

## **APPENDIX A**

### **UNDERWATER INSPECTION REPORT BY WATECH SERVICES INC.**



**UNDERWATER INSPECTION OF LAKE ST. CLAIR SEAWALL  
SEAWALL INSPECTION  
Windsor, Ontario**

**Prepared for:  
LANDMARK ENGINEERS Inc.**

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**WSI 19194**



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Above Water Photographs

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## **1. INTRODUCTION**

WATECH SERVICES INC. was retained by Landmark Engineers Inc. in October 2019 to carry out an underwater visual inspection of the existing structures that comprise a section of Lake St. Clair seawall along Riverside Drive in Windsor, Ontario. The location of the inspected seawall is shown on Figure 1.

The inspection work included visual examination above and below the water level. The inspection was carried out in order to determine present conditions and provide details for any identified repair or reconstruction requirements.

## **2. INSPECTION**

### **2.1. General**

The fieldwork was carried out by a three person WATECH SERVICES INC. inspection team in October and November of 2019.

Stationing was marked on the wall and/or deck for location control. The inspection began at the start of the steel sheet piling opposite Lakeview Avenue marked as Station 0+000. The end of the inspection was marked heading west to Station 0+1350.

### **2.2. Inspection Procedures**

The above water inspection was completed from the workboat and the concrete deck of the structure.

The underwater inspection was completed by our engineering divers using surface-supplied-air diving helmets equipped with voice communication and recording equipment. The inspection divers were in constant communication with the surface personnel relaying the results of the inspection.

Underwater visibility and water conditions were generally poor. A maximum visibility of 0.3 metres of underwater visibility was noted at the time of the inspection fieldwork.

### **3. OBSERVATIONS AND INSPECTION RESULTS**

The dock wall consists of a short section of steel sheet piling with the remainder of the wall constructed of timber pile supported concrete panels.

The steel sheet pile section of the wall is in generally good condition. The piling is typically not off vertical and the interlocks are intact.

The concrete panel sections are generally in fair to good physical condition. Spalling and erosion of the top of the panels is noted in some areas and occasional cracks were noted in a few of the panels. The concrete wall panels are undermined at many locations and significant fill loss from behind the wall is noted. 100mm diameter drain holes were noted in several locations. No drain tiles were noted behind the wall and probing of the holes generally indicated voids behind the wall.

The timber support pilings where visible are in generally fair to good condition. Minor rot and decay was noted. Timber splits were noted at a few locations.

It is understood the concrete deck behind the wall is typically owned by the adjacent landowner and the City of Windsor owns the actual wall. The concrete deck in many areas is in poor condition. Fill loss from behind the wall and failures of the deck are noted in many places.

The water depth in front of the seawall was typically 1.6 to 2.0 metres in depth. The lakebed was typically soft sand and silt over a harder substrate 0.5 to 1 metre below the lakebed. Table 1 summarizes water depths at the time of the inspection. The water level measured at the CHS gauge at Belle River was approximately 1.3 metres above chart datum (174.4) for Lake St. Clair.

The following provide detailed notes of the inspection:

<b>STATION</b>	<b>DESCRIPTION</b>
0+000	Start of Inspection. Beginning of sheet piling.
0+072	End of the sheet piling, and beginning of the concrete panel wall.

0+098	Vertical joint in the concrete panel area.
0+120	Surface spalling of top of concrete dimensioned 250mm wide by 80mm high by 80mm deep.
0+144	Spalling and concrete loss along the joint of the concrete panel, dimensioned 0.3 metres long by 0.2 metres wide by 150mm deep.
0+150	Spalling and concrete loss along the concrete panel areas, dimensioned 1.5 metres long by 0.4 metres wide by 150mm deep.
0+220	Spalling along the vertical face of the concrete panel area, dimensioned 1.8 metres long by 0.2 metres high by 50mm deep
0+229	Spalling along the vertical face of the concrete panel, dimensioned 0.5 metres long by 0.2 metres high by 50mm deep.
0+270	Minor concrete loss along the curb, up to 30mm deep
0+285	Concrete panel deck has sunk 0.8 metres
0+315	Missing surface concrete along the concrete panel area, up to 80mm deep.
0+330	Panel bottom and supporting timber in good condition void 50 to 100mm at bottom of panel. Drainage hole is located in the midpoint of the concrete panel, dimensioned 100mm in diameter.
0+338	Drainage hole measuring 100mm in diameter. No drain tile visible void behind wall noted
0+346	Drainage hole measuring 100mm in diameter. No drain tile visible void behind wall noted.
0+354	Drainage hole measuring 100mm in diameter. No drain

	tile visible void behind wall noted
0+360	Broken concrete located at the joint of the curb.
0+362	Drainage hole measuring 100mm in diameter. No drain tile visible void behind wall noted
0+369.4	Broken surface concrete at the point of deflection, to a depth of 50mm below the surface of the water. The concrete panel is at a lower elevation on the offshore side of the walkway, for a distance of 8.6 metres.
0+370	Drainage hole measuring 100mm in diameter. No drain tile visible void behind wall noted
0+378	End of the 8.6 metre long slope of the concrete deck. End of void at bottom of concrete panel.
0+420	The concrete panel area is at a higher elevation on the west side, and a lower elevation on the east side
0+428	Spalled concrete along the panel area, dimensioned 1 metre long by 0.5 metres wide by 100mm deep.
0+435	Concrete deck is in poor condition, with cracking and missing concrete. Beginning of offshore steel sheeting.
0+450	Failed inshore concrete panel for a length of 5 metres, and damage along the concrete wall joint, dimensioned 0.5 metres wide by 2.5 metres long by 200mm deep.
0+455	End of the failed offshore concrete panel.
0+469	Spalled concrete along the offshore edge.
0+520	Concrete deck is in poor condition; the panel is at a lower elevation towards the water for a length of 10 metres. Spalled and missing concrete is present along the offshore edge. Wall generally has a 30mm to 102mm gap between the lake bottom and the concrete wall.

0+530	End of sloping concrete panel
0+550	Two areas of spalling along the top of the wall, measuring each 2.5 metres in length. A drain hole was probed measuring 1.5 p.
0+555	End of spalled concrete area.
0+570	Failing concrete deck in very poor condition
0+557	Concrete deck is broken, with a large crack travelling diagonally across the slab. Crack width is approximately 50mm.
0+563	Spalled concrete along the top of the wall.
0+576	Spalled concrete located along the offshore edge of the concrete wall.
0+580	Typical vertical joints up to the 30mm gap. Concrete deck is sloping towards the water.
0+583	Spalled concrete along the offshore edge of the concrete wall.
0+590	Concrete deck is in poor condition, sloping towards the water.
0+600	Spalled concrete along the offshore edge of the concrete panel. Hard material present at 1 metre past the face of the underwater portion of the wall. Concrete wall is in typical condition.
0+610	Surface cracking along the concrete panel.
0+620	Surface cracking along the concrete panel.
0+621	Continuation of 30mm to 100mm gap between the lake bottom and concrete wall bottom. Continuation of surface cracking along the concrete panel.

0+630	Continuation of surface cracking along the concrete panel.
0+639	Rocky bottom along the riverbed. Continuation of surface cracking along the concrete panel.
0+640	Continuation of surface cracking along the concrete panel.
0+649	Spalled concrete along the offshore edge of the concrete wall.
0+660	Surface cracking is continued along the concrete panel.
0+670	Continued surface cracking along the concrete panel area.
0+671	Vertical crack in the concrete wall, beginning at the lake floor up to the full height of the wall. The vertical crack diameter is 3mm wide.
0+680	Continued surface cracking along the concrete panel area. Vertical joints are in good condition.
0+690	End of surface cracking along the concrete panel area.
0+694	Spalled concrete along the offshore edge.
0+708	Concrete is in good condition. There are typical gaps along the bottom and stones up to 100mm in diameter along the lake bottom.
0+723	Gap along the bottom of the concrete wall, measuring 200mm. Timber is exposed up to 200mm, and has a vertical split measuring 200mm long by 13mm wide.
0+725	Spalled concrete along the offshore edge of the concrete wall.
0+733 to 0+740	Failed concrete deck. Concrete panel is demolished



	throughout into many pieces.
0+740	Concrete deck is in poor condition. Multiple cracks are present along the surface.
0+750	Concrete deck is failing.
0+761	Typical gaps are located along the bottom, the wall is generally in good condition.
0+770	Spalled concrete along the offshore edge of the concrete wall.
0+778	Spalled concrete along the offshore edge of the concrete wall.
0+780	Concrete deck is in fair condition, with surface cracking.
0+790	Spalled concrete along the offshore edge of the concrete wall.
0+795	Spalled concrete along the offshore edge of the concrete wall.
0+796	Vertical crack beginning at the river bottom and ending at the top of the concrete panel.
0+800	Failed concrete deck in poor condition, for a distance of 135 metres.
0+803	Spalled concrete along the offshore edge of the concrete wall.
0+810	Failed concrete deck in poor condition. Spalling located along the offshore edge.
0+819	Spalled concrete along the offshore edge of the concrete wall.
0+820	Failed concrete deck in poor condition.

0+830	Failed concrete deck in poor condition. Cracking and sloping down towards the water edge has occurred.
0+834	Spalled concrete along the offshore edge of the concrete wall.
0+840	Failed concrete deck in poor condition. Spalling of concrete located on the offshore edge.
0+849	Spalled and missing concrete located on the offshore edge.
0+850	Failed concrete deck in poor condition.
0+858	Spalled concrete along the offshore edge of the concrete wall.
0+860	Failed concrete deck is in poor condition.
0+864	Spalled concrete along the offshore edge of the concrete wall.
0+870 to 0+880	Failed concrete deck is in poor condition. Spalled concrete is located along the offshore edge of the concrete wall.
0+880	Failed concrete deck is in poor condition. Spalled concrete along the surface measuring 1 metre long by 1/2 metre underwater. Surface erosion up to 25mm is present.
0+881	Spalled concrete along the offshore edge of the concrete wall.
0+890	Failed concrete deck is in poor condition.
0+895 to 0+890	Spalled concrete along the offshore edge of the concrete wall.
0+900	Failed concrete deck is in poor condition.

0+910	Concrete deck is in poor condition. Horizontal cracking along the surface of the deck. Spalled concrete located along the offshore edge of the concrete wall.
0+917	Failed concrete deck is in poor condition. Spalling located from the top of the vertical joint for a distance of 1 metre. The eroded area is 0.3 metres deep at the top, and 25mm metres deep at the bottom.
0+917 to 0+935	Spalled concrete along the offshore edge of the concrete wall.
0+935	Failed concrete deck is in poor condition. Multiple cracks and breakage.
0+940	Concrete deck is in good condition.
0+942	Spalled concrete along the offshore edge of the concrete wall. Spalling along the vertical joint with a drainpipe measuring 100mm in diameter. The spalling goes from the surface to 80mm below the water.
0+958	Spalling of concrete along the offshore edge.
0+959	Erosion along the vertical joint, measuring 300mm along the top and 25mm along the bottom, for a distance of 1 metre.
0+964	Tight vertical crack along the full height of the concrete panel.
0+973	Spalling of concrete along the offshore edge
1+000	Spalled concrete along the offshore edge of the concrete wall.
1+010	Concrete deck is in fair condition.
1+120	Spalled concrete along the offshore edge of the concrete wall.

1+040	Concrete deck is in poor condition. Cracking along the deck 1/3 of the way from the face of the wall. The deck is slanted on either side of the crack. Spalling located along the offshore edge of the deck.
1+048	Spalled concrete along the offshore edge of the concrete wall.
1+050	Concrete deck is in fair condition. Deck slants downwards towards the face of the wall.
1+060	Concrete deck is in fair condition.
1+064 to 1+070	Spalled concrete along the offshore edge of the concrete wall.
1+070	Wood support piles were located between the concrete wall and lake bottom, and were observed to have a high density. Concrete deck is in good condition.
1+080 to 1+090	Spalled concrete along the offshore edge of the concrete wall.
1+094	Spalled concrete located along the concrete deck, and along the offshore edge.
1+100	Concrete deck is in poor condition. Large cracks present.
1+140	Spalled concrete along the offshore edge..
1+155	Spalled concrete along the offshore edge of the concrete wall.
1+171	Vertical joint in poor condition. Missing concrete up to 80mm deep. Obstruction located in joint at a depth of 40mm past the surface of the joint.
1+172	Spalled concrete along the offshore edge of the concrete wall.

1+183	Spalling measured 0.6m high by 0.3m wide. A hole is located in the spalled concrete, 0.3m from the river bottom, measuring 100mm in diameter.
1+187	Spalling along the offshore edge of the concrete wall.
1+188	Vertical joint in poor condition. Missing concrete is dimensioned 0.5 metres at the top and 0.3 metres at the bottom, to a depth of 50mm.
1+193 to 1+196	Spalling along the offshore edge of the concrete wall.
1+198	A plastic drain tile measuring 100mm in diameter is located inside an opening measuring 150mm in diameter.
1+203	Spalling along the offshore edge of the concrete wall.
1+205	Spalling of the concrete is dimensioned 0.3 metres by 0.3 metres by 25mm deep. A hole measuring 100mm in diameter is located within the spalled area. A 50mm gap is located between the concrete panel and the lake bottom.
1+214	Collapsed 80mm drain tile.
1+219	Spalling along the offshore edge of the concrete wall.
1+225	Spalling along the offshore edge of the concrete wall.
1+232 to 1+237	Spalling along the offshore edge of the concrete wall.
1+265	Spalling along the offshore edge of the concrete wall.
1+275 to 1+303	Gap between the wall and lake bottom, measuring 0.3 metres in height
1+285 to 1+318	Gap located between the wall and the deck.
1+303	Gap between the wall and the lake bottom, measuring 1m high for a length of 0.5 metres.

1+304	Gap between the wall and lake bottom measures 0.3 metres. Timber piles measure 0.2 metres to 0.3 metres in diameter, and are in poor condition. Timber pile tops are eroded, and vertical cracks are present.
1+325	Corner of the concrete wall. A stone measuring 0.2 metres in diameter is located at the corner, and a gap measuring 0.3 metres wide is located between the stone and the bottom of the concrete panel. The total height of the gap, including the stone, is 0.5 metres.
1+329	Beginning of concrete retaining wall. No gaps are present.
1+345	End of concrete wall.

Table 1: Water Depths

Station	Water Depth (Metres)	Comments
0+010	1.9	Start of SSP
0+020	1.8	
0+030	1.8	
0+040	1.8	
0+050	1.9	
0+060	2.0	
0+072	1.8	End of SSP
0+080	1.9	Wall is Concrete
0+090	1.9	
0+100	1.8	

<b>Station</b>	<b>Water Depth (Metres)</b>	<b>Comments</b>
0+110	1.8	
0+120	1.7	
0+130	1.8	
0+140	1.7	
0+150	1.7	
0+160	1.8	
0+170	1.7	
0+180	1.8	
0+190	1.8	
0+200	1.9	
0+220	1.7	
0+230	1.7	
0+240	1.7	
0+250	1.7	
0+260	1.7	
0+270	1.8	
0+280	1.8	
0+290	1.9	
0+300	1.8	
0+310	1.7	
0+320	1.7	
0+330	1.7	

<b>Station</b>	<b>Water Depth (Metres)</b>	<b>Comments</b>
0+340	1.8	
0+350	1.7	
0+360	1.7	
0+369.3	1.5	Deflection in wall
0+370	1.6	
0+380	1.7	
0+390	1.6	
0+400	1.7	
0+410	1.8	
0+420	1.7	
0+430	1.9	
0+520	1.7	
0+530	1.7	
0+540	1.7	
0+550	1.6	
0+560	1.7	
0+570	1.7	
0+580	1.7	
0+590	1.7	
0+600	1.7	
0+610	1.7	
0+620	1.7	



<b>Station</b>	<b>Water Depth (Metres)</b>	<b>Comments</b>
0+630	1.7	
0+640	1.7	
0+650	1.7	
0+660	1.7	
0+670	1.7	
0+680	1.7	
0+690	1.7	
0+700	1.7	
0+710	1.8	
0+720	1.7	
0+730	1.7	
0+740	1.7	
0+750	1.6	
0+760	1.6	
0+770	1.7	
0+780	1.6	
0+790	1.6	
0+800	1.6	
0+810	1.7	
0+820	1.7	
0+830	1.7	
0+840	1.6	

<b>Station</b>	<b>Water Depth (Metres)</b>	<b>Comments</b>
0+850	1.6	
0+860	1.6	
0+870	1.7	
0+880	1.7	
0+890	1.5	
0+900	1.7	
0+910	1.7	
0+920		
0+930	1.7	
0+940	1.5	
0+950	1.6	
0+960	1.6	
0+970	1.7	
0+980	1.7	
0+990	1.6	
1+000	1.8	
1+010	1.7	
1+020	1.7	
1+030	1.7	
1+040	1.7	
1+050	1.6	
1+060	1.6	

<b>Station</b>	<b>Water Depth (Metres)</b>	<b>Comments</b>
1+070	1.7	
1+080	1.7	
1+090	1.6	
1+100	1.7	
1+110	1.7	
1+120	1.6	
1+130	1.6	
1+140	1.6	
1+150	1.5	
1+160	1.8	
1+170	1.7	
1+180	1.8	
1+190	1.5	
1+200	1.7	
1+210	1.7	
1+220	1.7	
1+230	1.6	
1+240	1.8	
1+260	1.9	.
1+270	1.8	
1+280	1.9	
1+290	2.0	

Station	Water Depth (Metres)	Comments
1+300	2.0	
1+310	1.8	
1+320	1.5	
1+325	1.0	
1+330	0.5	
1+345		End of Inspection

#### **4. RECOMENDATIONS**

The condition of the seawall sections inspected varies. The initial sheet pile section which represents approximately 70 metres of the wall inspected is in generally good condition. No recommendations for immediate remedial work area required for the sheet pile section.

The concrete portion of the seawall inspected is physically in fair to good condition; however, most of the concrete seawall panels are undermined and fill loss from behind the wall is occurring. The fill loss is causing settlement, cracking and ultimately failure of the concrete deck behind the seawall.

The following recommendations are offered to restore the seawall and deck. It is understood the deck is not owned by the city nevertheless the success of repairing the wall is linked to repairing both the wall and the deck.

The following recommendations are offered to restore the seawall and the deck:

1. Install fabric geotextile and suitably sized stone material to fill the gap at the bottom of the concrete panels. This should be completed for the full length of the concrete panel section to provide uniform protection to the toe of the wall.
2. Remove the existing deck where required and place suitable fill material.
3. Restore the deck. The deck does not necessarily have to be replaced in concrete; however, something other soil should be used to prevent waves overtopping the wall from washing out the soil.
4. The drain holes should hooked up to drain tiles if required or filter geotextile placed over the backside of the hole to prevent fill loss.

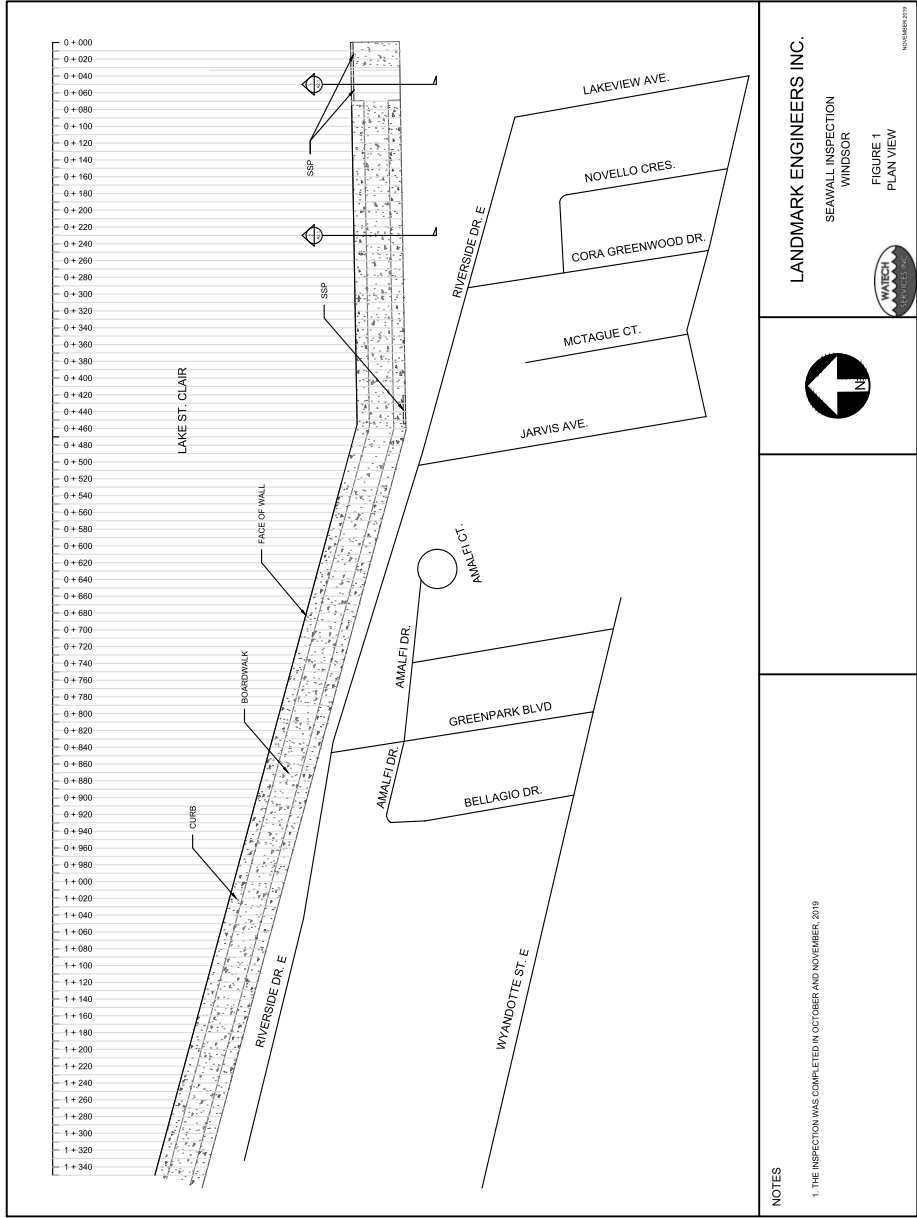
**UNDERWATER INSPECTION OF LAKE ST. CLAIR SEAWALL  
WINDSOR, ONTARIO**

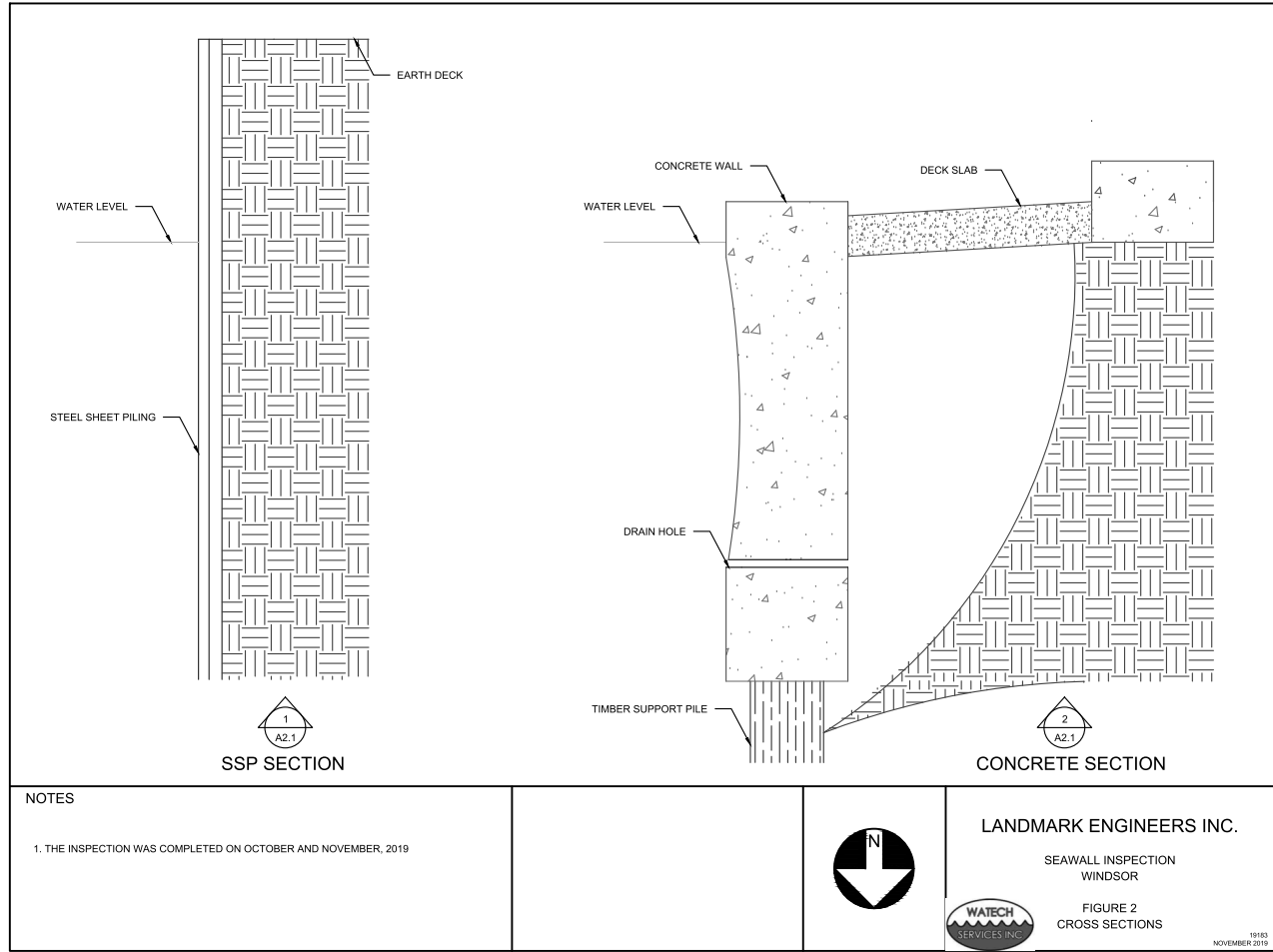
**LANDMARK ENGINEERS INC.**

**OCTOBER 2019**

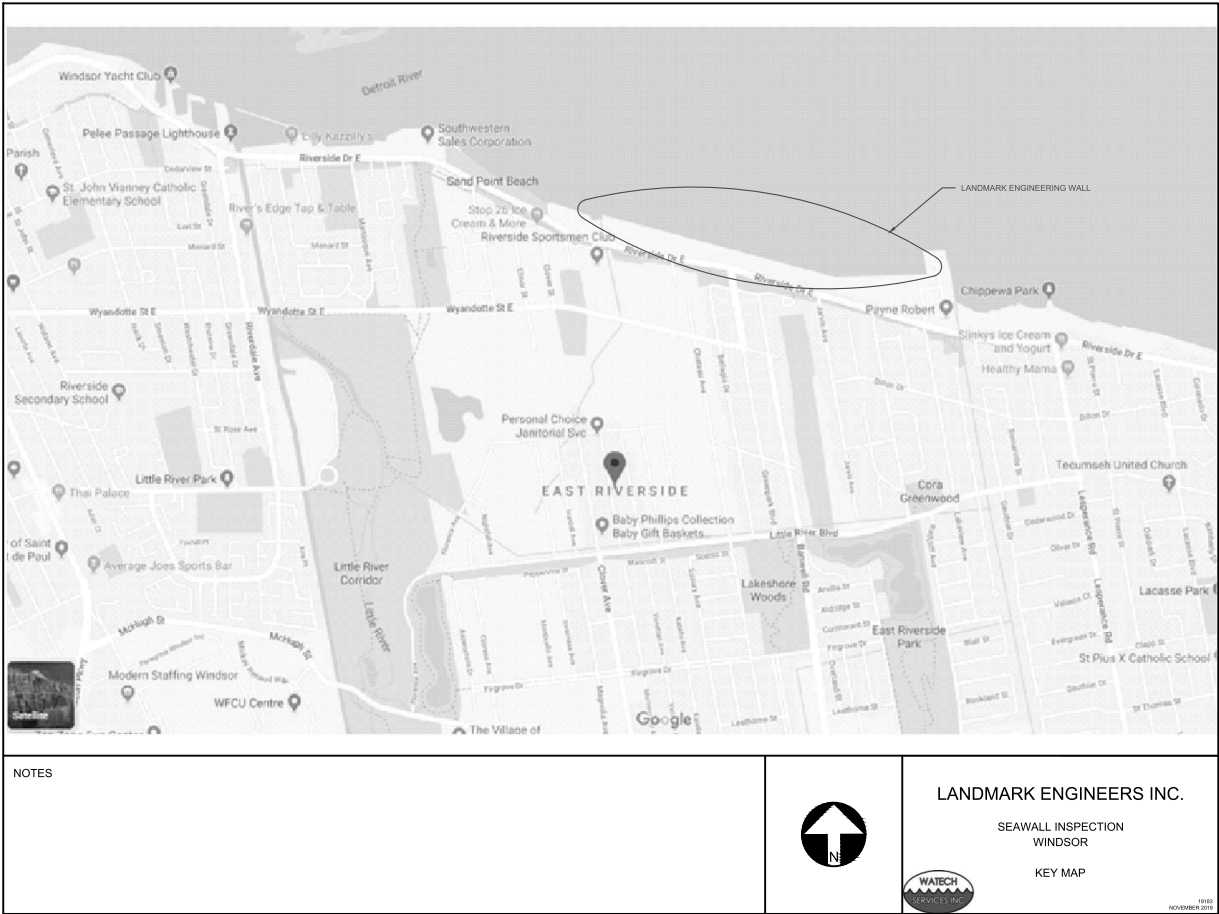
**Figures**

**WATECH SERVICES INC.  
WSI 19194**









**UNDERWATER INSPECTION OF LAKE ST. CLAIR SEAWALL  
WINDSOR, ONTARIO**

**LANDMARK ENGINEERS INC.**

**OCTOBER 2019**

**Above Water  
Photographs**

**WATECH SERVICES INC.  
WSI 19194**



PHOTO # 1

2 pile SSP at chainage  
0+000



PHOTO # 2

2 pile SSP at chainage  
0+000



PHOTO # 3

2 pile SSP at chainage  
0+010



PHOTO # 4

2 pile SSP at chainage  
0+010



PHOTO # 5

2 pile SSP at chainage  
0+020



PHOTO # 6

2 pile SSP at chainage  
0+020



PHOTO # 7

2 pile SSP at chainage  
0+030



PHOTO # 8

2 pile SSP at chainage  
0+030



PHOTO # 9

2 pile SSP at chainage  
0+050



PHOTO # 10

2 pile SSP at chainage  
0+050



PHOTO # 11

2 pile SSP at chainage  
0+072



PHOTO # 12

2 pile SSP at chainage  
0+072. This marks the end  
of the SSP





PHOTO # 13

Concrete panel area at  
chainage 0+090



PHOTO # 14

Concrete panel area at  
chainage 0+090



PHOTO # 15

Concrete panel area at  
chainage 0+100



PHOTO # 16

Concrete panel area at  
chainage 0+100



PHOTO # 17

Concrete panel area at  
chainage 0+120. Concrete  
surface spalling,  
dimensioned 0.254m wide  
by 0.076m high by 0.076m  
deep



PHOTO # 18

Concrete panel area at  
chainage 0+120. Concrete  
surface spalling,  
dimensioned 0.254m wide  
by 0.076m high by 0.076m  
deep





PHOTO # 19

Concrete panel area at  
chainage 0+140



PHOTO # 20

Concrete panel area at  
chainage 0+140



PHOTO # 21

Concrete panel area at  
chainage 0+144. Spalling  
and concrete loss located  
in the joint of the concrete  
panel, dimensioned  
0.254m long by 0.186m  
wide by 0.152m deep



PHOTO # 22

Concrete panel area at chainage 0+150. Spalling of concrete and concrete loss dimensioned 1.5m long by 0.381m wide by 0.152m deep



PHOTO # 23

Concrete panel area at chainage 0+150. Spalling of concrete and concrete loss dimensioned 1.5m long by 0.381m wide by 0.152m deep



PHOTO # 24

Concrete panel area at chainage 0+170



PHOTO # 25

Concrete panel area at  
chainage 0+170



PHOTO # 26

Concrete panel area at  
chainage 0+190



PHOTO # 27

Concrete panel area at  
chainage 0+190



PHOTO # 28

Concrete panel area at  
chainage 0+210



PHOTO # 29

Concrete panel area at  
chainage 0+210



PHOTO # 30

Concrete panel area at  
chainage 0+230. Concrete  
in typical condition





PHOTO # 31

Concrete panel area at chainage 0+230. Concrete in typical condition



PHOTO # 32

Concrete panel area at chainage 0+220. Spalling and on the vertical face dimensioned 1.83m long by 0.20m high by 0.05m deep



PHOTO # 33

Concrete panel area at chainage 0+220. Spalling on the vertical face dimensioned 1.83m long by 0.20m high by 0.05m deep



PHOTO # 34

Concrete panel area at chainage 0+229. Spalling on the vertical face, dimensioned at 0.5m long by 0.20m high by 0.05m deep

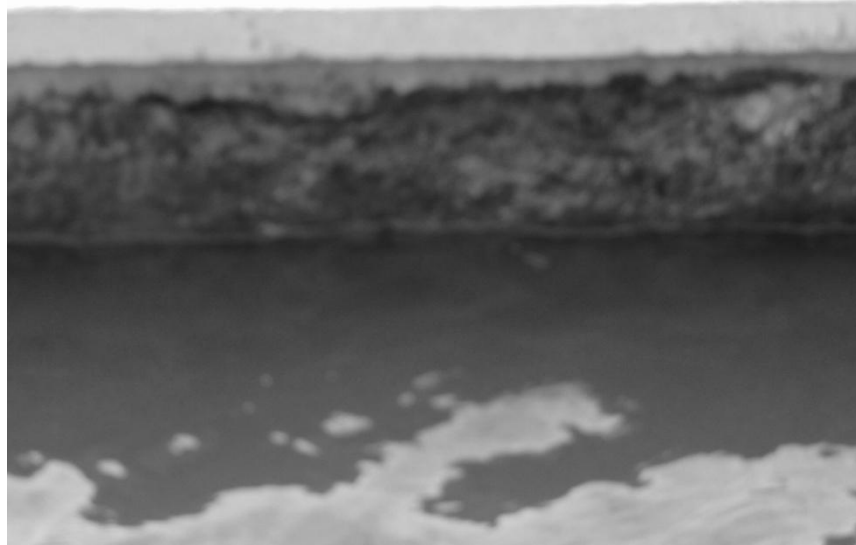


PHOTO # 35

Concrete panel area at chainage 0+229. Spalling on the vertical face, dimensioned at 0.5m long by 0.20m high by 0.05m deep



PHOTO # 36

Concrete panel area at chainage 0+250. Surface concrete is in typical condition



PHOTO # 37

Concrete panel area at chainage 0+250. Surface concrete is in typical condition



PHOTO # 38

Overall view of the concrete panel, looking towards chainage 0+000



PHOTO # 39

Overall view of the concrete panel, looking towards Windsor



PHOTO # 40

Concrete panel area at  
chainage 0+219



PHOTO # 41

Concrete panel area at  
chainage 0+270. Surface  
concrete is in typical  
condition



PHOTO # 42

Concrete panel area at  
chainage 0+270. Surface  
concrete is in typical  
condition





PHOTO # 43

Concrete panel area at chainage 0+290. Photograph going in the general direction of Windsor



PHOTO # 44

Concrete panel area at chainage 0+285. Concrete panel deck has sunk 0.813m



PHOTO # 45

Concrete panel area at chainage 0+310. Concrete is in typical condition



PHOTO # 46

Concrete panel area at chainage 0+310. Concrete is in typical condition



PHOTO # 47

Concrete panel area at chainage 0+310, looking east

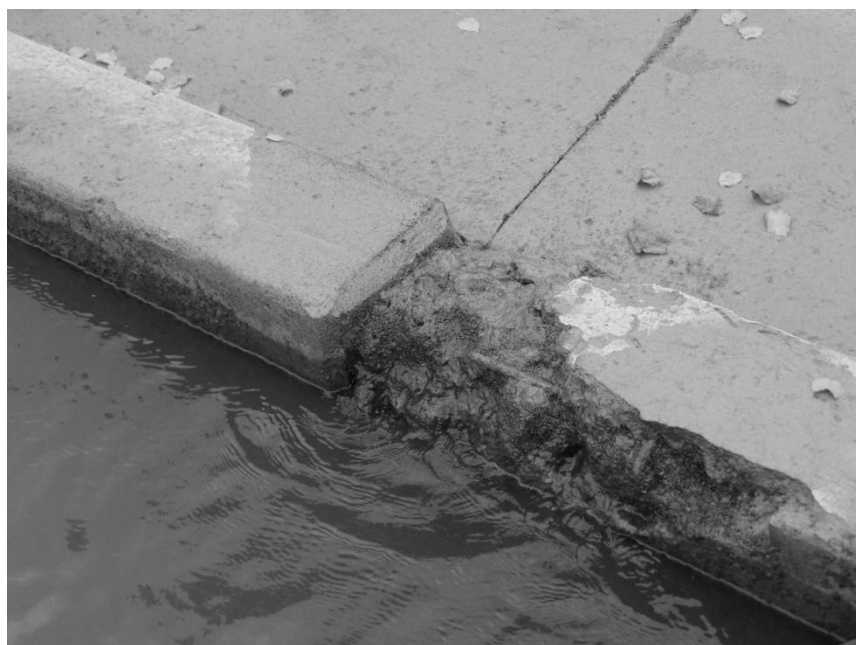


PHOTO # 48

Concrete panel area at chainage 0+315, showing missing surface concrete



PHOTO # 49

Concrete panel area at chainage 0+315, showing missing surface concrete



PHOTO # 50

Concrete panel area at chainage 0+330



PHOTO # 51

Overall concrete panel area looking east



PHOTO # 52

Overall concrete panel area looking west towards Windsor



PHOTO # 53

Concrete panel area at chainage 0+345, showing a typical joint



PHOTO # 54

Concrete panel area at chainage 0+350



PHOTO # 55

Concrete panel area at chainage 0+350 looking east



PHOTO # 56

Concrete panel area at chainage 0+360. Broken concrete shown at the joint



PHOTO # 57

Concrete panel area at chainage 0+369.4. Broken surface concrete at the point of deflection





PHOTO # 58

Concrete panel area at chainage 0+369.4. Broken concrete extends to 0.05m below the surface of the water



PHOTO # 59

Concrete panel area at chainage 0+369.4, looking east



PHOTO # 60

Concrete panel area at chainage 0+369.4, looking west. Concrete is lowered on the offshore side of the walkway.



PHOTO # 61

Concrete panel area at chainage 0+369.4, looking west. Concrete is lowered on the offshore side of the walkway.



PHOTO # 62

Concrete panel area at chainage 0+390, for a length of 20m.



PHOTO # 63

Concrete panel area at chainage 0+369.4 to 0+378, showing the slope of the concrete deck



PHOTO # 64

Concrete panel area at chainage 0+369.4 to 0+378, showing the slope of the concrete deck



PHOTO # 65

Concrete panel area at chainage 0+390, looking west, showing the slope of the concrete deck



PHOTO # 66

Concrete panel area at chainage 0+400, looking west, showing the slope of the concrete deck





PHOTO # 67

Concrete panel area at  
chainage 0+369.4 to  
0+380



PHOTO # 68

Concrete panel area at  
chainage 0+369.4 to  
0+380, continuation of  
preceding photograph

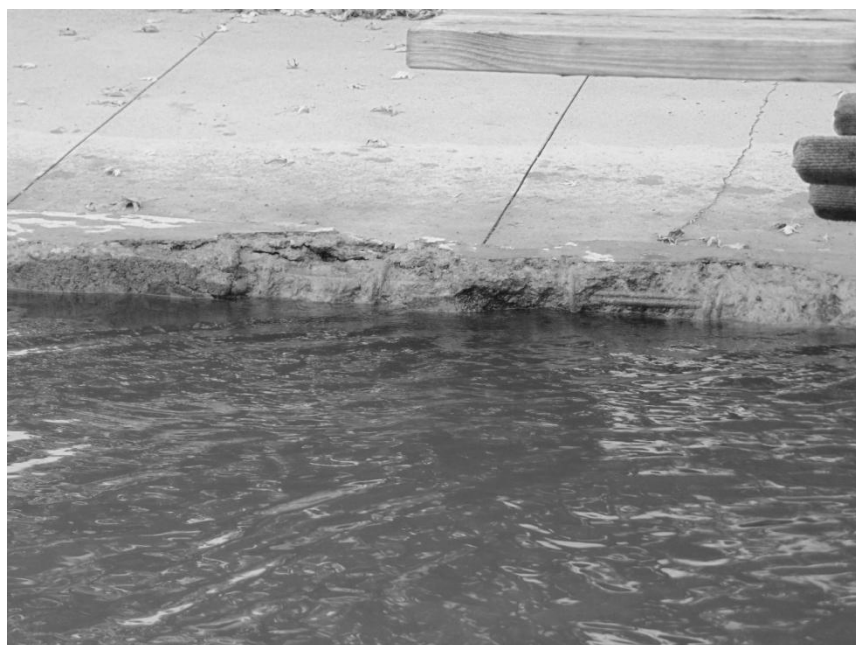


PHOTO # 69

Concrete panel area at  
chainage 0+428, showing  
spalled concrete  
dimensioned 1m long by  
0.46m wide by 0.10m deep



PHOTO # 70

Concrete panel area at chainage 0+428, showing spalled concrete dimensioned 1m long by 0.46m wide by 0.10m deep



PHOTO # 71

Concrete panel area at chainage 0+420, showing a higher westerly elevation and a lower easterly elevation



PHOTO # 72

Concrete deck at chainage 0+435 in poor condition



PHOTO # 73

Failed inshore panel at  
chainage 0+450



PHOTO # 74

Further view of the failed  
inshore panel at chainage  
0+450



PHOTO # 75

Damaged concrete wall  
joint at chainage 4+450,  
dimensioned 0.5m by 2.5m  
by 0.2m



PHOTO # 76

Failed concrete deck at  
chainage 0+450 to 0+455



PHOTO # 77

Continuation of the failed  
deck at chainage 0+450 +  
0+455



PHOTO # 78

Spalled concrete on the  
offshore edge, at chainage  
0+469 facing east



PHOTO # 79

Spalled concrete on the offshore edge, at chainage 0+469 facing east, at a closer magnification



PHOTO # 80

Facing west from chainage 0+470



PHOTO # 81

Facing west at chainage 0+490





PHOTO # 82

0+520 looking east toward  
0+490



PHOTO # 83

0+530 looking east toward  
0+520 poor condition  
sloping toward water



PHOTO # 84

0+540 looking east toward  
0+530 poor condition  
sloping toward water



PHOTO # 85

0+550 looking east toward  
0+540 fair condition



PHOTO # 86

0+560 looking east toward  
0+550 good condition



PHOTO # 87

0+570 looking east toward  
0+560 good condition



PHOTO # 88

0+580 looking east toward  
0+570 poor condition deck  
failing



PHOTO # 89

0+590 looking east toward  
0+580 poor condition  
sloping toward water



PHOTO # 90

0+600 looking east toward  
0+590 poor condition





PHOTO # 91

0+610 looking east toward  
0+600 good condition



PHOTO # 92

0+620 looking east toward  
0+610 fair condition with  
surface cracking



PHOTO # 93

0+630 looking east toward  
0+620 fair condition with  
surface cracking



PHOTO # 94

0+640 looking east toward  
0+630 fair condition with  
surface cracking



PHOTO # 95

0+650 looking east toward  
0+640 fair condition with  
surface cracking



PHOTO # 96

0+660 looking east toward  
0+650 fair condition with  
surface cracking



PHOTO # 97

0+670 looking east toward  
0+660 fair condition with  
surface cracking



PHOTO # 98

0+680 looking east toward  
0+670 fair condition with  
surface cracking



PHOTO # 99

0+690 looking east toward  
0+680 fair condition with  
surface cracking



PHOTO # 100

0+700 looking east toward  
0+690 fair condition with  
surface cracking



PHOTO # 101

0+710 looking east toward  
0+700 good condition



PHOTO # 102

0+720 looking east toward  
0+710 good condition

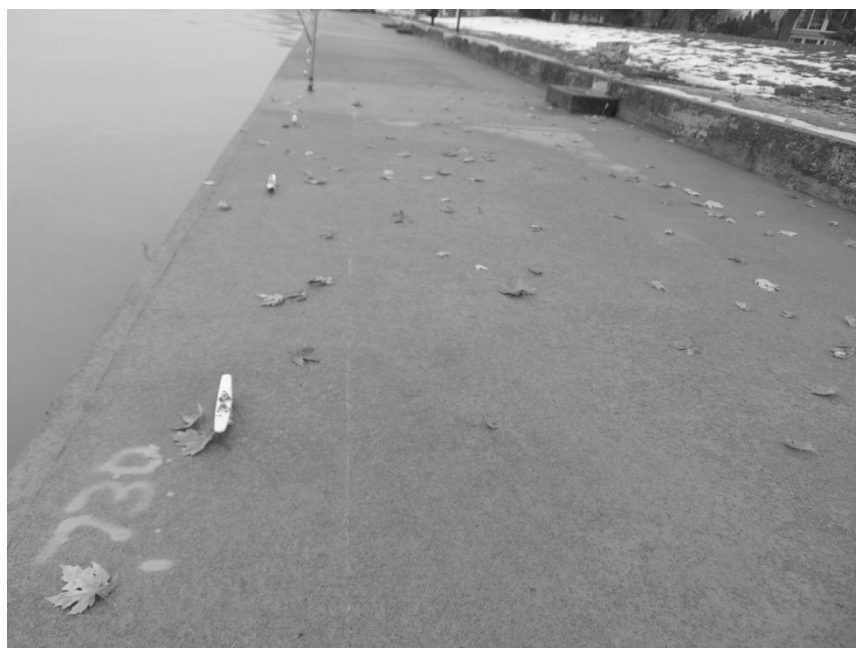


PHOTO # 103

0+730 looking east toward  
0+720 good condition



PHOTO # 104

0+740 looking east toward  
0+730 failed deck



PHOTO # 105

0+750 looking east toward  
0+740 poor condition





PHOTO # 106

0+760 looking east toward  
0+750 good condition



PHOTO # 107

0+770 looking east toward  
0+760 good condition



PHOTO # 108

0+780 looking east toward  
0+770 good condition



PHOTO # 109

0+790 looking east toward  
0+780 fair condition some  
surface cracks present



PHOTO # 110

0+800 looking east toward  
0+790 good condition



PHOTO # 111

0+810 looking east toward  
0+800 poor condition deck  
failed



PHOTO # 112

0+820 looking east toward  
0+810 poor condition deck  
failed



PHOTO # 113

0+830 looking east toward  
0+820 poor condition deck  
failed



PHOTO # 114

0+840 looking east toward  
0+830 poor condition deck  
failed





PHOTO # 115

0+850 looking east toward  
0+840 poor condition deck  
failed



PHOTO # 116

0+860 looking east toward  
0+850 poor condition deck  
failed



PHOTO # 117

0+870 looking east toward  
0+860 poor condition deck  
failed



PHOTO # 118

0+880 looking east toward  
0+870 poor condition deck  
failed



PHOTO # 119

0+890 looking east toward  
0+880 poor condition deck  
failed



PHOTO # 120

0+900 looking east toward  
0+890 poor condition deck  
failed



PHOTO # 121

0+910 looking east toward  
0+900 poor condition deck  
failed



PHOTO # 122

0+910



PHOTO # 123

0+910 looking west  
toward 0+917 poor  
condition cracking in the  
deck



PHOTO # 124

0+ 917 looking west  
toward 0+935 poor  
condition concrete deck  
failed



PHOTO # 125

0+935 looking east toward  
0+917 poor condition deck  
failed



PHOTO # 126

0+940 looking east toward  
0+935 poor condition deck  
failed



PHOTO # 127

0+950 looking east toward  
0+940 good condition



PHOTO # 128

0+960 looking east toward  
0+950 good condition



PHOTO # 129

0+970 looking east toward  
0+960 in good condition





PHOTO # 130

0+980 looking east toward  
0+970 good condition



PHOTO # 131

0+990 looking east toward  
0+980 good condition



PHOTO # 132

1+010 looking east toward  
0+990 good condition



PHOTO # 133

1+020 looking east toward  
1+010 fair condition



PHOTO # 134

1+030 looking east toward  
1+020 good condition



PHOTO # 135

1+040 looking east toward  
1+030 fair condition



PHOTO # 136

1+050 looking east toward  
1+040 poor condition



PHOTO # 137

1+060 looking east toward  
1+050 fair condition



PHOTO # 138

1+070 looking east toward  
1+060 fair condition





PHOTO # 139

1+080 looking east toward  
1+070 good condition



PHOTO # 140

1+090 looking east toward  
1+080 good condition



PHOTO # 141

1+100 looking east toward  
1+090 poor condition



PHOTO # 142

1+110 looking east toward  
1+100 good condition



PHOTO # 143

1+120 looking east toward  
1+110 good condition

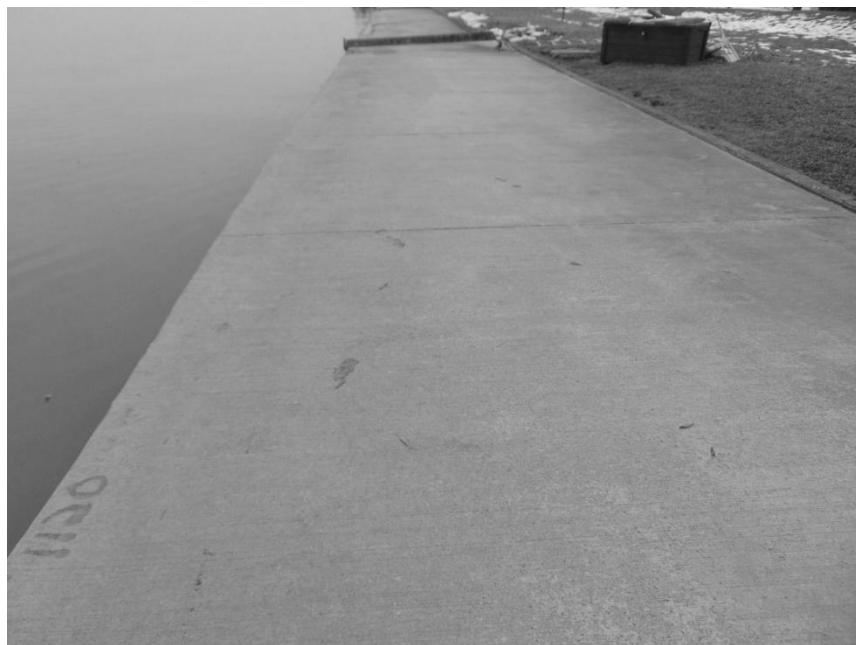


PHOTO # 144

1+130 looking east toward  
1+120 good condition



PHOTO # 145

1+140 looking east toward  
1+130 good condition



PHOTO # 146

1+150 looking east toward  
1+140 good condition



PHOTO # 147

1+160 looking east toward  
1+150 good condition



PHOTO # 148

1+170 looking east toward  
1+160 good condition



PHOTO # 149

1+180 looking east toward  
1+170 good condition



PHOTO # 150

1+190 looking east toward  
1+180 good condition



PHOTO # 151

1+200 looking east toward  
1+190 good condition



PHOTO # 152

1+210 looking east toward  
1+200 good condition



PHOTO # 153

1+220 looking east toward  
1+210 good condition





PHOTO # 154

1+230 looking east toward  
1+220 good condition



PHOTO # 155

1+240 looking east toward  
1+230 good condition



PHOTO # 156

1+250 looking east toward  
1+240 good condition



PHOTO # 157

1+250



PHOTO # 158

1+250 looking east toward  
1+240 good condition



PHOTO # 159

1+260 looking east toward  
1+250 ice covered



PHOTO # 160

1+270 looking east toward  
1+260 good condition



PHOTO # 161

1+280 looking east toward  
1+270 good condition



PHOTO # 162

1+290 looking east toward  
1+280 good condition





PHOTO # 163

1+300 looking east toward  
1+290 good condition



PHOTO # 164

1+310 looking east toward  
1+300 good condition



PHOTO # 165

1+320 looking east toward  
1+310 good condition

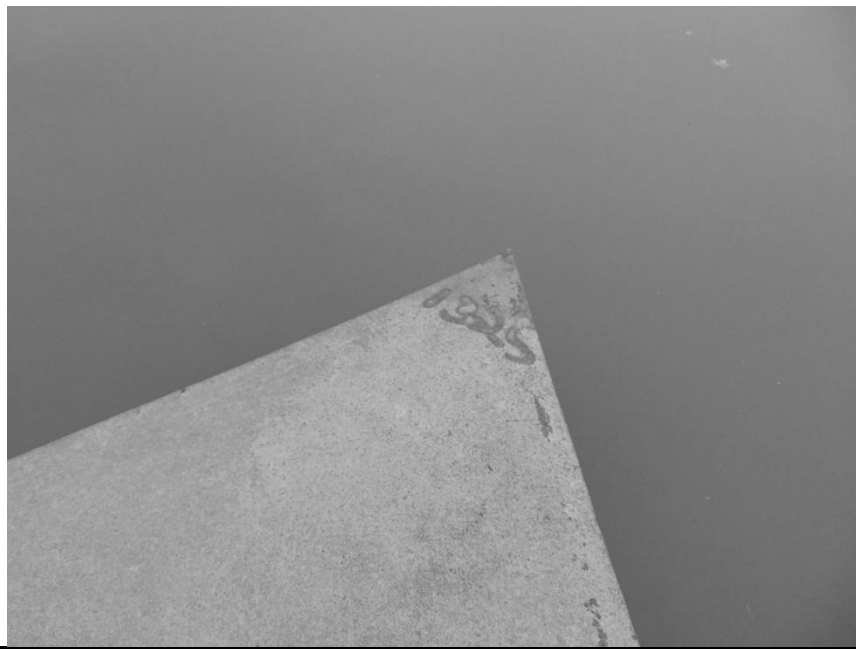


PHOTO # 166

1+325 looking west



PHOTO # 167

1+330 looking south  
toward 1+345



PHOTO # 168

1+330 looking south  
toward 1+345



PHOTO # 169

0+520 spalled and missing  
concrete on offshore edge

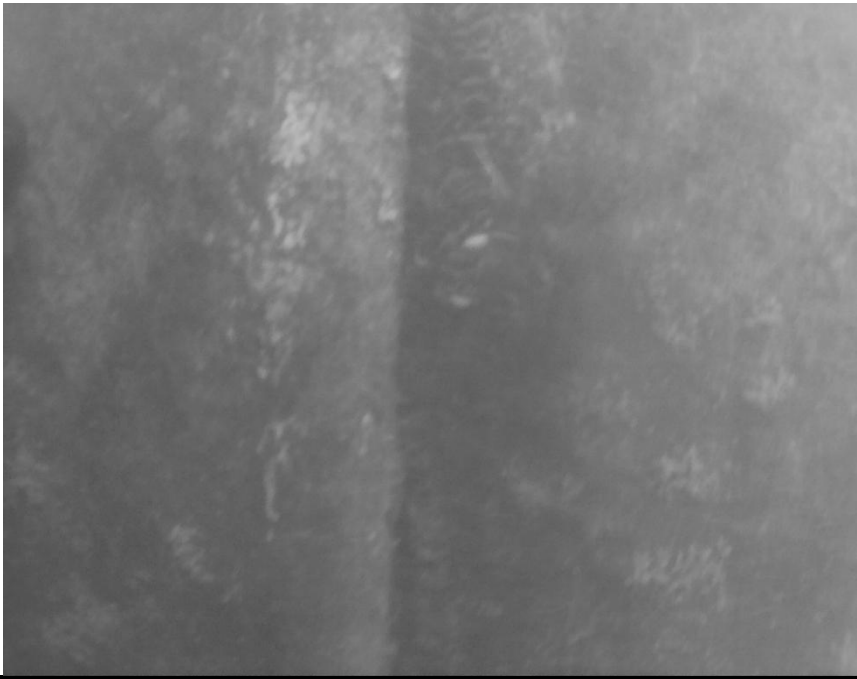
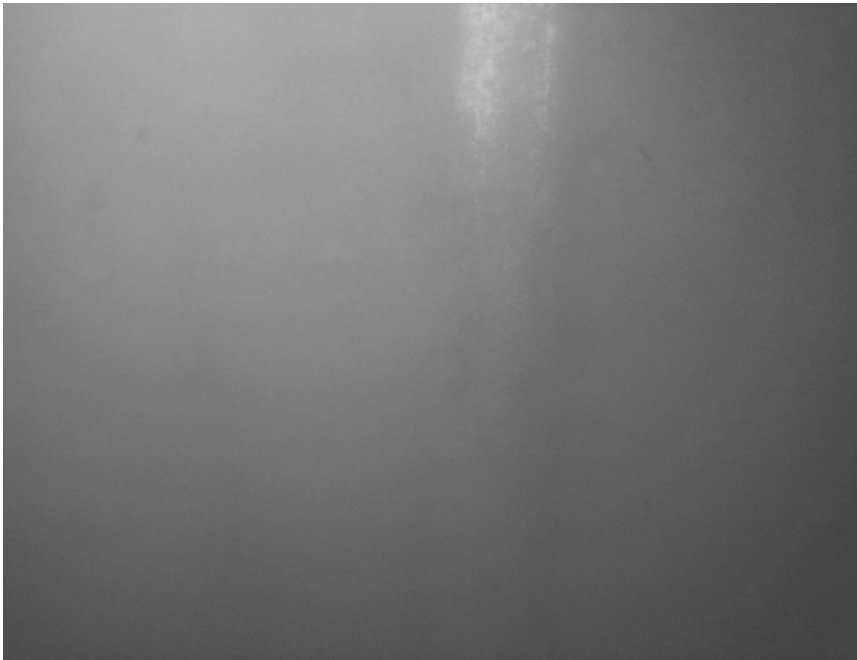

**UNDERWATER INSPECTION OF LAKE ST. CLAIR SEAWALL  
WINDSOR, ONTARIO**




**LANDMARK ENGINEERS INC.**




**OCTOBER 2019**


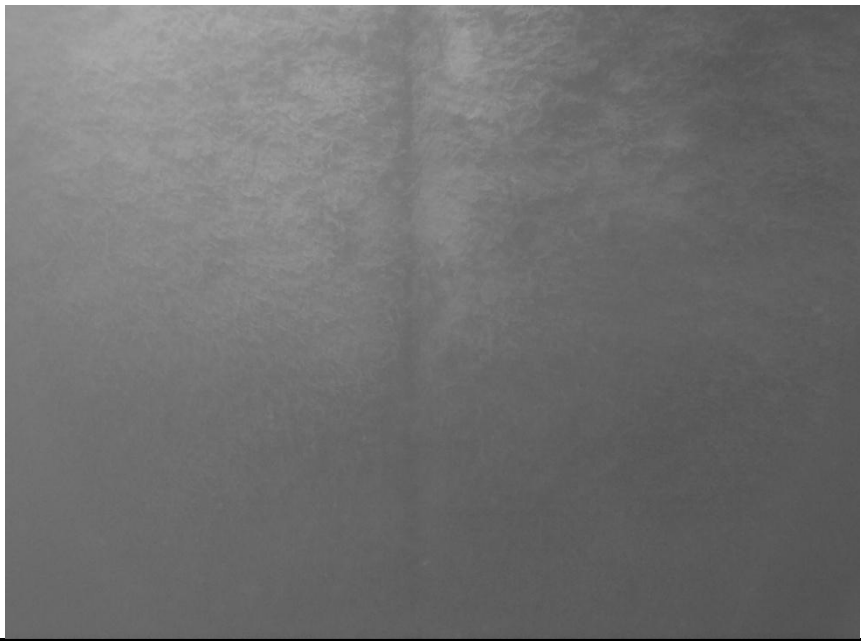
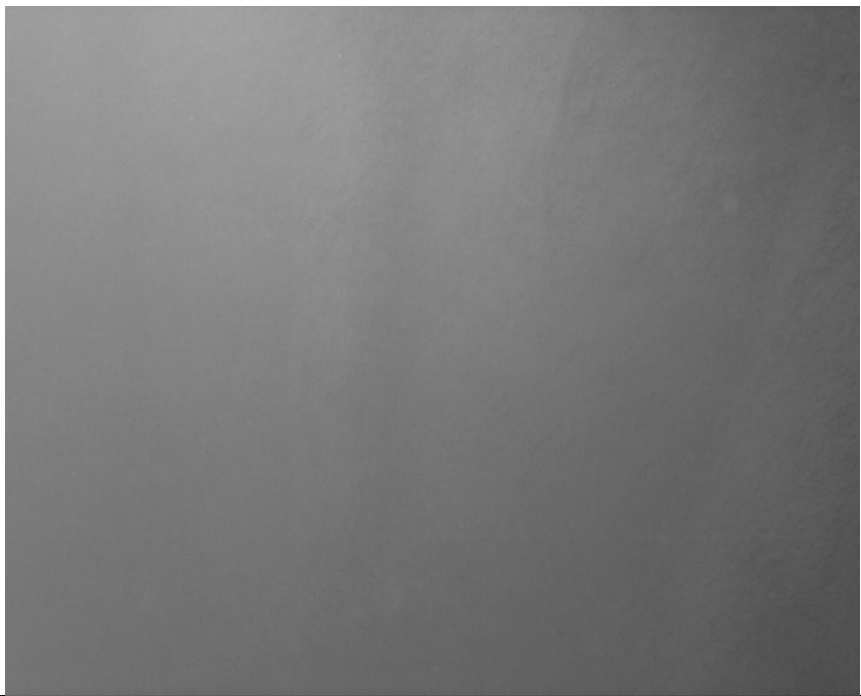
**Underwater  
Photographs**

**Watech Services Inc.  
WSI 19194**

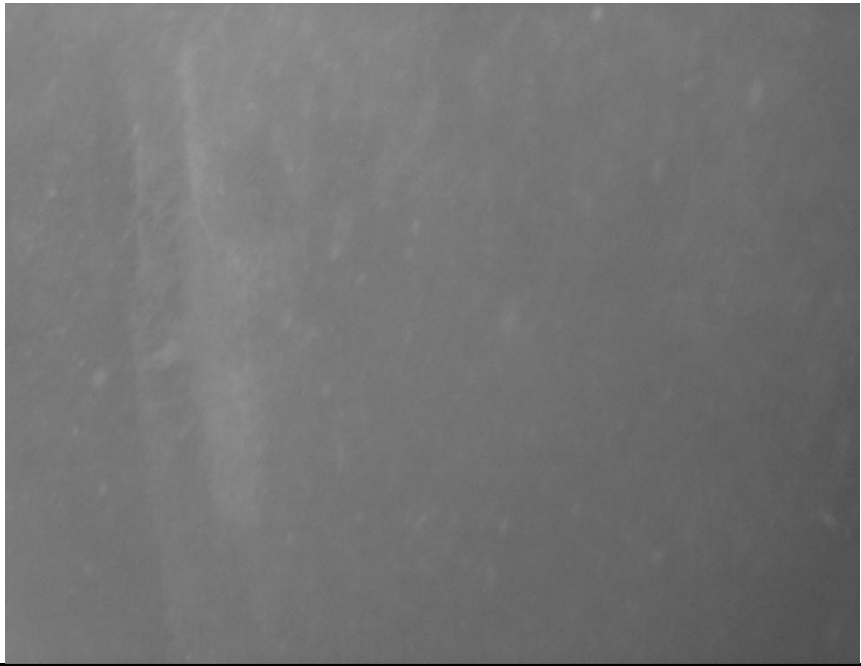

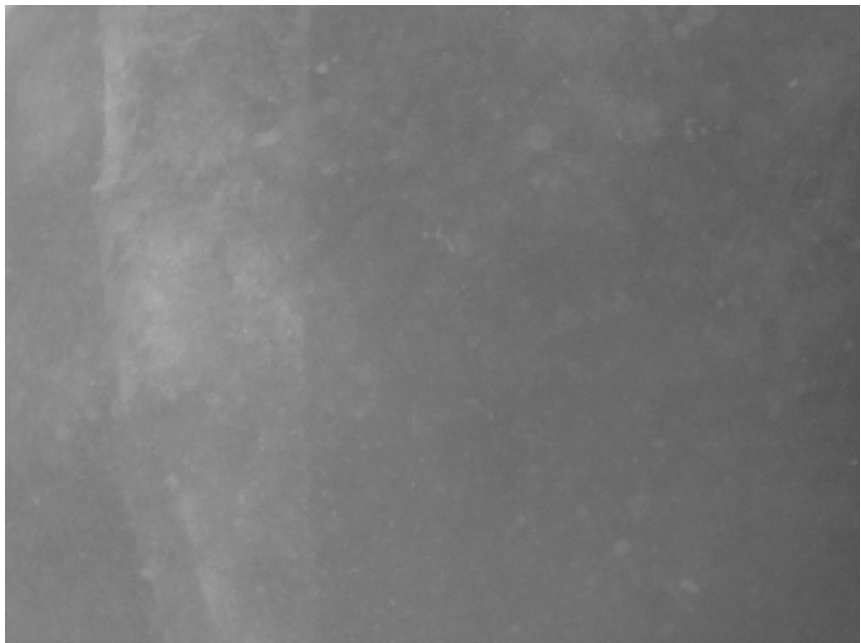
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	Beginning of "z" pile inspection
	PHOTO # 2
	Continuation of "z" pile inspection
	PHOTO # 3
	Continuation of "z" pile inspection




	PHOTO # 4
	Continuation of "z" pile inspection
	PHOTO # 5
	"z" pile at chainage 0+010
	PHOTO # 6
	"z" pile at chainage 0+010


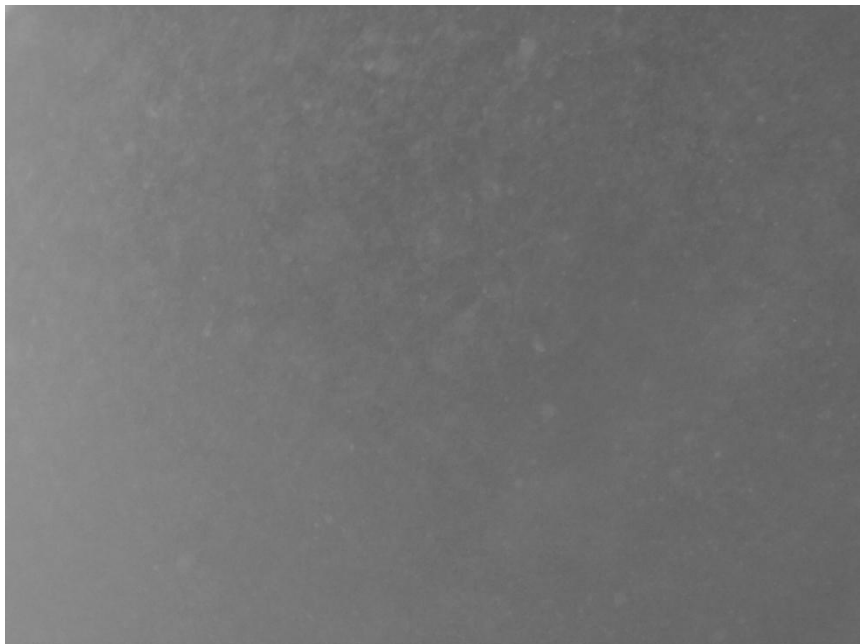
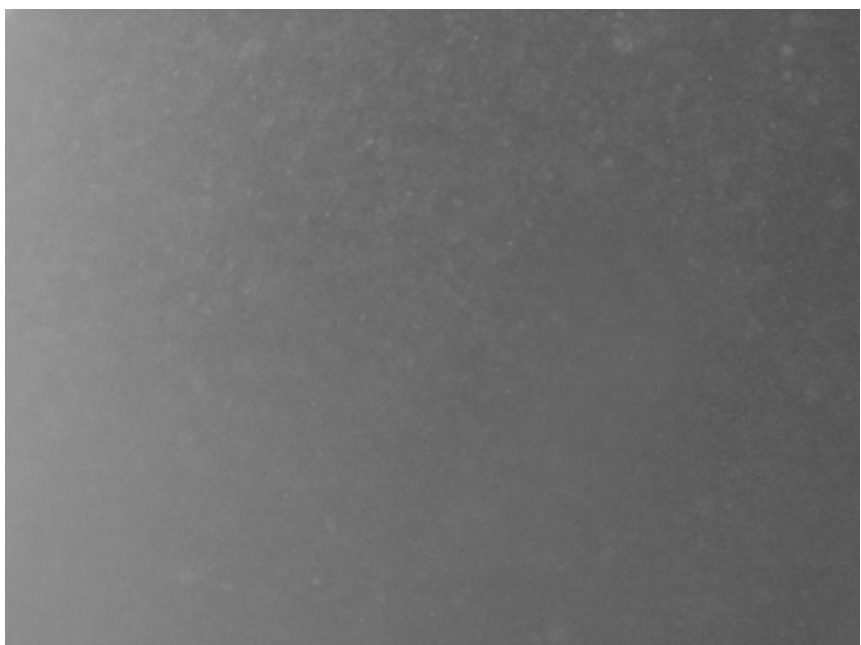
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	"z" pile at chainage 0+020
	PHOTO # 8
	"z" pile at chainage 0+020
	PHOTO # 9
	"z" pile at chainage 0+030

	PHOTO # 10
	"z" pile at chainage 0+030
	PHOTO # 11
	"z" pile at chainage 0+060
	PHOTO # 12
	"z" pile at chainage 0+060



	PHOTO # 13
	End of SSP, and beginning of the concrete panel wall at chainage 0+072
	PHOTO # 14
	Missing concrete dimensioned 0.3m high by 0.2m wide at chainage 0+072
	PHOTO # 15
	Continuation of missing concrete dimensioned 0.3m high by 0.2m wide at chainage 0+072

	PHOTO # 16
	Vertical joint, center to center, in the concrete panel at chainage 0+098
	PHOTO # 17
	Continuation of the vertical joint, center to center, in the concrete panel at chainage 0+098
	PHOTO # 18
	Continuation of the vertical joint, center to center, in the concrete panel at chainage 0+098

	PHOTO # 19
	Concrete panel at chainage 0+120
	PHOTO # 20
	Continuation of the concrete panel at chainage 0+120
	PHOTO # 21
	Continuation of the concrete panel at chainage 0+120


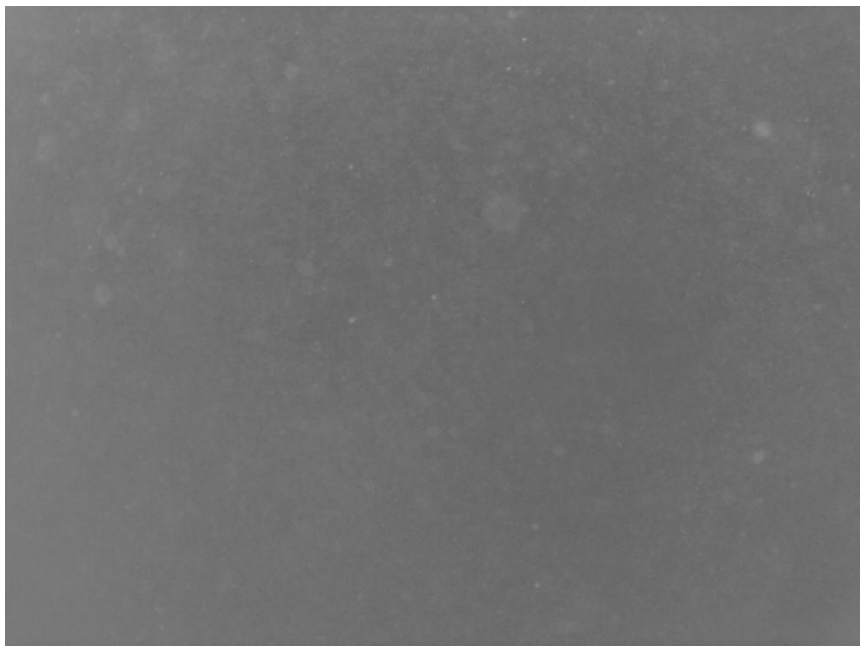

	PHOTO # 22
	Concrete panel at chainage 0+140
	PHOTO # 23
	Continuation of the concrete panel at chainage 0+140
	PHOTO # 24
	Continuation of the concrete panel at chainage 0+140



PHOTO # 25

Typical panel bottom and supporting timber at chainage 0+330



PHOTO # 26

Typical panel bottom and supporting timber at chainage 0+330

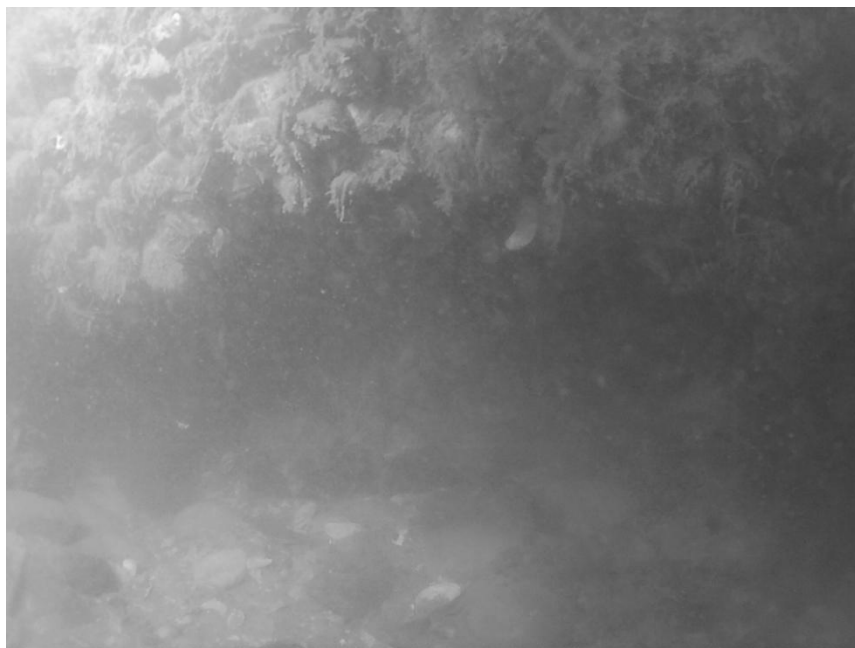


PHOTO # 27

Typical panel bottom and supporting timber at chainage 0+330



PHOTO # 28

Typical panel bottom and supporting timber at chainage 0+330



PHOTO # 29

Typical panel bottom and supporting timber at chainage 0+330

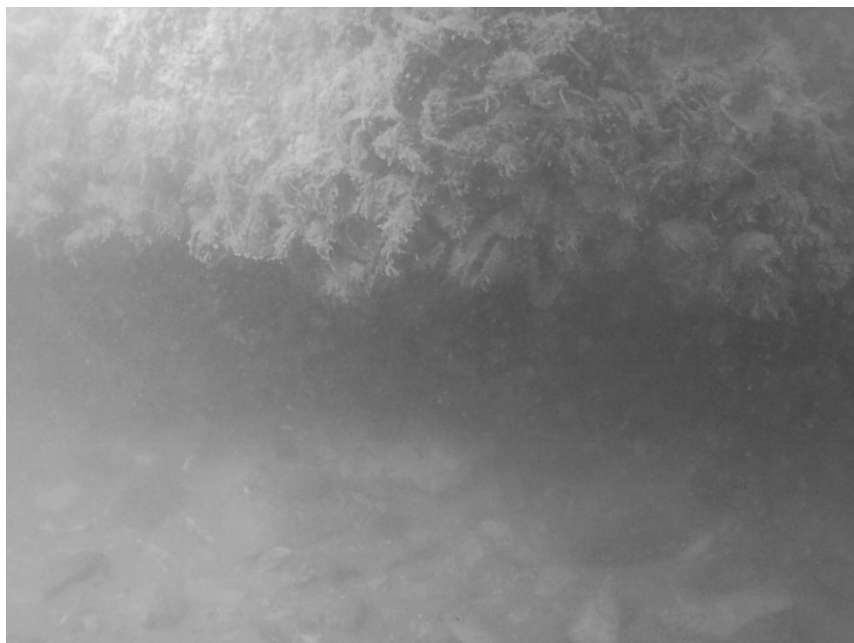


PHOTO # 30

Typical panel bottom and supporting timber at chainage 0+330

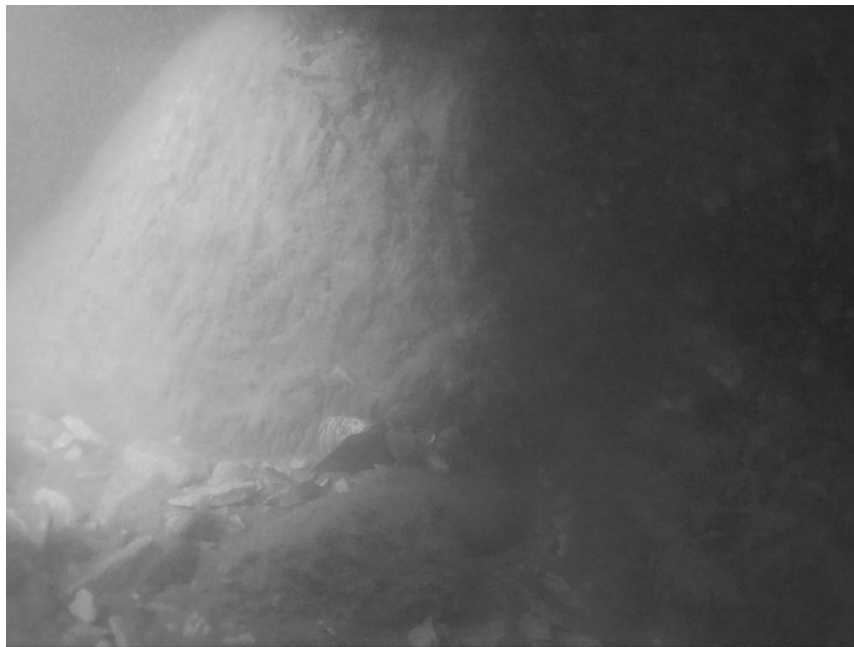


PHOTO # 31

Typical panel bottom and supporting timber at chainage 0+330

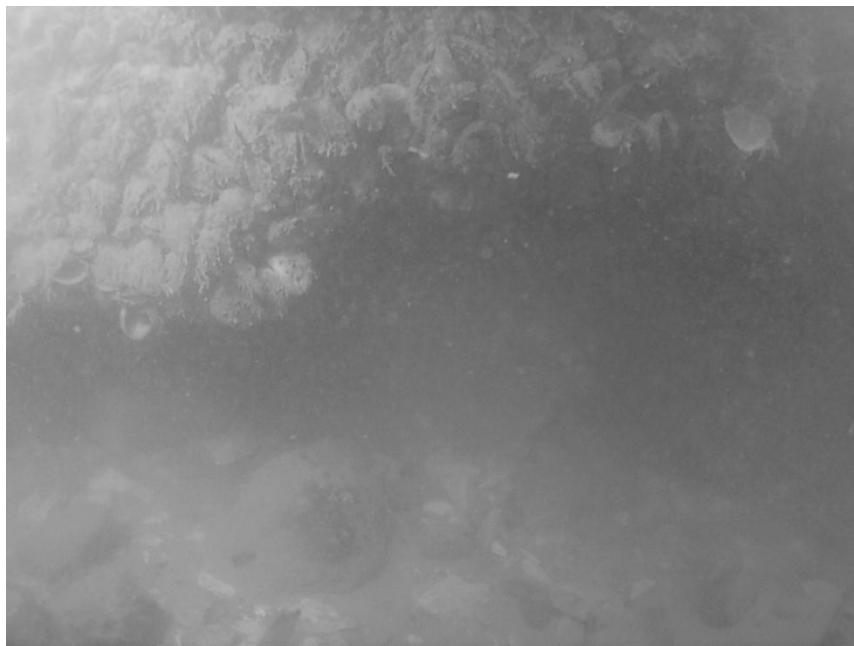


PHOTO # 32

Typical panel bottom and supporting timber at chainage 0+330



PHOTO # 33

Typical panel bottom and supporting timber at chainage 0+330





PHOTO # 34

Typical panel bottom and  
supporting timber at  
chainage 0+330



PHOTO # 35

Typical panel bottom and  
supporting timber at  
chainage 0+330

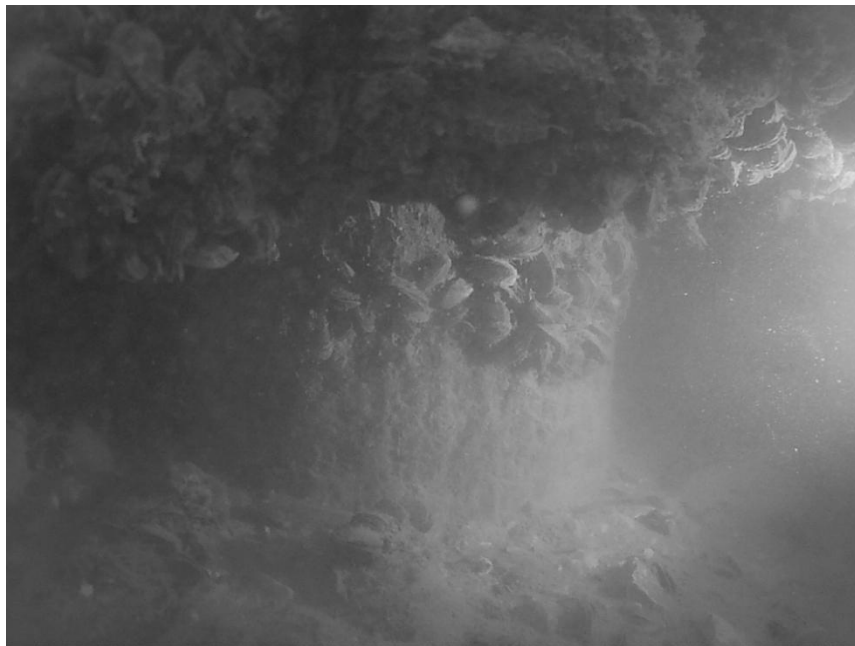





PHOTO # 36

Typical panel bottom and  
supporting timber at  
chainage 0+330



	PHOTO # 37
	Typical panel bottom and supporting timber at chainage 0+330
	PHOTO # 38
	Typical panel bottom and supporting timber at chainage 0+330
	PHOTO # 39
	Typical panel bottom and supporting timber at chainage 0+330

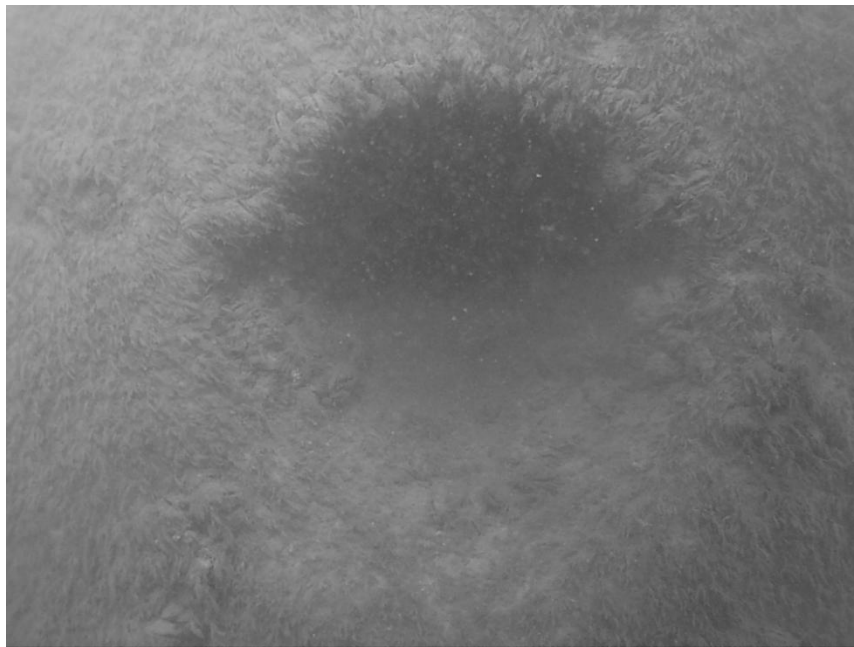


PHOTO # 40

Drain located in the midpoint of the concrete panel, dimensioned 0.1m in diameter at chainage 0+330

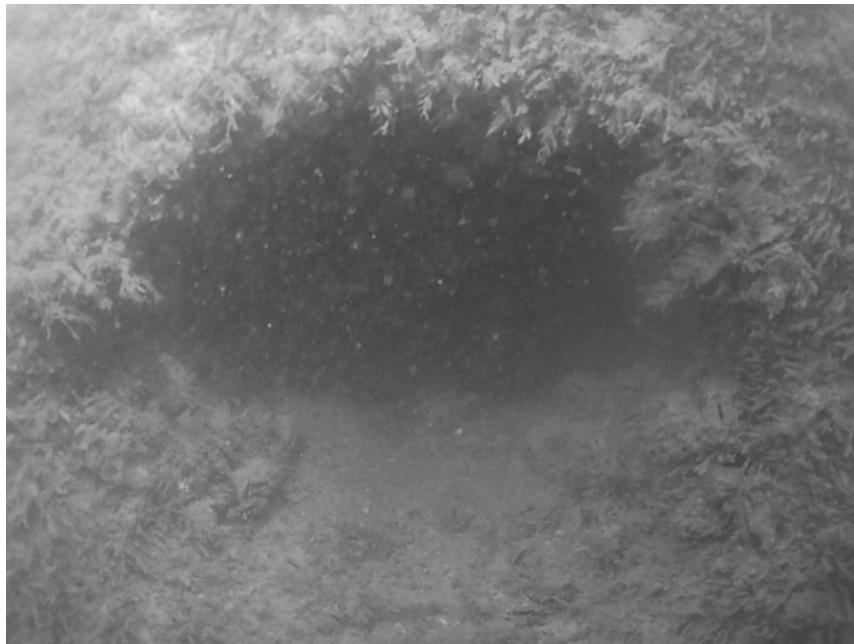


PHOTO # 41

0.1m diameter drainage hole at chainage 0+338

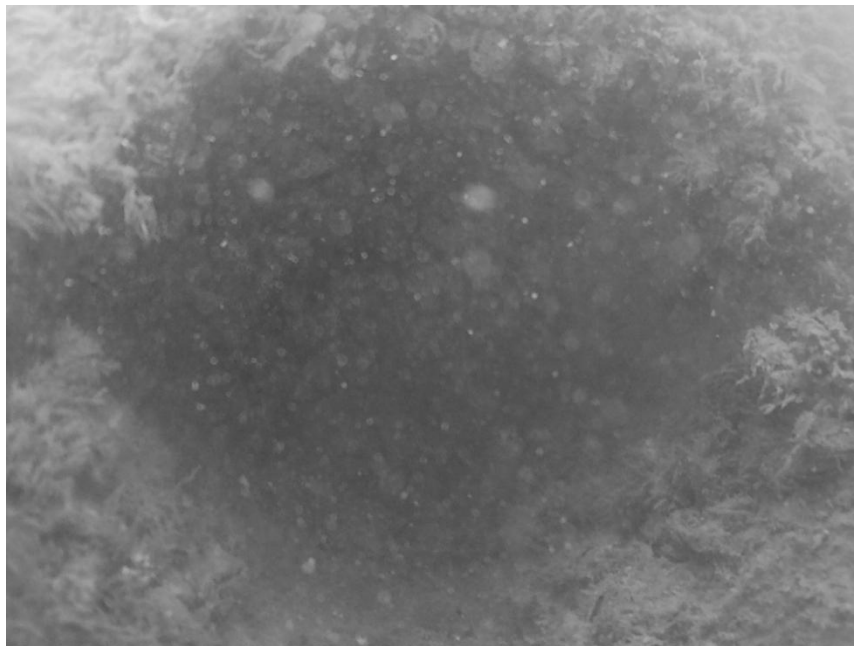
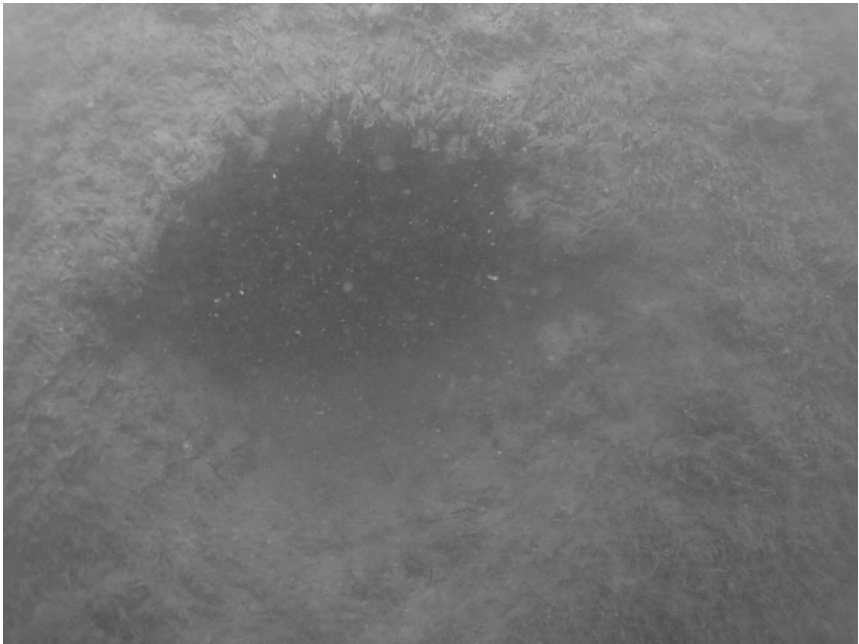
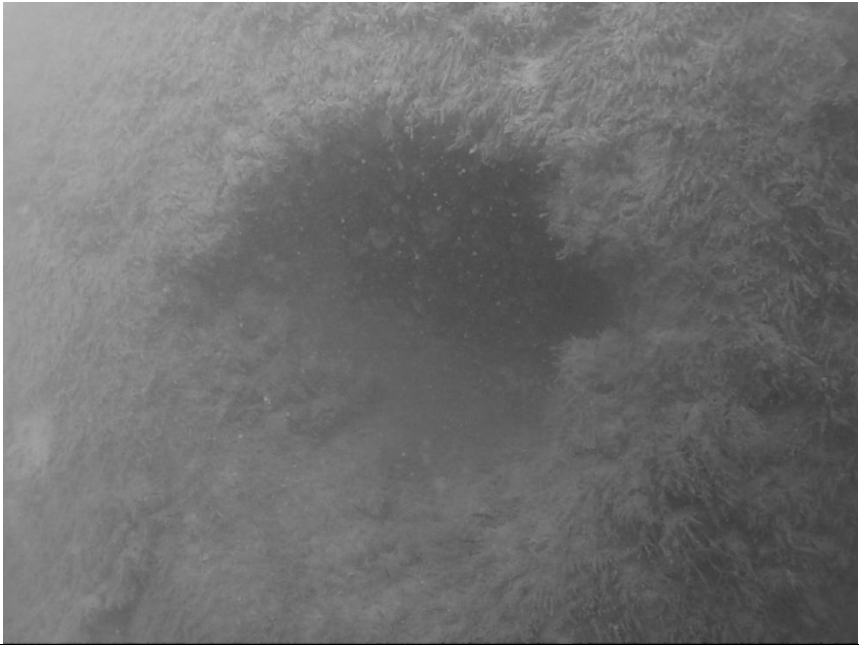
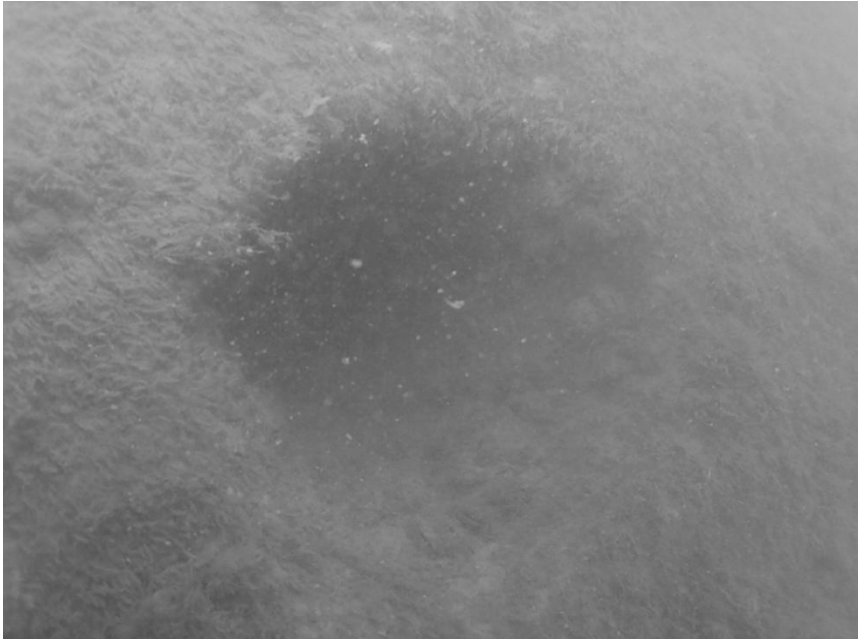


PHOTO # 42

0.1m diameter drainage hole at chainage 0+346

	PHOTO # 43
	0.1m diameter drainage hole at chainage 0+354
	PHOTO # 44
	0.1m diameter drainage hole at chainage 0+362
	PHOTO # 45
	0.1m diameter drainage hole at chainage. 0+370

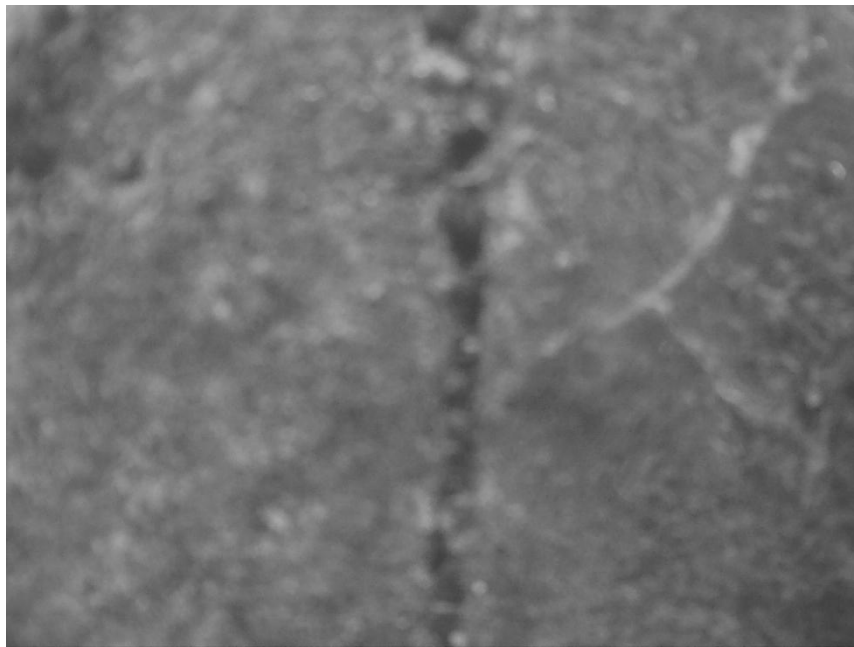


PHOTO # 46

Vertical cracking in concrete panel Station 0+671



PHOTO # 47

Vertical cracking in concrete panel Station 0+796

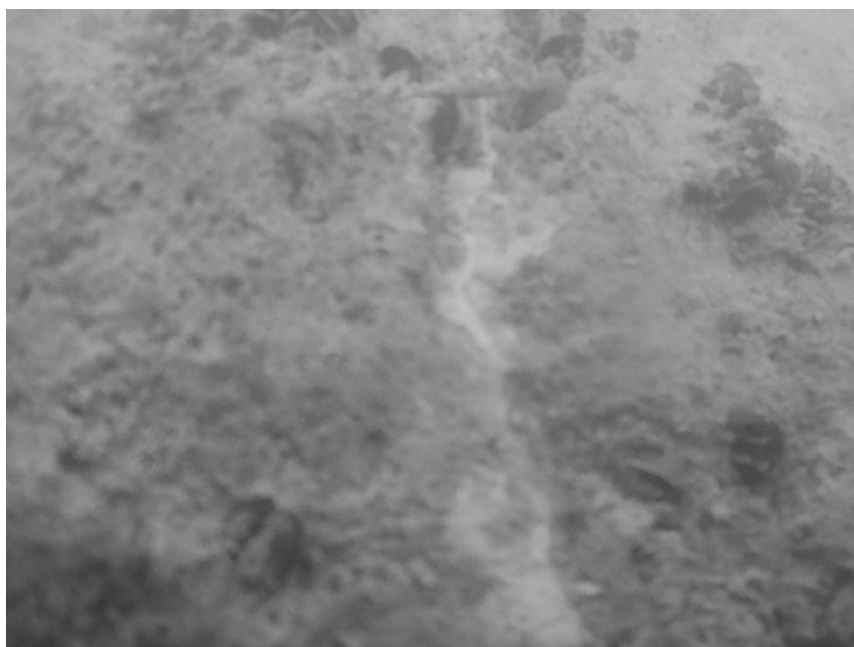


PHOTO # 48

Tight vertical crack in concrete panel Station 0+964



PHOTO # 49

Undermining of concrete panel

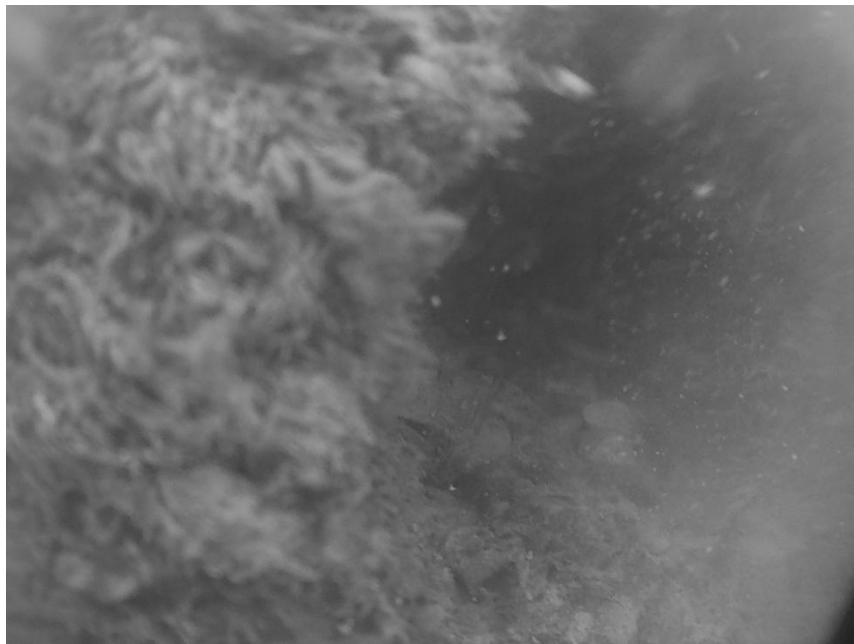


PHOTO # 50

Drain hole



PHOTO # 51

Typical photograph of undermining below concrete panel

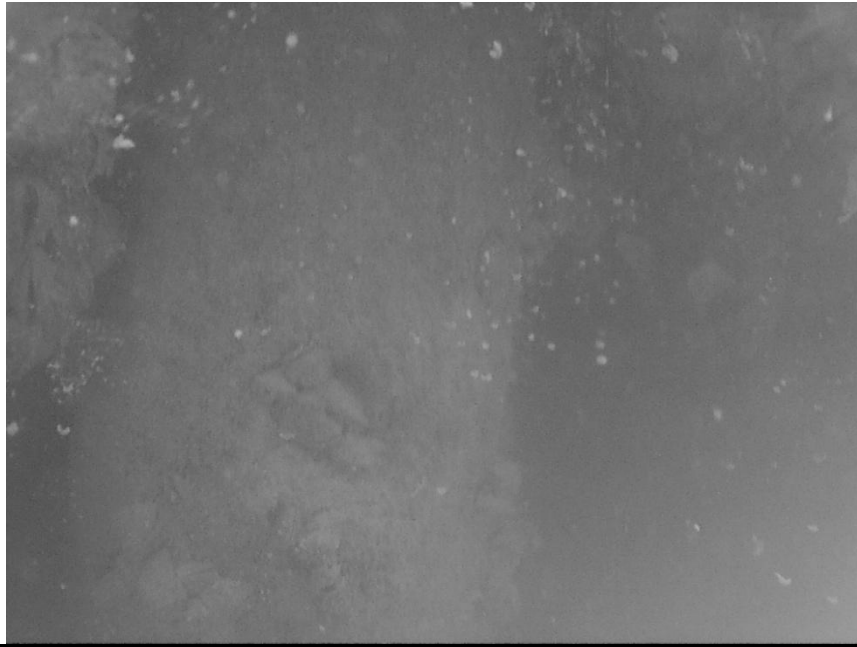


PHOTO # 52

Timber pile below  
concrete panel in large  
undermined area at Station