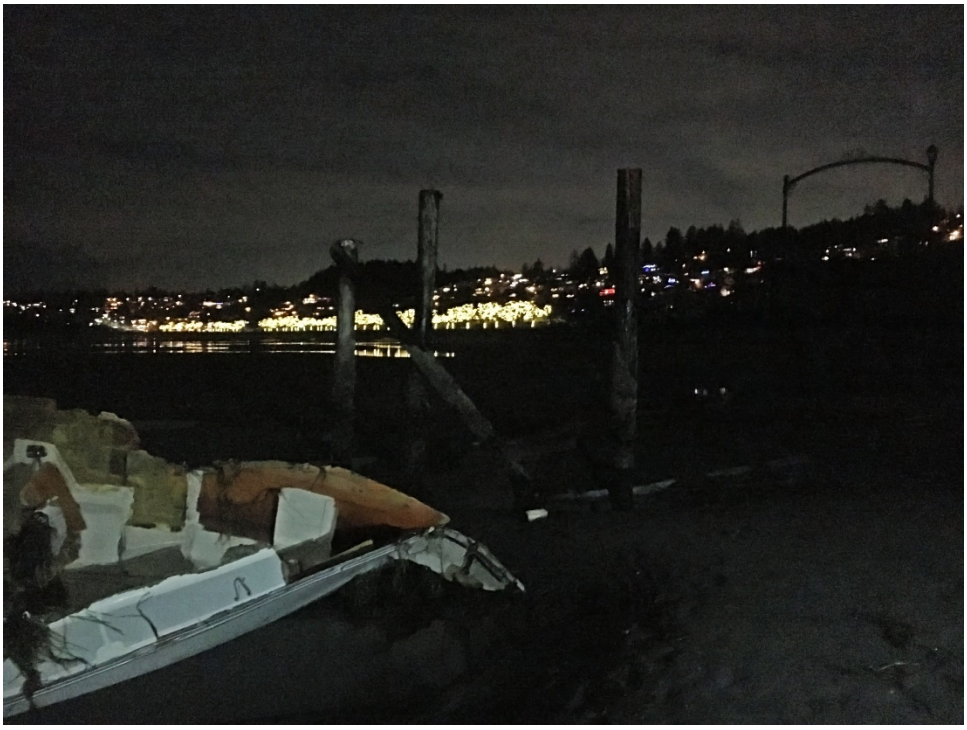

Photo 2: Failed section of Pier between Bent No. 33 to 44

Photo 3: Failed section of Pier between Bent No. 33 to 44

Photo 4: Failed section of West Marina Float

Photo 5: Failed section of West Marina Float

Photo 6: Boat debris lodged between pile bents

Photo 7: Boat debris lodged between pile bents

Photo 8: New services installed near shore abutment