Metro

Smith and Bybee Wetlands
Multnomah Channel Marsh
Water Control Facilities
Structural Inspection Report

March 16, 2015

INTRODUCTION

The Smith and Bybee Wetlands water control structure is located in the Smith and Bybee Wetlands Natural Area at 9387 N. Columbia Boulevard Portland, Oregon. The two Multnomah Channel Marsh water control structures are located in the Multnomah Channel Marsh Wetlands adjacent to Sauvie Island off US Route 30 at approximately milepost 15.0 (see Pictures 1 through 4). The existing structures are as follows:

Smith and Bybee Wetlands: Three channel reinforced concrete box culvert and weir, constructed in 2003.

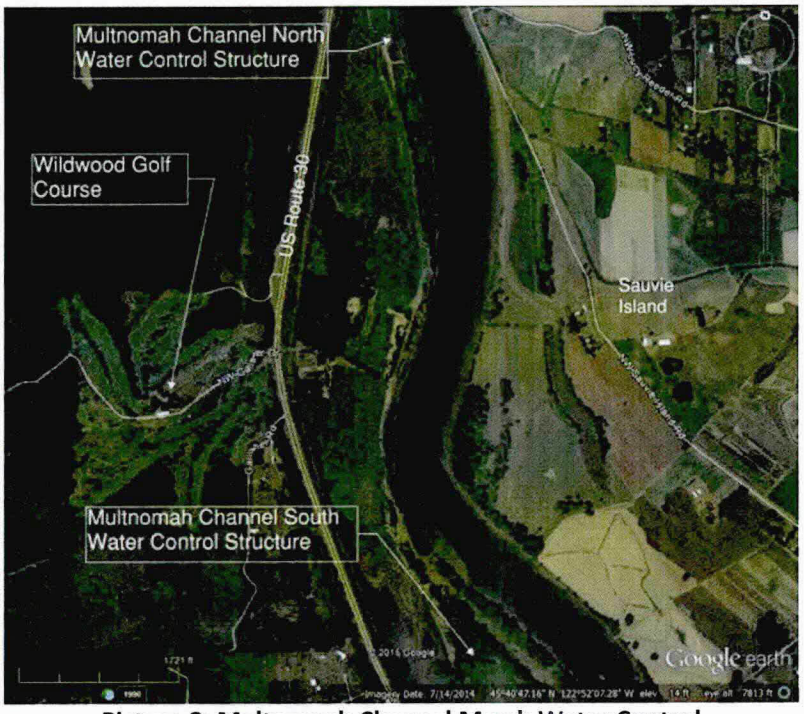
Multnomah Channel Marsh North: Two channel welded wire mesh with shotcrete facing mechanically stabilized earth wall and grouted rip-rap slope culvert, constructed in 2000.

Multnomah Channel Marsh South: Two channel concrete retaining headwall on welded wire mesh with shotcrete facing mechanically stabilized earth wall and grouted rip-rap slope culvert constructed in 2000.

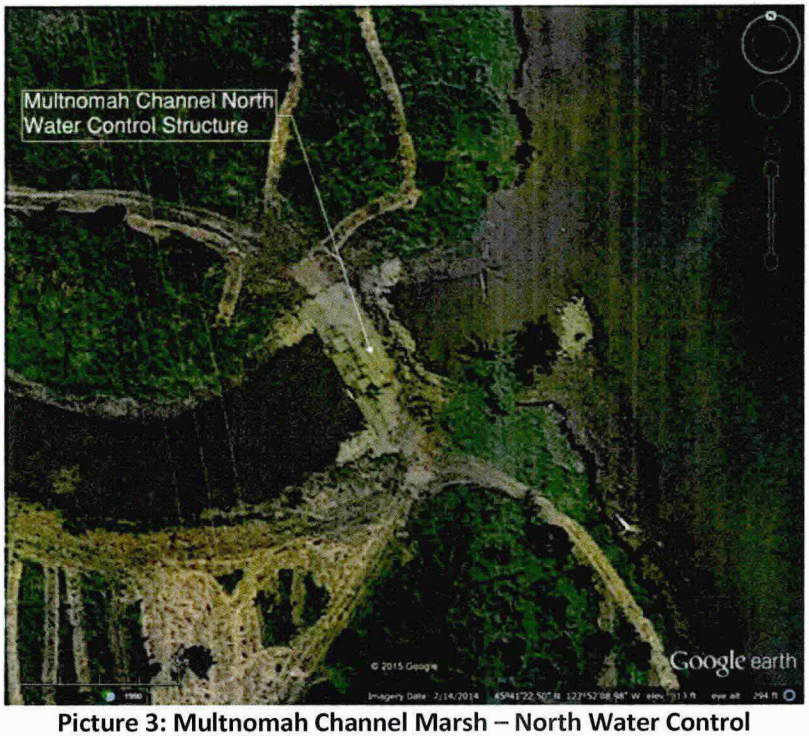
The structures are currently used for water control.

At Metro's request, KPFF was scoped to visually evaluate the structural integrity of the water control structures above the water line and to evaluate the structural condition of the water control structures based upon our visual observations.

Picture 1: Smith and Bybee Wetlands Water Control Structure (from Google earth)



Picture 2: Multnomah Channel Marsh Water Control Structures (from Google earth)



Picture 3: Multnomah Channel Marsh – North Water Control Structure (from Google earth)

Picture 3: Multnomah Channel Marsh – South Water Control Structure (from Google earth)

EXISTING DOCUMENTATION

Existing drawings were provided by Metro and are included in Appendix B.

EXISTING STRUCTURE

SMITH AND BYBEE WETLANDS

The existing water control structure is an approximately 65 feet wide (out to out to ends of the wing-walls) by 39 feet long reinforced concrete culvert and weir with three culvert channels. The roadway fill width over the culverts is approximately 30 feet. The structure includes railing along the top of walls, tide gates, removable wood gates, and internal water control weirs.

MULTNOMAH CHANNEL MARSH NORTH

The existing water control structure is an approximately 50 feet long by 34 feet wide mechanically stabilized earth retaining wall and grouted rip rap slope culvert with two culvert channels. The roadway width over the culverts is approximately 12 feet. The west face consists of welded wire mesh and shotcrete facing mechanically stabilized earth wall with grouted rip-rap side slopes. The east face consists of a grouted rip-rap slope. Each Culvert consists of six feet diameter corrugated steel pipe. Tube steel grating covers the culverts on the east face. A three feet diameter fish passage way is provided between the two culverts.

MULTNOMAH CHANNEL MARSH SOUTH

The existing water control structure is approximately 50 feet long by 38 feet wide mechanically stabilized earth retaining wall and grouted rip rap slope culvert with two culvert channels. The roadway width over the culverts is approximately 12 feet. The south face consists of a reinforced concrete retaining headwall on top of a welded wire mesh with shotcrete facing mechanically stabilized earth wall with grouted rip-rap side slopes. The north face consists of a grouted rip-rap slope. Each Culvert consists of eight feet diameter corrugated steel pipe. Tube steel grating covers the culverts on the north face. An approximately four feet diameter fish passageway is provided at the east side of the structure.

SITE VISITS

On January 21, 2015, KPFF performed a site visit to visually inspect the existing Smith and Bybee Wetlands water control structure. On February 4, 2015, KPFF performed a site visit to visually inspect the existing Multnomah Channel Marsh North and South water control structures.

At the Smith and Bybee Wetlands water control structure, at the time of our site visit, the gage height readings for the water level was approximately 8.55 feet and 8.35 feet, based on the water gages located on the northeast and southwest faces of the culvert, respectively.

At the Multnomah Channel Marsh North water control structure, a water gage reading was not obtained. The water level on the west face of the structure was approximately 10 inches below the culvert invert elevation.

At the Multnomah Channel Marsh South water control structure, at the time of our site visit, the gage height reading for the water level was approximately 10.85 feet, based on the water gage located on the south face of the culvert.

Overall condition of the main elements for each structure were found to be in good to fair condition. Inspection findings for each structural element are listed below. For information pertaining to specific conditions, reference Appendix A of this report for photos and accompanying descriptions. For overall conditions, reference photos A1 through A5 for the Smith and Bybee Wetlands, A25 through A36 for the Multnomah Channel Marsh North and A37 through A40 for the Multnomah Channel Marsh South.

SMITH AND BYBEE WETLANDS

(Photos A1 through A24)

CONCRETE STRUCTURE

Concrete walls comprise most of the structure and appear to be in good condition. On the southern face of the northeast wall, concrete spalling occurs approximately 52 inches from the east end. The spall is approximately three inches deep and three inches wide at the top of the curb, and approximately three inches deep and seven inches wide on the wall face (see photo A6).

On the southwest wall, at the third railing post from the north end, the concrete is spalled at the top anchor of the rail post connection (see photo A7).

RAILING

Steel pipe railing is located along the wingwalls and curbs both sides of the roadway and appeared to be in good to poor condition.

- On the southern end of the northeast wall at the rail post connection plate, a nut and washer appear to be missing from the top anchor and the connection plate shows signs of light corrosion (see photo A8).
- On the northern end of the northeast wall, the rail post connection plate shows signs of light corrosion (see photo A9).
- Along the northeast wall and a few locations along the southwest wall the rail posts and their connections appear to be buried below grade. This condition may accelerate corrosion at the buried post sections (see photo A10).
- At the end rail post connection to the concrete at the northern end of the northeast wall the top anchor nut appears loose (see photo A11).
- At some of the rail post connection anchors, the anchors show signs of corrosion (see photo A12).
- At the southern end of the northeast wall, the top rail is split at the corner with signs of corrosion (see photo A13).
- On the northeast wall, approximately 10 inches from the southern corner, the top rail appears to be dented (see photo A14).
- On the southwest wall at the center rail post, the top rail has sheared apart (see photo A15).
- Loss of paint coating has occurred on many areas of the rail and is peeling in other areas (see photo A16).
- At many locations on the rails, small areas of corrosion are noticeable through the rail coatings (see photos A17).

WALKWAY OVER INLETS

A metal grating catwalk with metal posts and chain rail is located over the inlets and appears to be in good condition. Approximately half of the chain rail posts are wobbly. It is unclear if this condition is due to inappropriately tightened anchors, oversized holes in the posts, or initial failure of the anchors (see photo A18).

On the walkway grating, minor areas of corrosion occur (see photo A19) and some sections of grating do not appear to be anchored to supports.

MISCELLANEOUS METAL FRAMING

The miscellaneous metal framing for the water retention structure appears to be in good condition. Pins located near the top of the inlet keeper slots show signs of corrosion (see photo A20). Light corrosion appears at many locations on the miscellaneous metal inlet framing (see photos A21 through A23).

Four steel tube gates were located on grade at the north end of the structure. These gates show signs of corrosion with light pitting on one end of the gate (see photo A24).

MULTNOMAH CHANNEL MARSH NORTH
(Photos A25 through A36)

GROUTED RIP-RAP SLOPES
Grouted rip-rap slopes were covered with moss and appeared to be in good condition (see photo A25).

STEEL OUTLET SCREENS
Steel outlet screens over the two culverts on the east face consist of galvanized tube steel framing and appear to be in good condition. Light corrosion is evident on the steel (see photo A30).

CORRUGATED METAL PIPE CULVERTS
Corrugated metal pipe culverts appear to be in good condition.

MISCELLANEOUS METAL FRAMING AT INLETS
The miscellaneous metal framing appears to be in good condition with light signs of corrosion (see photo A31).

INLETS
Inlets consist of corrugated metal pipe with grating covers and appear to be in good condition (see photos A32 and A33). At the fish passage pipe, light corrosion occurs on the grating hinges (see photo A34). Concrete pads are placed behind the inlets and appear to be in good condition (see photos A32 and A35).

Around the area of the inlet pipes, 2x wood members are placed between concrete pads and the typical grouted structure surface and appear to be in fair to poor condition. In some areas this wood has fully disintegrated and in other areas can be penetrated with an awl up to approximately ¼ inch (see photos A32, A33, A35 and A36). These members may be left in place forms.

MULTNOMAH CHANNEL MARSH SOUTH
(Photos A37 through A56)

GROUTED RIP-RAP SLOPES
Grouted rip-rap slopes appeared to be in good to fair condition.

On the north face of the structure, two cracks beginning near the roadway surface run vertically down the face of the slope. The first crack is located approximately 21'-9" from the east end of the structure and the second crack is located approximately 28 feet from the east end of the structure. Cracks are approximately six feet long. A horizontal crack connecting the vertical cracks occurs at approximately 4'-9" down from the top of the slope (see photos A41 through A44). A tree sapling is located adjacent to one of the cracks and may be contributing to the crack propagation.

On the south face of the structure:

- At the east end, a crack near the top of the slope at the base of the concrete slab-on-grade runs horizontally to approximately one foot of the head wall. Two vertical cracks propagate down the slope from this horizontal crack. The first vertical crack is located approximately one foot off the headwall and the other crack is located approximately 5'-9" off the headwall (see photos 45 and 46).

- A void appears to occur at the base of the concrete slab-on-grade near the east end of the headwall, which may allow loss of material from underneath the slab and behind the headwall (see photo A47).
- Between the east culvert and fish passage, cracks appear to occur in the grouted rip-rap slope (see photo A48).

CONCRETE SLAB-ON-GRADE AND HEADWALL

A 20'-4" long by 3-6" high concrete headwall is located along the south face of the structure with an approximately five feet wide slab-on-grade extending back into the roadway surface. The headwall appears to be in good condition and the slab-on-grade appears to be in fair condition.

At the east corner of the slab-on-grade, the corner of the concrete is cracked (see photo A49).

Near the east end of the headwall a crack occurs the full width of the slab-on-grade (see photo A50).

On the south face of the west end of the headwall, a small rock pocket occurs and appears to be part of the original construction (see photo A51).

STEEL OUTLET SCREENS

Steel outlet screens over the two culverts on the north face consist of galvanized tube steel framing and appear to be in good condition. Light corrosion is evident on the steel (see photo A52).

CORRUGATED METAL PIPE CULVERTS

Corrugated metal pipe culverts appear to be in good condition.

MISCELLANEOUS METAL FRAMING AT INLETS

The miscellaneous metal framing appears to be in good condition with light signs of corrosion above the typical water line and slightly heavier corrosion near the water line (see photo A53 through A55).

INLETS

Inlets consist of corrugated metal pipe with grating covering and appear to be in good condition. The grating is supported by angles welded to the corrugated metal pipe. Gaps occur between the inlet pipes and the grouted slope/headwall and appear to be due to forming for the grouted slopes (see photo A56). Wood members occur along the edges of the grouted slope and appear to be left in place forms. At most locations, the wood can be penetrated with an awl up to approximately ¼ inch to ¾". At the center of the structure, the wood member on the south face can be penetrated approximately 3 inches with an awl.

CONCLUSIONS AND RECOMMENDATIONS

Overall, the Smith and Bybee Wetlands water control structure appeared to be in good condition with the railing in good to poor condition, the Multnomah Channel Marsh North water control structure appeared to be in good condition, and the Multnomah Channel Marsh South water control structure appeared to be in good to fair condition.

To maintain the structures, KPFF recommends the following structural repairs and preventative maintenance:

Smith and Bybee Wetlands:

- Replace missing washer and nut at rail post connection located at the southern end of the northeast wall.
- Expose buried rail posts.
- Repair separated or split top rails.
- Clean and recoat railing.
- Tighten loose anchor nuts.
- Clean and touch-up coating on miscellaneous metal framing.
- Tighten or reset anchors, as needed, at chain rail posts.

Multnomah Channel Marsh North:

- Clean and touch-up coating on miscellaneous metal framing.

Multnomah Channel Marsh South:

- Clean and touch-up coating on miscellaneous metal framing.
- Remove tree sapling on north face.
- Investigate cause of cracks in grouted rip-rap slopes and repair as needed.

LIMITATIONS

Observation and investigation of the structure was limited to areas observable by reasonable visual investigation and by limited accessibility via shore. Access to the structures was limited to the sections in reach above the water line and above existing grade and did not include sections below the waterline. Conditions described in this summary report are strictly based on visual assessment. Load rating of the structures was not performed.

Observations, analyses, conclusions, and recommendations contained within this report reflect our best engineering judgment. Concealed problems with the construction of the water control facilities may exist that cannot be revealed through drawings, visual observation and photos alone. Therefore, KPFF can in no way warrant or guarantee the condition of the existing construction of the structures, or their future structural performance.

Appendix A – Photos

Smith and Bybee Wetlands

Photo A1: Southwest Elevation (looking northeast)

Photo A2: Southwest Wall (looking south)

Photo A3: Northeast Elevation (looking northwest)

Photo A4: Northeast Elevation (looking south)

Photo A5: Northeast Wall (looking north)

Photo A6: Spall in Northeast Wall

Photo A7: Spall in Southwest Wall at Rail Post Anchor

Photo A8: Southern End of Northeast Wall - Rail Post Connection

Photo A9: Northern End of Northeast Wall – Rail Post Connection

Photo A10: Northeast Wall – Typical Buried Rail Post

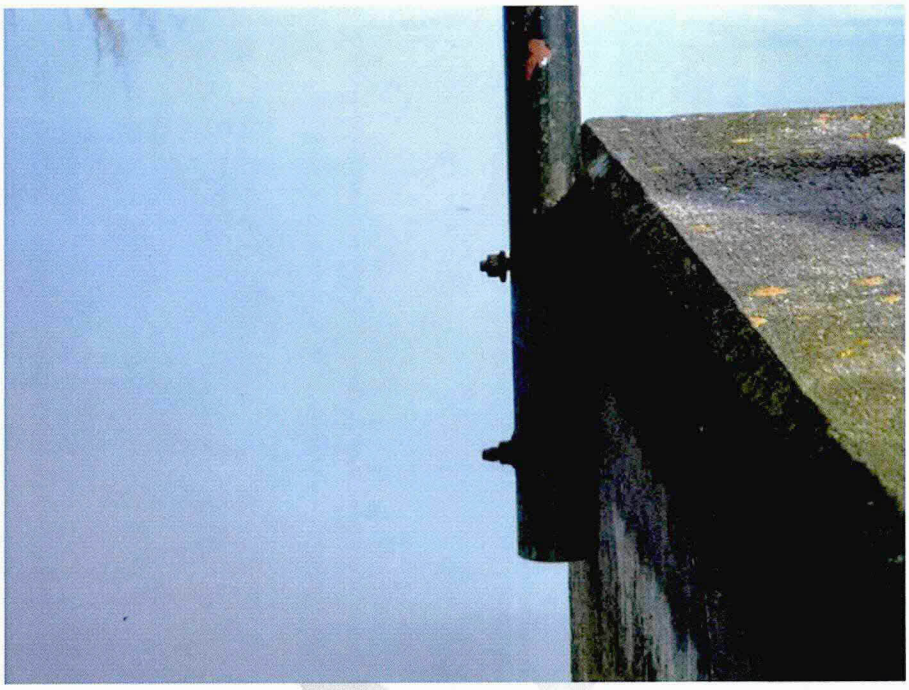


Photo A11: Northeast Wall Northern End– End Rail Post Connection

Photo A12: Typical Rail Post Connection – Corrosion at Anchors

Photo A13: Southern End Northeast Wall – Split Top Rail

Photo A14: Northeast Wall – Dented Top Rail

Photo A15: Southwest Wall – Separated Top Rail

Photo A16: Typical Railing – Coating Loss and Peeling

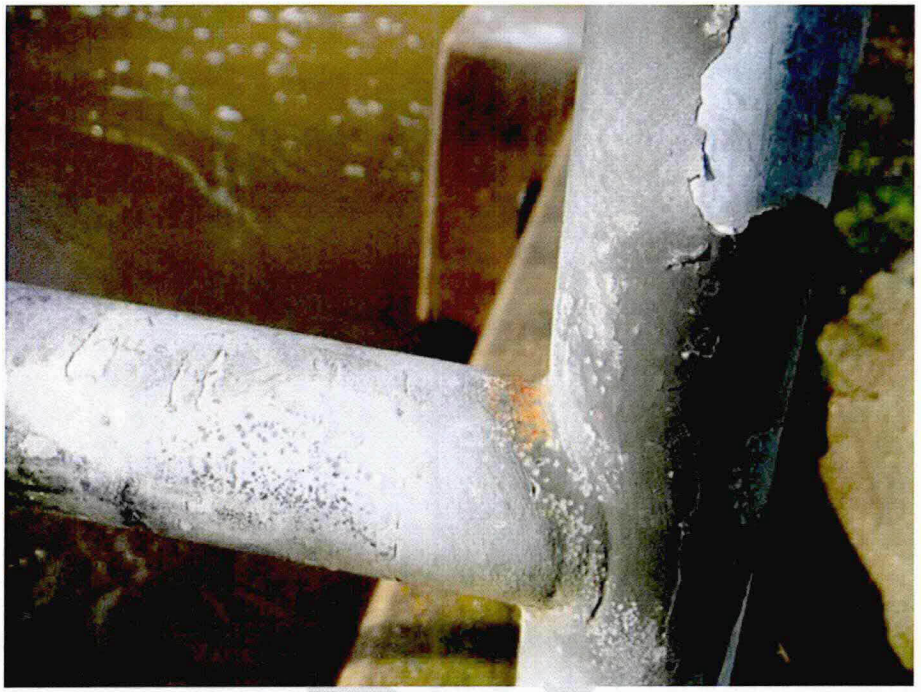


Photo A17: Typical Railing Corrosion

Photo A18: Walkway Over Inlets and Chain Railing

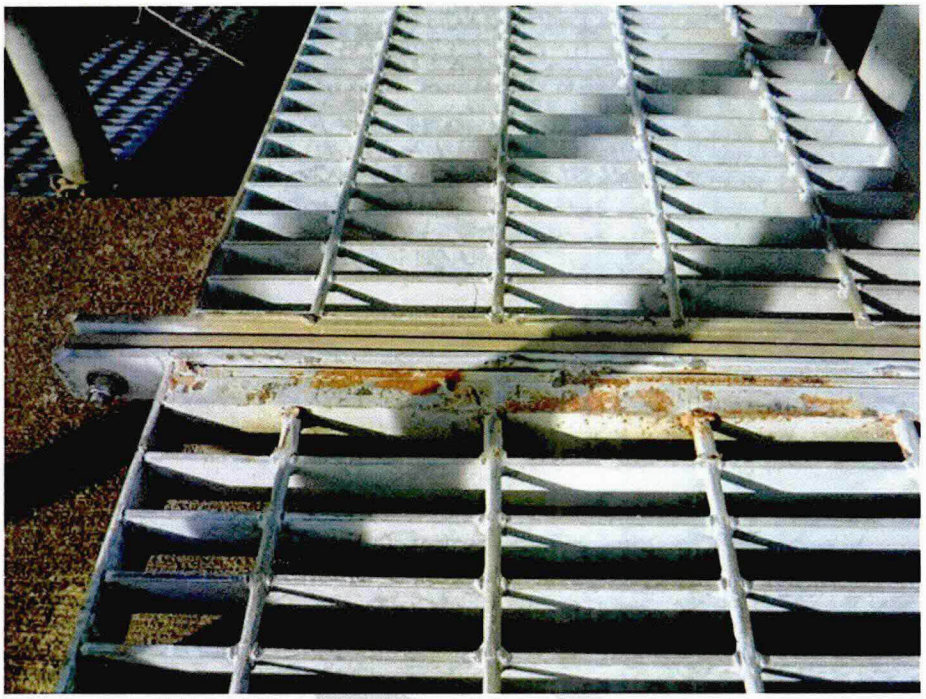


Photo A19: Walkway Over Inlets – Typical Corrosion

Photo A20: Pin Corrosion at Inlet Keeper Slots

Photo A21: Typical Corrosion on Miscellaneous Metal Framing

Photo A22: Typical Corrosion on Miscellaneous Metal Framing

Photo A23: Typical Corrosion on Miscellaneous Metal Framing

Photo A24: Tube Steel Gates – Typical Corrosion and Pitting

Multnomah Channel Marsh North

Photo A25: East Elevation (looking northwest)

Photo A26: East Elevation (looking southwest)

Photo A27: West Elevation (looking northeast) (photo taken November 10, 2014)

Photo A28: West Elevation (looking north)

Photo A29: West Elevation (looking southeast)

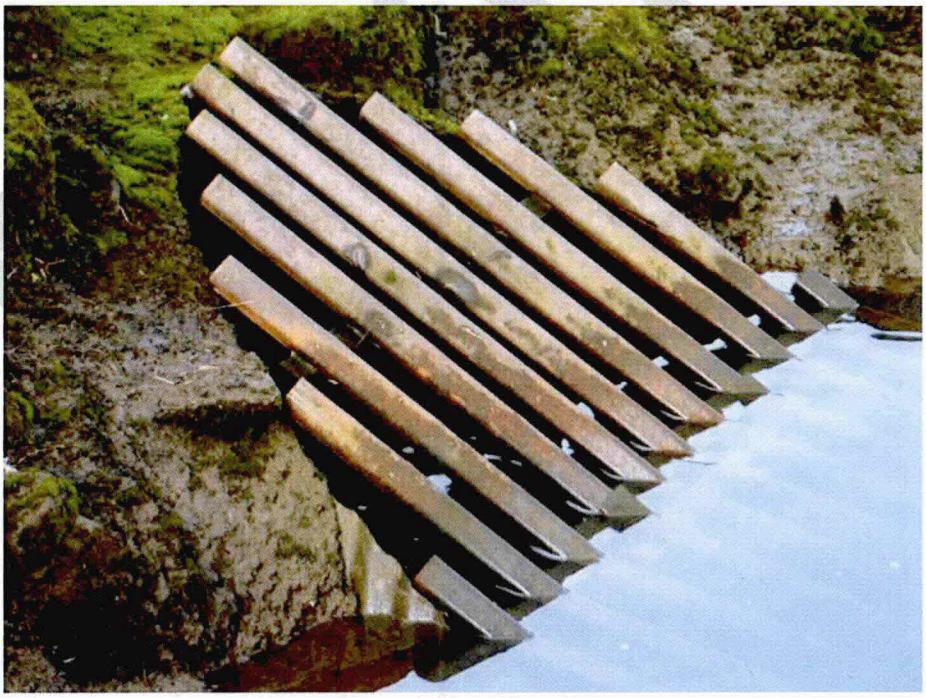


Photo A30: Typical Steel Outlet Screen

Photo A31: Typical Corrosion on Miscellaneous Metal Framing

Photo A32: South Inlet

Photo A33: North Inlet

Photo A34: Center Fish Passage

Photo A35: North Inlet – Concrete Pad

Photo A36: South Inlet – Deteriorated Wood

Multnomah Channel Marsh South

Photo A37: South Elevation (looking northwest)

Photo A38: South Elevation (looking northeast)

Photo A39: North Elevation (looking southwest)

Photo A40: South Face Inlets and Headwall (looking east)

Photo A41: North Face – Cracks in Slope

Photo A42: North Face – Cracks in Slope

Photo A43: North Face – Cracks in Slope

Photo A44: North Face – Cracks in Slope

Photo A45: South Face – Cracks at Top of Slope

Photo A46: South Face – Cracks Adjacent to Headwall

Photo A47: South Face – Void at Base of Slab-On-Grade Near Headwall

Photo A48: South Face – Cracks Between East Culvert and Fish Passage

Photo A49: Crack at Corner of Slab-On-Grade

Photo A50: Crack in Slab-On-Grade

Photo A51: Rock Pocket in Headwall

Photo A52: Typical Steel Outlet Screen

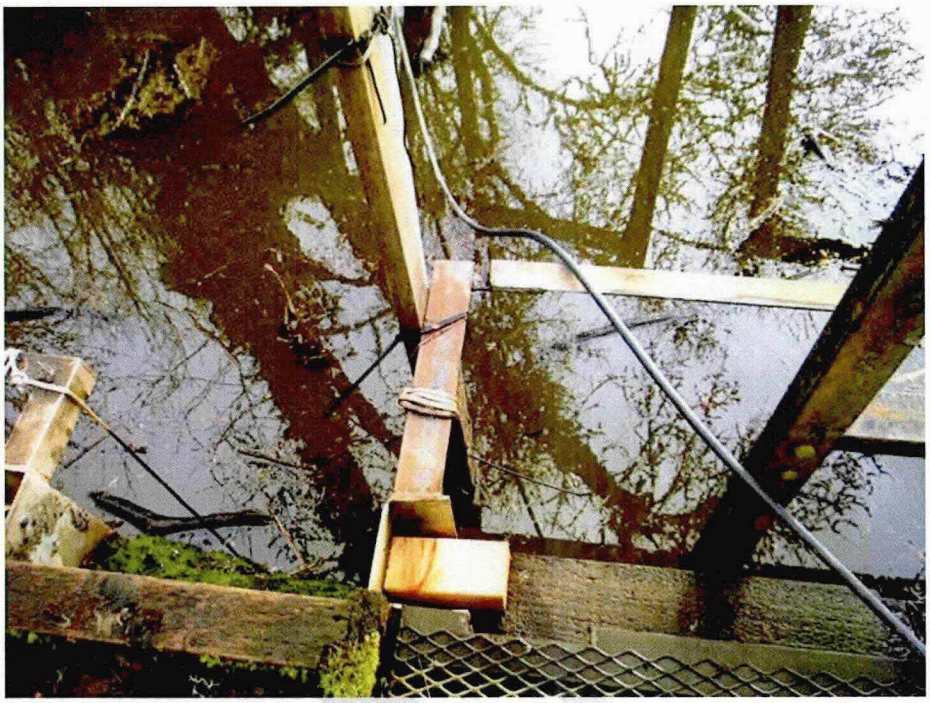


Photo A53: Typical Corrosion on Miscellaneous Metal Framing

Photo A54: Typical Corrosion on Miscellaneous Metal Framing

Photo A55: Typical Corrosion on Miscellaneous Metal Framing

Photo A56: Inset Wood and Gap at Inlet

Appendix B: Existing Drawings