INCA ENGINEERS INC.

July 27, 2007

David Porter
Clackamas Heritage Partners
1726 Washington
Oregon City, OR 97045

Subject: **Final Submittal, Willamette Falls Locks Engineering Study**
Large Scale Capital Costs
Name of Project: Willamette Falls Locks Engineering Study
INCA Job No.: 07-015

Dear Mr. Porter:

We are pleased to submit 10 hard copies and 2 electronic copies of the Final Submittal of the Willamette Falls Locks Engineering Study, Large Scale Capital Costs for your use and files. We appreciated the opportunity to work with you in your efforts to arrive at long-term solutions for the operation of the Willamette Falls Locks. Please don't hesitate to contact me if you have any questions or if we can be of further assistance to you in the future.

Sincerely,

INCA Engineers, Inc.

Lisa R. Pierce, PE
Navigation Group Manager

Enclosures

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CERTIFICATE OF ENGINEER

The work contained herein was prepared under the supervision and direction of the undersigned.

Lisa R. Pierce, PE
Navigation Group Manager

Roy T. Ouchida, PE
Sr. Electrical Engineer

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1.0 EXECUTIVE SUMMARY

The purpose of this study was to ascertain the structural integrity of the Willamette Falls Locks and identify major capital investments required in the 20-year period from 2007 to 2027.

Willamette Falls Locks opened in 1873 and were operated by a number of owners before the U.S. Army Corps of Engineers purchased it in 1915. The Willamette Falls Locks have multiple lifts, with a total lift of 41 feet. The locks are composed of four chambers that are each 40 feet wide and 210 feet long, a canal basin, a flood control guard lock chamber at the upstream end of the canal, and upper and lower approach structures (300 feet long and 150 feet long, respectively).

The Willamette Falls Locks, operated by the U.S. Army Corps of Engineers**,** provide the only passage for boats around the Willamette Falls. The Corps' operating budget has been steadily decreasing in recent years, and the Federal FY 2006 budget put the locks in "caretaker status." The Corps of Engineers has indicated their willingness to work with a local/state group to develop a transition plan toward eventual local/state operation. However, before serious discussions can begin with potential local/state institutional sponsors, the physical condition of the locks needed to be evaluated and long-term capital costs more clearly identified.

Overall, based on a review of applicable engineering and inspection reports and a site visit on April 19, 2007 that included observation of the operation of all lock miter gates, the Willamette Falls Locks were found to be in significantly better condition than would be expected for locks opened in 1873. The locks have been periodically inspected and maintained by the U.S. Army Corps of Engineers. The reduction in lock usage and the conditions of operation also serve to extend the design life of the critical lock structures.

The lock miter gates are one of the most critical elements of lock operation and lock integrity and also require the highest level of capital investment. No record of refurbishment was found for lock miter gate #3. If this gate has not been refurbished since it was installed in 1968, then its condition is of significant concern. A Hydraulic Steel Structure (HSS) inspection of all of the lock miter gates is recommended before the 2008 summer season. While each miter gate is removed for HSS inspection, evaluation and repair of each of the miter gate leaves is recommended, including gate #3. Based on this evaluation, the general condition of gate #3 and urgency of refurbishment of this gate can be determined more accurately. If gate repairs are budgeted and timed to be completed during the HSS inspection and subsequent dewatering of lock chambers, it should reduce the long-term capital investment costs by reducing the number of contractor mobilizations and the total amount of dewatering required. During lock chamber dewatering, after the HSS inspections, miter gate #3 pintles should also be examined, determining whether they have been replaced since they were installed in 1968. If they have not been replaced since 1968, then pintle replacement is likely to be required within the next 5 years.

However, there is some reason to believe that gate #3 may have been refurbished since 1968. It had a timber miter post replaced in 1974, and the timber facing on gate #3 is in good condition and does not appear to be the original timbers placed in 1968. The actual condition of miter gate #3 steel members and supporting pintles is unknown.

As discussed, more information is needed on the condition of gate #3. However, the other six lock miter gates have all been refurbished within the last 15 years. Due to the relatively recent and extensive refurbishment of these miter gates, it is anticipated that the majority of the miter gate leaves are in relatively good condition with the exception of less critical items such as the fill/empty valve operators and seals. Routine maintenance of these and other items will be required in order to keep the locks in good operating condition and minimize escalation of this work into large-scale investments.

The rock and masonry lock walls appear to be in relatively good condition, considering the age of the Willamette Falls Locks. Minor to moderate loss of materials, as found, is to be expected over time, and there did not appear to be a systemic reason for material loss. The timber lock wall lining and framing are in better condition than anticipated, given the age, materials, and lock operating conditions. Most likely, a good maintenance program and reduced usage of the locks have extended the design life.

The largest capital costs anticipated over the 20-year planning horizon for this study are for miter gate refurbishment, miter gate linkage and anchorage repairs, and timber wall lining/framing replacement. It is anticipated that the largest of these costs, which is the refurbishment of gates #1 and #7, will be required towards the end of the 20-year timeframe and that initial costs will be relatively moderate. In 2007 dollars, it is estimated that approximately $560,000 will be required between 2007 and 2012 for large-scale capital investments at Willamette Falls Locks, unless miter gate #3 refurbishment is determined to be needed before 2012. If it is needed, then an additional amount of approximately $480,000, in 2007 dollars, will be required.

The following summarizes an estimate of the major capital investments, in 2007 dollars, that are reasonably likely to be required between 2007 and 2027 at the Willamette Falls Locks:

Large Scale Capital Requirement	**Approximate Year of Capital Cost**	**Opinion of Probable Cost 2007 Dollars**
Documentation of Electrical/Power System	2008 or 2009	$ 50,000
Replacement of Standby Generator and New Fuel Tank (Optional)	2008 or 2009	$ 50,000
Repair 2 Fill/Empty Valve Operators	2011	$ 30,000
Repair 2 Gate Linkages/Anchorages	2012	$ 140,000
Replacement of a Portion of Lock Wall Timber Lining	2012	$ 250,000
Replacement of Missing Lock Wall Stones	2012	$ 40,000
Repair 2 Fill/Empty Valve Operators	2015	$ 30,000
Refurbish Gate #3	Unknown	$ 480,000, if required
Replacement of a Portion of Lock Wall Timber Lining and Framing	2017	$ 530,000
Replacement of Digital Controls	2018	$ 12,000
Repair 2 Fill/Empty Valve Operators	2019	$ 30,000
Repair 2 Gate Linkages/Anchorages	2022	$ 140,000
Replacement of a Portion of Lock Wall Timber Lining	2022	$ 250,000
Repair 2 Fill/Empty Valve Operators	2023	$ 30,000
Refurbish Gate #1 and Gate #7	2023	$ 1,660,000
Possible Flood Recovery Cost	Unknown	$ 50,000
		$ 3,772,000 Total

The probable large-scale capital costs, shown above, do not include the cost of recommended additional evaluation work described in this report, and they do not include the cost to repair or replace other items or deficiencies that may be identified as a result of the additional evaluations. In addition, the above costs assume only limited repair and replacement of miter gates, operating machinery, and timber members. It is possible that a greater extent of repair and/or replacement work may be required.

Recommendations for additional evaluation are described in detail in Section 6.0. Recommended additional evaluation includes the following:

- HSS inspections, completing repairs while miter gates are removed
- Observation of dewatered locks after HSS repairs are completed
- Full condition assessment, testing, and record search to determine age and replacement interval for the timber wall lining and framing
- Program of subsidence monitoring
- Periodic inspection of the locks every 2 years or 500 lockages, whichever comes first, including inspection of the miter gate anchorages and linkages
- Inspection of the standby generator diesel engine

As a historic water resources structure opened in 1873, Willamette Falls Locks is on the National Register of Historic Places and is designated as a State Historic Civil Engineering Landmark by the American Society of Civil Engineers. At the same time, the locks are operating structures which must meet applicable operation, safety, and environmental requirements. The locks have been adapted, as needed, in order to continue operation. This work has included replacement of the original timber miter gates with steel miter gates, replacement of the original manual operation of the gates with hydraulic operating machinery, and replacement of the analog electrical system with digital controls.

When developing concepts and major capital costs for Willamette Falls Locks, various considerations must be balanced, including the use of historically appropriate materials, environmental issues, and costs for different materials and construction methods. When a capital improvement is located where it is highly visible to the public, historic preservation considerations are of particular concern. The opinions of probable costs, shown on the previous page, are based on large-scale capital improvements that retain the essential historic character of the Willamette Falls Locks.

2.0 INTRODUCTION

2.1 Background

The Willamette Falls Locks, operated by the U.S. Army Corps of Engineers**,** provide the only passage for boats around the Willamette Falls. The Corps' operating budget has been steadily decreasing in recent years, and the Federal FY 2006 budget put the locks in "caretaker status", essentially closing the locks for all uses, with the exception of rare emergencies. The locks are in imminent danger of being permanently closed unless local or state funding and operation can be arranged.

Photo 2 -1

In 2005, Congresswoman Darlene Hooley convened a multi-agency Steering Committee, Willamette River United, which began planning a forum to connect the efforts for economic revitalization of river communities along the Willamette. From that forum, the continuation of Willamette Falls Locks operation was designated as an Oregon Solutions project by the Governor, with former Superintendent of Schools Verne Duncan named as convener. Technical assistance was also received from the Willamette American Heritage Rivers Initiative through the Bureau of Land Management.

Since October 2005, a group of more than 20 local, state, federal, and private-sector collaborative partners has been meeting to consider various alternatives for continued operation and funding of the Locks. The first phase of this project ended in May 2006 with the raising of funds toward a partnership agreement with the Corps of Engineers to keep the Willamette Falls Locks operating for the next two years, while a more permanent solution is developed.

The Corps of Engineers has indicated their willingness to work with a local/state group to develop a transition plan toward eventual local/state operation. However, before serious discussions can begin with potential local/state institutional sponsors, the physical condition of the locks needed to be evaluated and long-term capital costs more clearly identified.

Therefore, INCA Engineers, Inc. was authorized by Clackamas Heritage Partners, in April 2007, to conduct an engineering study to ascertain the structural integrity of the locks and identify any major capital investments required in the next 20 years.

2.1.1 Description of Willamette Falls Locks

Willamette Falls Locks opened in 1873 and was operated by a number of owners before the U.S. Army Corps of Engineers purchased it in 1915. The Willamette Falls Locks have multiple lifts, with a total lift of 41 feet. The locks are composed of four chambers that are each 40 feet wide and 210 feet long, a canal basin, a flood control guard lock chamber at the upstream end of the canal, and upper and lower approach structures (300 feet long and 150 feet long, respectively).

Photo 2 -2

The annual number of lockages by vessel type, in recent years, is as follows:

Dry Cargo	8
Commercial	51
State/Local	1
Passenger/Ferry	36
Federal	2
Recreational	393
Tow/Barges	46

Several renovations and major rehabilitations of the locks have been completed. In 1916, the lock chambers were deepened from 3 feet to 6 feet so that they could accommodate deeper draft vessels. In 1941, the original wooden lock gates were replaced with steel miter gates and hydraulic operating machinery was installed, replacing the previous manual operation. In the late 1960s and early 1970s, the steel miter gate leaves were replaced. Filling and emptying of the lock chambers is accomplished with vertical slide gate valves that are inset into the lock miter gates.

2.2 Purpose and Scope

The purpose of this study was to ascertain the structural integrity of the locks and identify major capital investments required in the 20-year period from 2007 to 2027.

The scope was defined through conference call discussions that were facilitated by Oregon Solutions, and the members present at these discussions were selected by Oregon Solutions. An initial conference call was completed on April 3, 2007. In this call, the scope was discussed and clarified to focus the effort on big ticket, large-scale costs required over the 20-year planning horizon and not on routine maintenance items and associated safety considerations (e.g. handrail) that will be addressed as routine maintenance.

Also, during the initial April 3, 2007 conference call, the categories of major capital costs and routine maintenance costs were discussed. For the purpose of this study, the division between major capital costs and routine maintenance costs was roughly determined by magnitude of cost, necessity for the cost under current operating conditions, and whether the cost is required annually/short-term periodically or it is needed only on a long-term basis. Examples of the assumptions for the two categories are shown below.

Routine Maintenance

- Installation or repair of handrail that is needed to continue current operating requirements of the locks, such as the railing at the lower mooring platform
- Testing and correction of the grounding system
- Replacement of piping that is currently crossing the lock chamber floor
- Small scale changes to prevent environmental problems from potential spills of hydraulic fluid, such as changing the type of fluid used to an environmentally friendly fluid or by constructing a spill containment structure at the hydraulic controls area
- Repair and maintenance of utilities, mechanical/electrical systems, and structures, such as repair of control house #6
- Temporary, short-term repairs of gate or operating cylinder anchorages
- Backlog of routine maintenance items, as detailed in the Fiscal Year 2006 Willamette Falls Locks Annual Report

Major Capital Costs

- Stabilization of lock walls (anchorages and supporting soils)
- Repair of lock walls, where there is leakage into lock chamber
- Replacement of lock wall lining
- Replacement or major rehabilitation of miter gates
- Replacement of digital control system
- New standby generator fuel tank
- Long-term repairs of gate or operating cylinder anchorages

Cosmetic items, such as replacement of a small amount of missing timbers or isolated wall blocks, and lower cost items, such as replacement of a few hundred feet of handrail to meet public access code requirements are not considered to be major capital costs. However, since they are not required in order to meet current operating conditions, they are also not considered to be routine maintenance. The need for these items is dependent on the desired type of future use for Willamette Falls Locks. Items in this category are not strictly included in the scope of this study, but one or two may be included and addressed, at the discretion of Clackamas Heritage Partners.

The scope of this study included data collection of relevant drawings, technical information, recent USACE safety reports and periodic inspection reports, and historical cost information. The scope also included a site visit to observe the lock condition and subsequent civil engineering, structural engineering, mechanical engineering, electrical engineering, and

preliminary cost estimating services, evaluating the current and anticipated future operating requirements for the major lock structures, operating machinery, and electrical systems for the period from 2007 to 2027.

2.3 Study Methodology

In order to determine the major capital costs anticipated to be required between 2007 and 2027, the following approach was implemented.

1. Data was collected from the U.S. Army Corps of Engineers, including applicable drawings, pertinent information and geology, recent inspection reports, and the 2006 annual report for Willamette Falls Locks.

2. A site observation visit was conducted on April 19, 2007. The entire length of the multiple lift locks and canal were observed, and all of the miter gates were operated. A short project kickoff meeting was also held on this day, after the site observation was completed.

3. The findings from the site observation were considered and evaluated. Based on the observed condition of the locks, anticipated large-scale capital requirements were determined for the 20-year planning horizon assumed in this study.

4. Opinions of probable costs, in 2007 dollars, were developed for each of the large-scale capital requirements that were identified.

2.4 Site Visit/Study Limitations

The determination of anticipated major capital costs was based on a review of a considerable amount of information and observation, but the site visit and study also had a number of limitations, including the following:

- During the site observation visit on April 19, 2007 and in the earlier periodic inspection report, completed by the U.S. Army Corps of Engineers in 1994, there was timber lining on the downstream face of all of the miter gates, and there was timber lining on portions of the lock wall faces. Therefore, it was not possible (and has not been possible for some time) to examine portions of the lock wall face behind the timber wall lining and to examine the structural steel members and welds of the miter gates behind the timber gate lining.

- During the site observation, the lock water levels were lowered as much as possible by opening the vertical slide gate valves that are inset into the miter gates. However, the locks were not fully dewatered and will not be fully dewatered until a Hydraulic Steel Structures (HSS) inspection can be completed by the Corps of Engineers. The condition of the portions of the lock walls, miter gates, and other features that were underwater could not be observed.
- Per U.S. Army Corps of Engineers requirements, an HSS inspection needs to be performed on the miter gates at Willamette Falls Locks. In order to perform this inspection, it is anticipated that miter gates will need to be removed, laid flat at a location accessible to inspectors, and the timber gate lining will need to be removed. Once this is done, the miter gate members and welds can be inspected. If the miter gates are found to be in acceptable condition, then the locks can be dewatered and further lock observations/inspections can be performed. Funding is currently not available in order to complete the required HSS inspection.
- No testing was performed for this engineering study. Without testing, it is not possible to definitively determine current material strengths, extent of corrosion, current rock anchor capacities, and other types of detailed data. Similarly, no coring, instrumentation, or mapping was completed at the lock walls. As such, it is not possible to definitively determine the existence and/or extent of the loss of supporting soils from behind the lock walls and whether there are any layers of relatively weak soil interbedded with the rock behind portions of the lock walls.

2.5 Materials

2.5.1 Consideration of Historically Appropriate Materials

As a historic water resources structure opened in 1873, Willamette Falls Locks is on the National Register of Historic Places and is designated as a State Historic Civil Engineering Landmark by the American Society of Civil Engineers. At the same time, the locks are operating structures which must meet applicable operation, safety, and environmental requirements. The locks have been adapted, as needed, in order to continue operation. This work has included replacement of the original timber miter gates with steel miter gates, replacement of the original manual operation of the gates with hydraulic operating machinery, and replacement of the analog electrical system with digital controls.

When developing concepts and major capital costs for Willamette Falls Locks, various considerations must be balanced, including the use of historically appropriate materials, environmental issues, and costs for different materials and construction methods. When a capital improvement is located where it is highly visible to the public, historic preservation considerations are of particular concern. In these cases, historically appropriate materials are discussed and considered in the report. Where possible, several construction options are presented, including one or more that address historic preservation.

2.5.2 Environmental Considerations

Some materials, while historically appropriate, are not considered to be environmentally friendly. Various techniques have been tried historically to prevent biological degradation of wood by impregnating the wood with a poison such as creosote or copper, arsenic and cyanide. Active, effective poisons that prevent wood deterioration may bleed into the environment and cause deleterious biological impacts.

Plastics have been used successfully to replace wood in wet environments. Plastics do not degrade like wood in the wet and do not bleed out preservatives.

The Willamette Falls Locks use a lot of treated wood. Copper arsenic treated wood line the walls and gates, and creosoted wood is used for the miter and quoin posts. When walls or gates are refaced, replacement of damaged wood parts with plastic parts or other environmentally inert materials might be considered. Use of recycled plastic lumber may be an option for the gate and wall lining, but a different material would be required for the miter posts and quoin posts, due to material property requirements, if the treated wood was eliminated at these locations. Even though it is not necessarily historically appropriate, elimination of treated wood from most or all locations at Willamette Falls Locks may be desirable, based on environmental considerations.

The material cost of recycled plastic lumber is around three times the cost of the same size treated timber. The material cost is a relatively small part of the total installation cost, however. Life cycle evaluations may also show the recycled plastic lumber outlasting treated wood, reducing the cost difference between these materials.

2.5.3 Cost Considerations

There are a range of materials and construction alternatives that can be used in the large-scale capital improvements addressed in this report. Some of these may be historically accurate, historically comparable, or provide a similar appearance. Others may be different but are considered to be a necessary adaptation to ensure safe and efficient operation of the locks.

Some historically appropriate materials and construction methods may be cost effective while others may be cost prohibitive, such as replacement of the ashlar wall masonry with locally quarried basalt. While it is certainly possible to quarry and dress replacement stones, it is likely to be cost prohibitive to replicate the construction methods. In the case of the wall stones, it would be necessary to remove the in-place stones, down to the location of the missing stone, and rebuild the wall with the replacement stone in place. Re-setting a stone without removal of the stones above it is not likely to be successful, as the stones are held in place by inter-stone contact forces. It is not possible to size the replacement stone to simultaneously be small enough to be placed in the hole produced by the missing stone and large enough to interlock with the adjacent stones. A cost effective solution, which does not significantly compromise the use of historically accurate materials, would be to grout a

replacement quarried stone in place. This solution would be historically consistent, as the use of mortar and grout in masonry construction proceeded from the need to stabilize ashlar masonry.

2.6 Safety Considerations

In general, small-scale repairs and replacements that address safety considerations are considered to be part of routine maintenance and are not addressed in this report.

As mentioned in Section 2.2, replacement of a few hundred feet of handrail on the Corps side of the lock, near the lock office and historical information center, to meet public access code requirements is also not considered to be a major capital cost and was not included in this report. However, since this is not required in order to meet current operating conditions, it is also not considered to be routine maintenance. The potential need for this item is dependent on the desired type of future use for Willamette Falls Locks.

2.7 Consideration of Large Flood Events

The flood of 1996 was a very large flood event, and it caused damage to Willamette Falls Locks on the order of $280,000, in 1996 dollars. Clean up costs included electrical repair and silt removal.

It is worthwhile to consider the likelihood of another flood event of this size occurring during the next 20 years and what anticipated repair costs would be. Reviewing records for statistical reoccurrence assumes that the weather patterns in the future will follow current weather trends, which is not necessarily the case. The 1996 flooding was due to a combination of high snow pack and a warm rain ("Pineapple Express"). Global warming effects may increase precipitation in the Pacific Northwest but may reduce snow pack. So, if is difficult to accurately assess the likelihood of future flooding, but another very large flood such as the one that occurred in 1996 is not expected to occur in the next 20 years based on statistical information shown in Appendix A of this report.

The electrical systems replaced as a result of the flooding of 1996 are also better able to survive flooding, resisting flood damage. Therefore, electrical damage is anticipated to be less if a large flood occurs. In the case of a large flood event, it is anticipated that there would be little damage to the electrical system, but some silt clean up would be required.

2.8 References

This engineering study was based on the following documents and the most recent editions of the applicable engineering codes and U.S. Army Corps of Engineers guidelines:

- Information Brochure for Periodic Inspections of Willamette Falls Locks
- Report of Inspection of Lock Structures, Willamette Falls Locks, July 1978
- Periodic Inspection Report No. 1, Willamette Falls Locks, March 1994
- Field Inspection Trip Report at the Willamette Falls Locks on June 29th, Memorandum for Record, July 31, 2006
- Fiscal Year 2006 Willamette Falls Locks Annual Report
- Willamette Falls Locks Brochure, 1998

3.0 STRUCTURAL EVALUATION

This section presents the structural evaluation of the lock integrity and identifies major capital improvements that are anticipated to be required during the 20-year planning horizon.

3.1 Lock Walls

3.1.1 Leakage and Loss of Supporting Soils

The lock walls are leaking through the masonry miter gate monoliths and through the chamber walls in general. It does not appear that the volume of water lost, due to leakage, is a concern to the lock operators, and it does not appear that the leakage of water into the mill facilities is a concern to the mill operators.

3.1.1.1 Introduction to Through Wall Leakage

The following series of photographs illustrate the magnitude of the leaks and the mechanism of how the leak functions. These photographs show the initiation and development of leakage through an ashlar masonry miter gate monolith as the adjacent upstream chamber fills. Through wall leakage is similar, with less flow volume.

Photo 3-1 **Through Wall Leakage (Riverside)**
(Flow initiates as the chamber begins to fill)

Photo 3-2 **Through Wall Leakage (Riverside)**
(Flow rate increases and flow path lengthens as the chamber fills)

Photo 3-3 **Through Wall Leakage (Riverside)**
(Flow path continues to lengthen as the chamber fills)

3.1.1.2 Discussion of Landside Leakage

The preceding series of photographs illustrated a leak propagating through a riverside miter gate monolith. The same thing happens on the landside, albeit with very different consequences. The following photographs show leakage, at various water surface elevations in the upstream chamber, through landside lock wall monoliths. The three riverside photographs are of the same monolith at different times; the landside photographs show three different lock wall monoliths.

Photo 3-4 Through Wall Leakage (Landside) / Prior to Filling Upstream Chamber

The vegetative growth, loss of ashlar masonry stones, and open joints in the masonry are likely the result of water moving through the miter gate monolith.

Photo 3-5 Through Wall Leakage (Land Side)
(Enough soil has been washed into the joints to support vegetation)

Photo 3-6 Through Wall Leakage (Landside)
(Flow path extends beyond masonry)

This photograph highlights the different consequences of through wall leakage on the landside versus the riverside. As the leak path propagates beyond the masonry miter gate monolith, it encounters the general lock chamber wall construction. The chamber wall construction has multiple designs, including a timber lined excavated rock face, a timber lined excavated rock face with soil and concrete fill, and a combination of timber and concrete faced rock cut. Each of these designs is shown below.

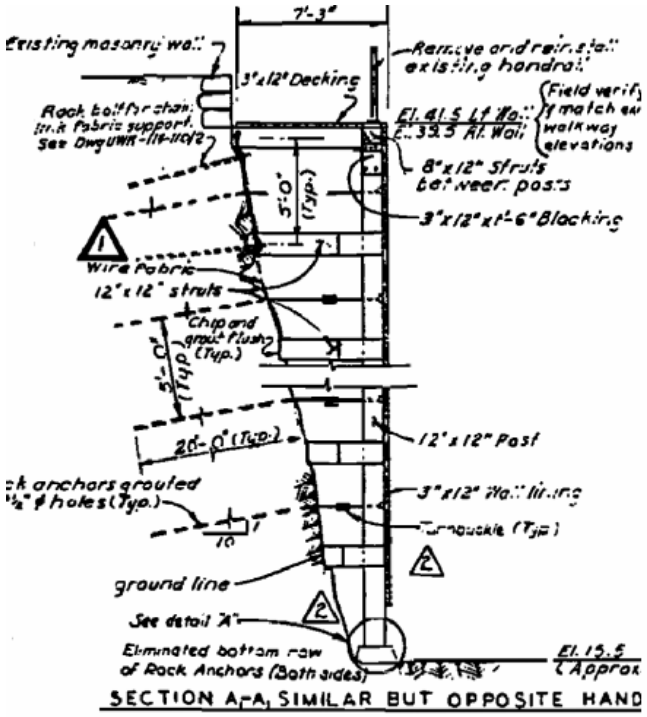


Figure 3-1 Timber Lined Excavated Rock Face

When the leak path encounters this chamber wall construction, the movement of water does not negatively affect the chamber wall.

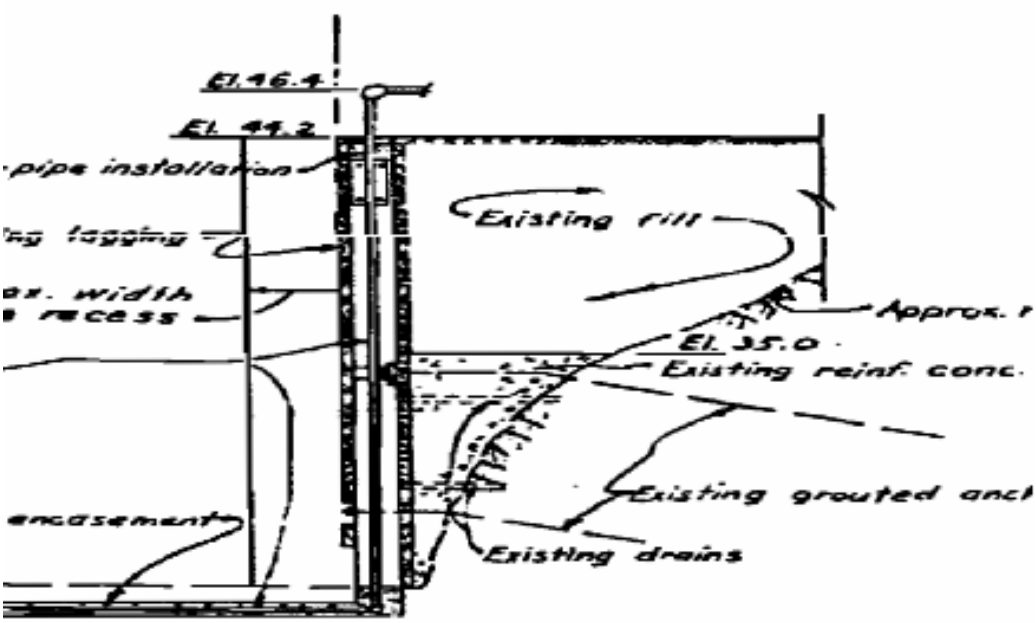


Figure 3-2 Timber Lined Excavated Rock Face with Soil and Concrete Fill

When the leak path encounters this type of lock chamber wall construction, there is potential for the movement of fill material through the wall facing. This wall section shows reinforced concrete fill with drains in the lower portion and soil fill above. In the photograph that shows the flow path extending beyond the masonry, this coincides with the paved area adjacent to the wall and the picnic table area beyond. Since the water coming through the wall appears to be clear (it does not appear to be carrying suspended solids), it is likely that the water has been collected by the drains and directed through the timber facing. The turbidity in the chamber water was due to filling and emptying the chamber immediately prior to the photograph, although it would support the hypothesis that the wall leakage is washing the soil fill through the timber facing.

If the wall leakage is washing the fill material through the wall facing, it will be necessary to implement a capital improvement project to address the situation. This case is the only situation, of all possible combinations of wall location (riverside/landside) and fill configuration (none/soil/concrete), which would require work. Possible retrofit designs would either address the leakage or address the movement of material; it would not be necessary to address both. Of these two options, the preferred option is to allow the continued leakage and provide a drain system that intercepts the flow and prevents the movement of the soil fill material. Attempting to stop the leak is problematic and may require an upstream impermeable membrane or a cutoff wall within the fill mass.

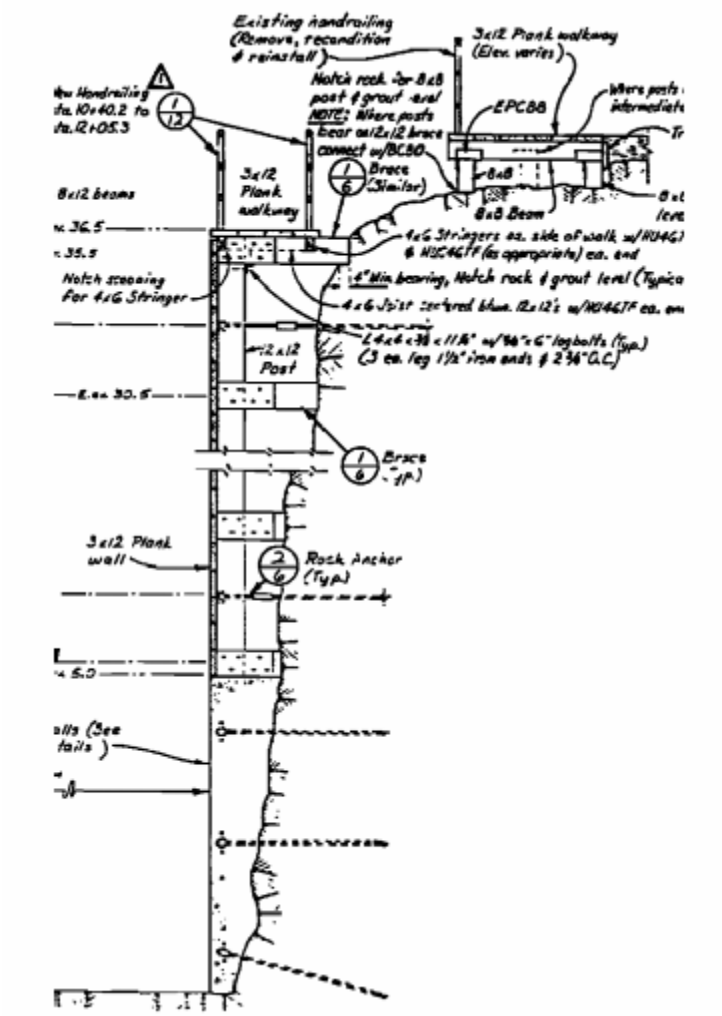


Figure 3-3 Combination of Timber and Concrete Faced Rock Cut

When the leakage flow path encounters this version of the lock chamber wall construction, it drains through the timber facing without negatively affecting the chamber wall.

3.1.1.3 Discussion of Riverside Leakage

As previously mentioned, the consequences of through wall leakage on the riverside are significantly different from the consequences of leakage on the landside. The following photographs illustrate the difference.

Photo 3-7 Riverside Wall - Chamber Side at the Mill Warehouse

Photo 3-8 Riverside Wall - Mill Side at the Mill Warehouse

There are two things to notice in the photograph shown above. First, the leakage discharges from the wall as a free water surface and is carried away via surface flow. Second, a barrier (a thin sheet of plywood) has been erected to contain the splash zone.

Photo 3-9 Riverside Wall - Mill Side at the Mill Warehouse

This photograph also shows the mill warehouse. It is taken at a point approximately sixty feet upstream of the previous picture. At this location, there is less through wall leakage, so the warehoused material can be closer to the chamber wall. The consequences of through wall leakage on the riverside appear to be limited to a lack of storage on the mill side of the river wall, which is significantly different than the potential for loss of fill material. There may be additional effects on the hydroelectric project (FERC No. 2233) operations that we were unable to determine during our site visit.

3.1.1.4 Summary

The lock chamber walls leak and, in most locations, it does not become a significant concern either because there is minimal effect on the lock structure or on the adjacent uses. There is a combination of landside wall leakage and soil fill behind the chamber wall where there is a possibility that fill material may be currently washed through the chamber wall and deposited in the lock chamber. If this situation is occurring, then it would be require a capital expenditure to design and install a solution. Our recommendation would be to provide a drainage system on the backside of the chamber wall rather than attempting to stop the leakage or cut off the flow path.

Section 6 recommends a monitoring program to evaluate lock wall and supporting soils movement. Based on the results of this program, it can be determined whether a drainage system on a portion of the landside lock chamber walls is required.

3.1.2 Wall Anchorage

There are two uses and two different types of rock anchors in the lock walls. The original rock anchor is specified as a 1¼-inch diameter steel rock anchor installed in a 2½-inch diameter hole, inclined downward at a slope of 1 vertical to 10 horizontal. The anchors are located horizontally at each frame and vertically on a 5-foot spacing, typical. These anchors have 20 feet of grouted embedment. Based on field observations, they are galvanized. Also, based on field observations, they appear to be a smaller diameter than shown on the drawings, possibly as small as 3/4-inch diameter.

The following photographs show a number of the original wall anchors.

Photo 3-10 Land Side - Chamber 1 Wall Anchors and Timber Framing

Photo 3-11 **Land Side - Chamber 1 Face of Rock Cut, Wire Fabric on Upper Portion and Timber Lining**

Photo 3-12 **River Side - Chamber 1 Wall Anchors and Timber Framing**

Photo 3-13 River Side - Chamber 1 Wall Anchor

In addition to the rock anchors installed during the original construction of the lock walls, there have been rock bolts installed for what appears to be stability issues; either the stability of the cut rock face or stability of the gate monoliths. The following photograph shows a rock anchor used to support the rock slope.

Photo 3-14 Land Side - Chamber 1 Rock Bolt

Photo 3-15 Landside Wall - Chamber 1 *(Note Core Holes for Rock Bolts)*

Based on what we could observe during the site visit, we did not find a need for a capital improvement project related to either the wall anchors or rock bolts. Monitoring the lock walls and the region behind the lock walls for movement is recommended, as discussed in Section 6.

3.1.3 Replacement of Missing Stone Blocks and Wall Lining Timbers

There are several locations where facing elements are missing from the gate monoliths and chamber walls. At the gate monoliths the facing is ashlar masonry; the chamber wall are generally faced with timber lagging. The exception is the chamber walls of the canal basin and guard lock. The landside of the canal basin is unfaced rock cut; the landside wall of the guard lock is faced with a cast-in-place concrete wall, and the riverside wall of the guard lock and canal basin is ashlar masonry. Replacement of the missing ashlar masonry and timber lagging is addressed in the following paragraphs.

3.1.3.1 Ashlar Masonry

One of the signature features of the Willamette Falls Locks is the ashlar masonry gate monoliths and chamber walls. The masonry, made from locally quarried stones, was placed without mortar. In a number of places, the surface stones have become displaced. We did not note any locations where two adjacent stones have become displaced, an indication of imminent failure. All missing stones appeared to be individual occurrences. A portion of these instances are shown below.

Photo 3-16 Riverside Wall

Photo 3-17 Riverside Wall - Chamber 3

Photo 3-18 Riverside Wall - Chamber 2

Photo 3-19 Riverside Wall - Downstream Approach

3.1.3.1.1 Extent of Problem

We observed more displaced masonry downstream of gate #4 and less upstream of gate #4. This is both on an absolute and relative measure. There are more missing stones per masonry element, monolith or wall, in the lower chambers and there are less masonry faced elements in the upper chambers. Our observations may have also been related to the order in which the gates were operated and chambers filled; i.e., we were able to observe Chamber 3 more times than Chamber 4.

3.1.3.1.2 Structural Severity of Problem

It is our opinion that there are no apparent structural deficiencies related to the missing stones at this time. Continued loss of masonry facing, especially if the new displaced stones are adjacent to the existing missing stone, would compromise the structural integrity of the facility. The rate of stone loss will increase with age and will increase much more quickly in the areas adjacent to the current missing stones. Increasing the frequency of lockages will also increase the rate of stone loss. We estimate that a portion of the missing stones will need replacement within the 20-year planning horizon. Ideally, all missing stones would be replaced at one time to take advantage of one mobilization/demobilization of the construction crew.

3.1.3.1.3 Replacement Alternatives

There are several replacement alternatives, including:

- Replacement in kind using locally quarried rock installed without mortar
- Replacement in kind using locally quarried rock installed with mortar
- Replacement with colored and carved pneumatically placed concrete (shotcrete)
- Replacement with colored cast-in-place concrete using textured form liners. The surface of the liner could be produced by taking an impression of a portion of the existing ashlar masonry surface.

There are several variations of alternatives using concrete to replace the stones - color/no color, textured/non-textured, and placement technique.

Section 5 provides discussion of the estimated probable cost for stone replacement.

3.1.3.2 Timber Wall Lining

Most of the chamber walls, between the gate monoliths, have timber facing installed on timber framing. Typical lining elements are shown below.

Photo 3-20 Land Side Wall - Chamber 4 Timber Wall Lining

Photo 3-21 Land Side - Chamber 1 Timber Framing

3.1.3.2.1 Extent of Problem

During the site visit, we observed that broken and missing facing is limited to the land side wall of the downstream approach, shown below, and the river side of Chamber 1 near gate #2, also shown below.

Photo 3-22 **Landside Wall - Downstream Approach**
(Note missing wall facing and core holes for wall anchors)

Photo 3-23 **River Side Wall - Chamber 1 One Board Missing**

3.1.3.2.2 Recent Repairs

Project staff provided documents showing replacement of wall lining elements in Chamber 1 (1987) and Chamber 2 (1976). These repairs were accomplished twenty and thirty years ago using preservative-treated wood. The repaired areas are also the areas where we observed damage to the facing boards.

3.1.3.2.3 Structural Severity of Problem

There are unique structural considerations for each of the lining elements - the facing and the framing. We do not consider damage to the facing elements to be structurally significant. We did not observe damage to the framing members, where we could see them, during the site observation visit. Therefore, at this time, we consider facing board replacement a maintenance issue rather than a capital improvement.

Given the normal service life of treated timber in a marine environment, we expect that it will be necessary to replace the wall lining timbers within the planning horizon. This will be a capital improvement. Section 5 provides discussion of the probable cost for timber wall lining replacement.

3.1.3.2.4 Corrosion Considerations

During the design of the replacement wall lining, or the specification of replacement-in-kind, it will be important to consider the effect of preservative treatment on the fasteners and hardware used in the reconstruction. Effective December 31, 2003, the preservative -treated wood industry voluntarily transitioned from Chromated Copper Arsenate (CCA-C) to alternative treatments. In recent years, pressure treated wood received negative publicity mainly focused on the use of arsenic in CCA. CCA is no longer being produced for residential or general consumer use. While CCA is no longer produced for general consumer use, it is still being produced for use in some industrial, highway, and agricultural applications.

Testing has shown that certain alternative replacement treatments are generally more corrosive than CCA-C (in some cases up to three times as corrosive). It will be important to carefully select the coating for the fasteners and hardware used in the rebuild, to ensure adequate corrosion protection, based on the type of wood preservative available at the time of construction.

3.2 Miter Gates

The miter gates appear to be painted, and most or all gates have been rehabilitated in the last 15 years. The table below shows the most recent miter gate installation and rehabilitation dates.

Table 1 - Gate Installation and Rehabilitation

Gate	1	2	3	4	5	6	7
Installed	1970	1970	1968	1970	1971	1966	1966
Rehabilitated	1993	2001	?	2001	1997	1997	1993

Steel gates replaced the originally constructed timber gates in the 1940s. At the time of replacement, bearings and operators were upgraded. Although there is banging and squeaking during operation, no fundamental flaw has been identified in the long history of operation.

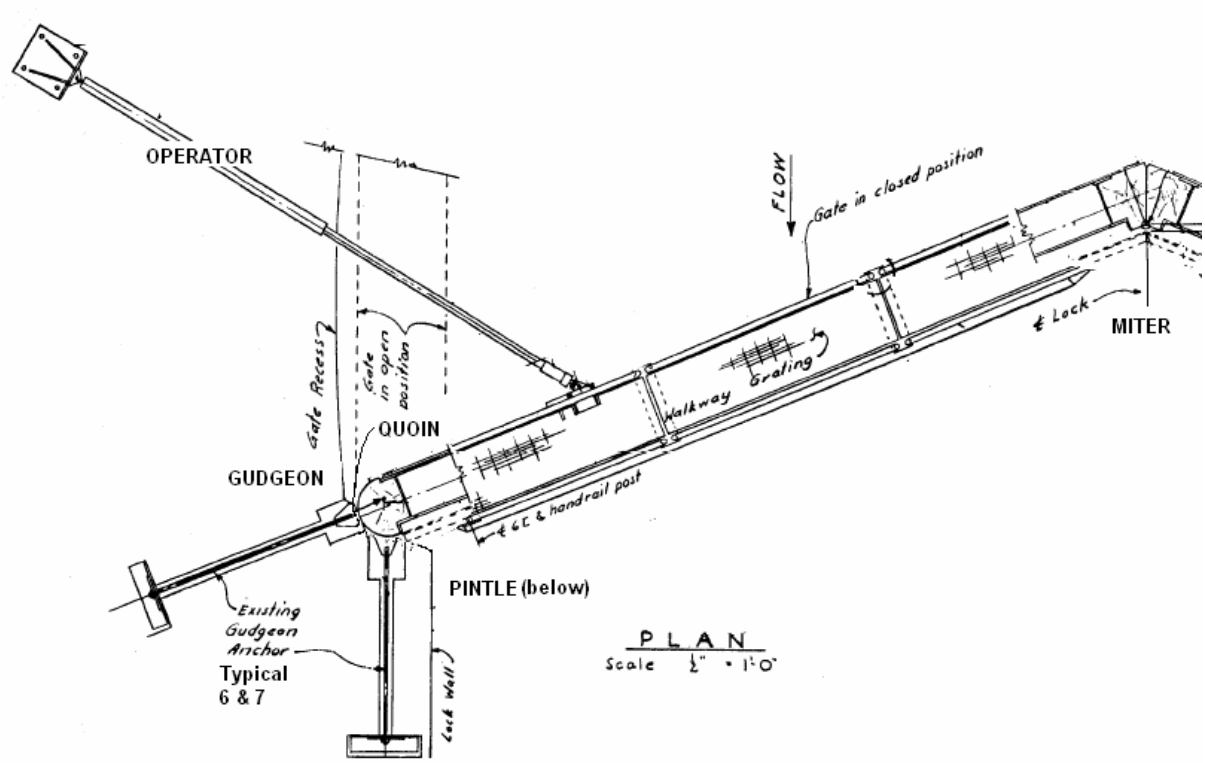


Figure 3-4 Plan View of Miter Gate, Anchorages and Operator

3.2.1 Miter Gate Leaves, Miter Posts, and Quoin Posts

Miter gate leaves could be seen from the upstream side of the partially dewatered locks. The plate and rolled sections that comprise the leaf may be in satisfactory condition, but this could not be verified under the timber facing. The gate leaves are generally in compression for most of their operational life. The members that are always in tension and susceptible to fatigue and shock loadings are the diagonals, but local tendon stresses could exist in regions of the gates, especially near the pintle, which could cause local cracking. Without removing the timber gate lining, the gates could not be checked for local cracking of steel members or welds. The diagonal details shown in the figure below are appropriate.

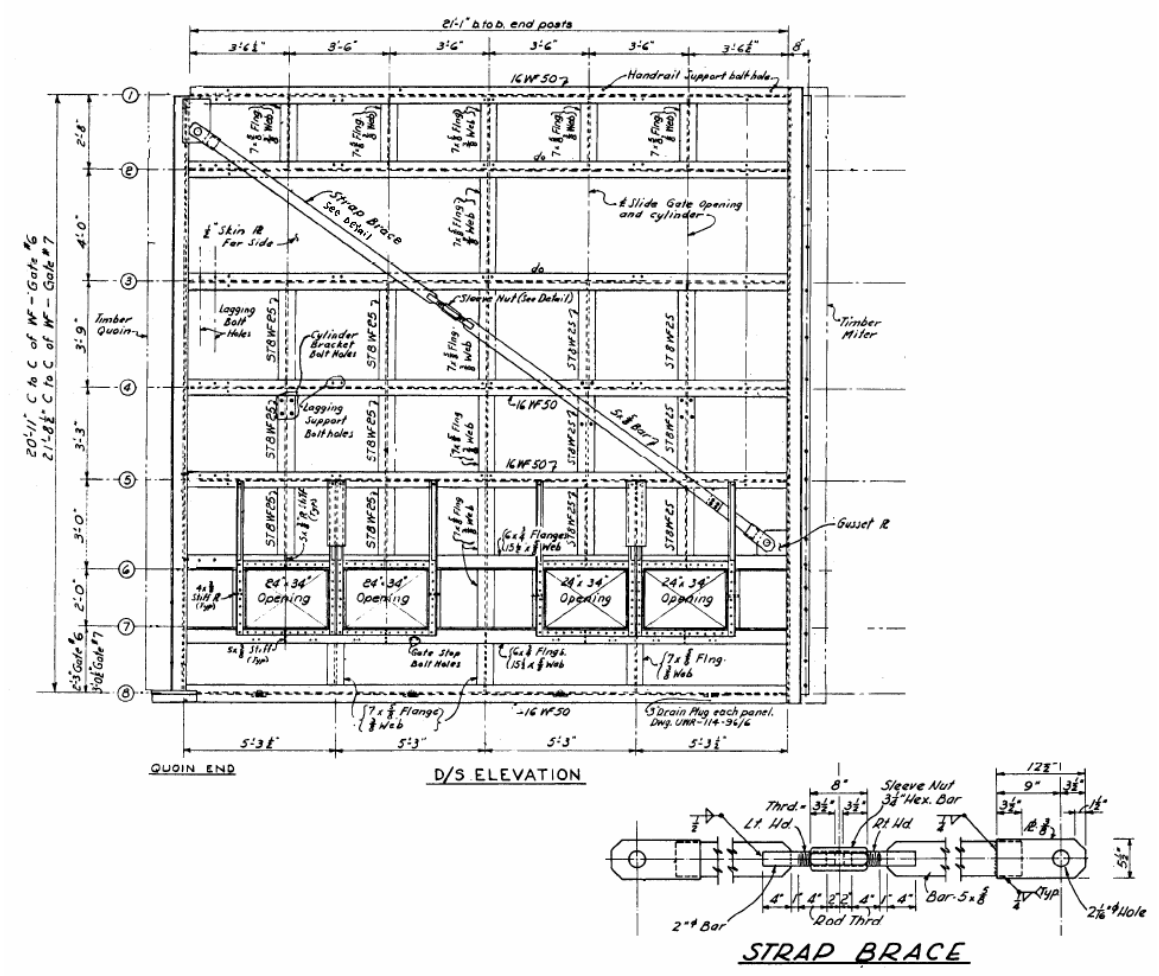


Figure 3-5 Typical Gate Elevation and Strap Detail

The end connection does not attract moment, so no tension cracking should start at the ends. Length adjustment is done with a threaded connector in the middle of the diagonal. This minimizes moment induced, and cyclic stress in the diagonals. The drawback is that this detail is very difficult to adjust. However, with all the shielding in place, adjustment may not occur every 20 years. Further, the gates operate with a lot of play; a little miss-adjustment in the diagonals is tolerable.

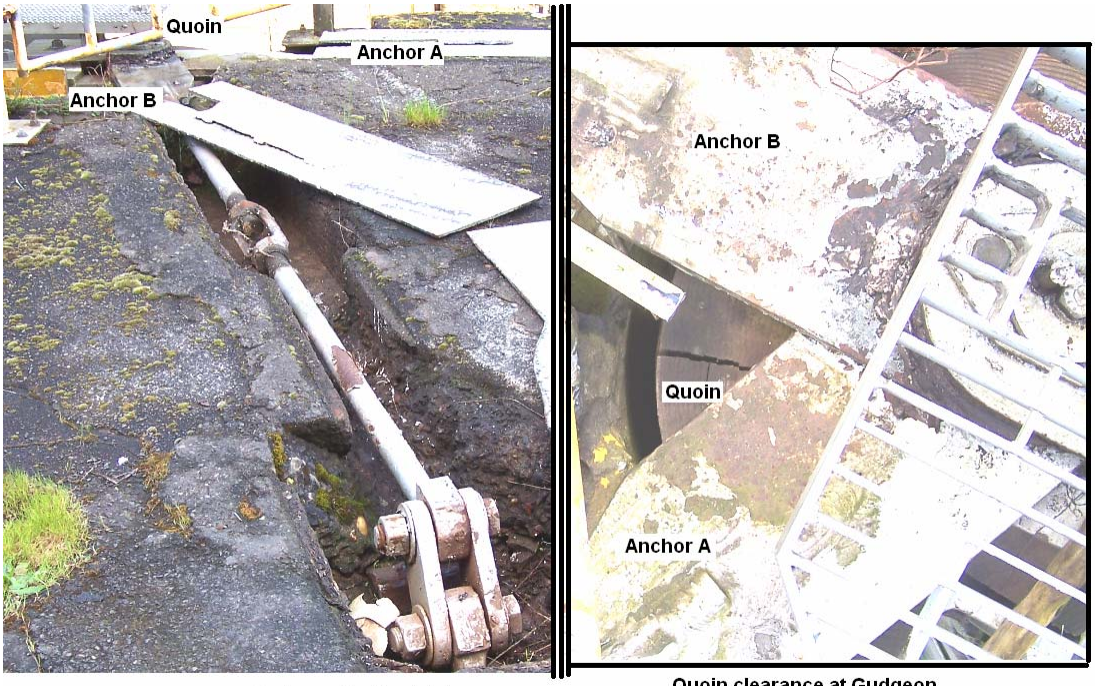
The quoin and miter posts are creosoted wood timbers. Wood is softer than a steel post, but it tolerates the loose fitting gates and allows for a loose seal without damaging embedded parts. Damaged members do not immediately fail, they just leak a little more.

Therefore, we expect attention will be paid to the diagonals during the anticipated HSS inspection, (which is required in accordance with the Corps of Engineer's guidelines). If there should be a problem identified with the diagonal strap, the cost of repair is small compared to the cost of mobilizing for the inspection, if the repair can be performed while

the gates are removed for inspection. Another potential problem area is the pintle region. Cracking may be observed between the valve frame closest to the pintle and the quoin framing. It is likely to be cost effective to complete many of the potential repairs during the HSS inspection and subsequent dewatering of the lock chambers.

3.2.2 Gudgeon and Pintle

The design of the gudgeon linkages allows for more movement than is typical in current miter gate designs. The gudgeon pin is not anchored rigidly. Movement up to 3 inches is estimated based on observations during the site visit and previous inspection reports. The gate tilts free of the wall when rotating from open to closed position. When the gates miter in the middle, the leaves push each other back to seal at the abutments. Linkage design varies in how this is accomplished at different miter gates in the Willamette lock chambers. A common detail is shown in the photos below. There is a link between the ground anchor and the link to the pin that prevents the rod from resisting compression. Others locations make use of slotted rods, but, at gates #6 and #7, the tie is tension only.



Gudgeon Anchor Linkage

Quoin clearance at Gudgeon

Photo 3-24 Gudgeon Linkage Gate 3

Only at gate #1 does the design detail in the figure below appear to show a fixed gudgeon pin attachment. The drawing shows a rigid attachment and closely fitting pins. The photos below show where field motion was observed in the linkage.

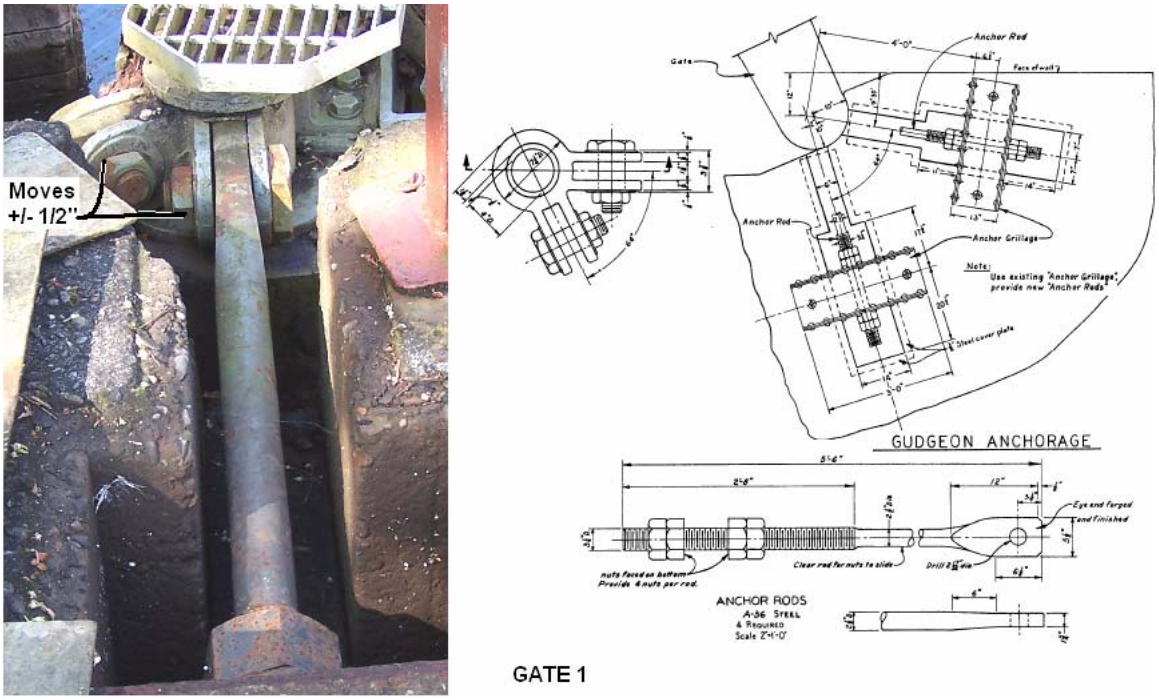


Figure 3-6 Gudgeon Anchorage at Gate 1, Mill Side

Field observation of movement at the gudgeon attachment of a half inch may be due to wear and not due to intentional slotting seen at other gates. Gate #1 is taller than the other gates and large movements could create greater problems.

The linkage designs allow for movement so that the gudgeon does not attempt to resist water load except, perhaps, at gate #1. This approach has worked with wood quoin and miter blocks for the relatively small gates. The long period of operation suggests the design is adequate, appropriate, and safe.

The gate rides on a pintle ball and socket at the base. The design is robust compared to the anchorage used for the earlier wood gates. The original pintle diameter was 4⅛ inches, and the current pintle diameter is 10 inches. The choice of materials is also good. When there is a lot of play in the miter gate, the risk is that the pintle may be overloaded. The pintle design appears to be adequate.

3.2.3 Operating Mechanism

3.2.3.1 Anchorage

The operating cylinder design assumes rigid anchorage points. The cylinders are anchored to steel plates, which spread out the anchored load to the rock abutment.

Based upon the site visit observation, some movement occurs somewhere in the linkage that was not intended at most gates. This movement occurs at loose abutments, noted at gate #2 where the Corps' side has recently been modified to reduce movement, and is also observable on the mill side. The photos below show that relative movement occurs between the block to which the plate is bolted and the adjacent block, and also between the plate and the block. At other gates, relative motion in the operator was also noted.

Photo 3-25 Motion Observed between Open and Closed Position, Gate 2

At gate #1, there is relative sliding between the anchor bolts and the anchor plate. At gate #5, the anchorage is very rigid and relative motion occurs at the pin connection.

Photo 3-26 Operator Anchorage Motion Observed at Gate 5 and Gate 1

3.2.3.2 Operation

During operation, the position of the gate is not completely controlled by the operator. The gate may continue to move as a result of inertia even though the operator has stopped. Or, the valve is open, but the gate cannot move any further because of a physical stop. There are several causes, as described below:

- The gates are loosely constrained at the gudgeon. The linkages are slotted and/ or articulating. This was an approach used historically to solve the engineering dilemma of having the miter gate supported on a hinge while rotating, but off the hinge when holding water. The historical solution works for small gates such as these and infrequent operation. It would not be used in larger gates or gates that are operated more frequently. Although the design solves the hinge problem, at some point in the closing cycle the gate will move freely and then be suddenly restrained by a gudgeon linkage or by the operating cylinder in what is experienced as a sudden impact at a linkage (i.e., banging). This is a dynamic loading not typically included in any design considerations. It contributes to the wear observed at connections and anchorages. It tends to soften the abutments/attachments, which further increases the looseness of the constraints. The shock loading may cause premature failure in the hydraulic system, which is experienced first as a seal or hose failure.

- Another possible cause of overload is that, at closure, gates must be pushed together to seat. The sag in the gate position is rectified when the operators push the miter gate to closure. Some bouncing around occurs, which again is seen at the connections as momentary overloads that tend to loosen one or more of the parts.

There are no working limit switches to control gate operation. At the end of the stroke, based on visual signals, the control valve is closed. This procedure results in the system running at maximum system pressure, where relief valves must open with every operation. The situation is noted and explained for the benefit of future inspections. Repair is not immediately necessary.

Some concern with loose connections was noted in the gate inspection in 1994 by the COE (Periodic Inspection No. 1, Appendix C - D, Erickson & M. Hanson) where it is stated, ". . . the impact load from the operating arm will eventually loosen the anchor plate or anchor bolts."

A design to accommodate instantaneous overloads at the linkages might include polyurethane inserts. Polyurethane sleeves are used on high performance automobile suspension connections in order to minimize stresses from shock loads. This design change is not essential, but the ongoing rough operation will continue to degrade linkage stiffness. Use of polyurethane inserts may be a cost effective if it successfully minimizes linkage degradation. However, for an infrequently operated system, which already has a long history of operation, it may be adequate to simply repair anchorages when the movement becomes excessive. The need for anchorage repairs would be based upon periodic inspections.

3.2.4 Filling/Emptying Valves

Filling and emptying valves are inset into each miter gate. A typical valve configuration is shown in the figure below. Leakage in the hydraulic system is observed as erratic movement during operation of the miter gate and lack of control of the valves. Since the lock filling valves and the miter gate operator are on the same hydraulic line, leakage is more difficult to isolate.

Some of the valves close when there is not enough hydraulic pressure to keep them open. This indicates that the seals have failed at some of the cylinders. This is shown in the photos below. The yellow flags indicate the position of the valve; up is open, down is closed. When the hydraulic system is turned off, some valves close under their own weight, overcoming cylinder seals. As seen in this photo, when the valves are opened to fill the lock, the valve does not open if the cylinder seals are too badly damaged. If only one valve is affected, it only delays lock emptying/filling. It is expected that additional valve operator seals will fail, and seals will need to be replaced.

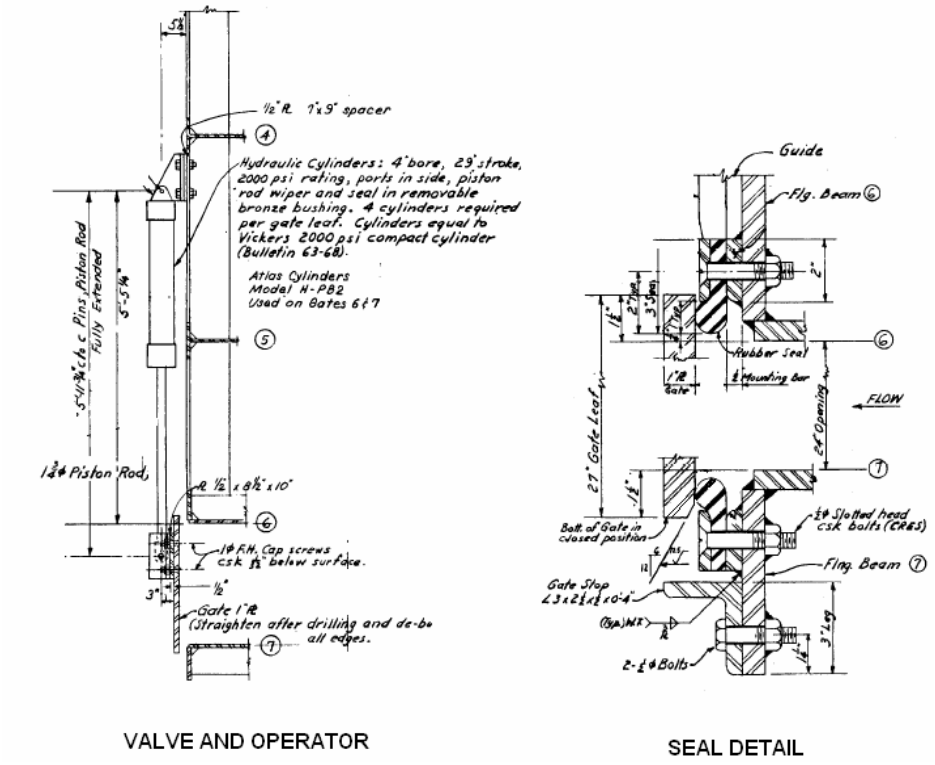


Figure 3-7 Valve Elevation and Seal Detail

Photo 3-27 Valve Operator Position and Valve Leakage

When the valves lower under their own weight, it indicates that the operator seals failed, and it is likely that the rubber J-seals around the valves have failed as well. The photos above also show typical leakage around a closed valve. This is seen at most gates when the downstream side is dewatered. The amount of leakage seen at the gates suggests that the J-bulbs have failed. The volume of water leaking is small compared to the discharge capacity of downstream valves, so the leakage alone is not a serious problem.

However, it is possible that the J-bulb clamps, shown in the valve configuration details in the figure above, could become loose and interfere with valve operation. That situation could make it difficult to fully close a valve, which would jeopardize lock operation. Therefore, the seal condition on the valves is important.

4.0 MECHANICAL & ELECTRICAL EVALUATION

This section presents the mechanical and electrical system evaluation of the lock and identifies major capital improvements of these systems that are anticipated to be required during the 20-year planning horizon.

4.1 Mechanical Operating Machinery

In general, the existing mechanical operating equipment is considered to be an appropriate size for continued lock operation into the foreseeable future. Routine maintenance, particularly replacement of the cylinder seals for the filling and emptying operators, is required now and will be an ongoing requirement.

The cylinders operating the miter gates all appear to have tight seals. No leakage was observed. The cylinders seem tight enough so that they may have caused the anchorages and linkages to degrade.

The cylinders operating the filling and emptying valves appear to be in need of repair. The seals have failed on some valves. Therefore, the seals are suspect for all of the valves. There are screeching noises during operation of the filling and emptying valves. This noise appears to be from the rising stem. A little lubrication would greatly reduce the noise, but the lubrication and seal replacement is considered to be a routine maintenance issue.

The water seal around the filling and emptying valves is not very effective, but it is not considered to be a crucial flaw.

There are bumping noises as the gates operate, caused by the sliding linkages hitting their limits. Some of this is part of the original design, but smoother operation would occur with working limit switches. This bumping limits the total number of cycles possible, as it provides peak fatigue loads to the linkages. As mentioned earlier in this report and by other inspections, impact loads will tend to degrade the linkages.

The reservoirs for the hydraulic power unit for the hydraulic cylinders are closer to the water than considered environmentally acceptable. Some additional protection of the water is appropriate. However, changing the type of fluid used to an environmentally friendly fluid or constructing a spill containment structure at the hydraulic controls area is not considered to be a large-scale capital cost.

4.2 Electrical System

4.2.1 Site Inspection

The electrical system, including power distribution, lighting, and control, was inspected, to the extent possible, during a site visit on April 19, 2007.

In 1996 the Willamette River flooded, damaging a large portion of the electrical distribution system. Much of the wiring and some components were replaced as part of the flood damage repair.

Photo 4-1 480V Panel Board Providing Power to Locks

A number of junction boxes were opened during the April 19, 2007 site observation, and with the exception of a small accumulation of water in one box, the wiring was found to be in very good condition.

Photo 4-2 Junction Box Contained Water When Opened

The original analog control system for the Willamette Falls Locks had been upgraded to a digital system. The date of this upgrade, extent, manufacturer, and model of the control devices are unknown, due to a lack of documentation.

There is a 75kVA standby diesel-engine generator set, located in the Lockmaster's Office. The primary purpose of this generator is to provide power for operation of the gates and lighting. This generator, and its automatic transfer switch, appears to be in good repair.

Photo 4-3 75kVA Diesel Engine Standby Generator

4.2.2 Evaluation and Noted Deficiencies

4.2.2.1 Electrical Drawings

The main deficiency identified is the lack of electrical system documentation. The electrical drawings are old and are not up-to-date. There does not appear to be a one-line diagram of the electrical distribution system. The control drawings do not appear to have been updated to reflect the upgrade to digital controls. The area lighting around the site has been upgraded in some areas, but this also does not appear to be reflected on the drawings. Without up-to-date drawings, such things as maintenance and modifications are made much more difficult.

4.2.2.2 Fuel Tank for Standby Generator

The standby generator has not operated in some time. It was reported that the fuel tank for the standby generator had been removed and was not replaced. A diesel engine, such as the one providing power for the standby generator, needs to be regularly exercised to keep it in good working order. The ideal would be to run the engine weekly or, at a minimum, monthly. Each exercise cycle should be long enough to permit the engine to reach operating temperature.

4.2.2.3 Limit Switches

It was noted that several of the limit switches, installed on or near the miter gates, are not operational. In some cases, the operating levers are not functioning and, in other cases, the devices used to operate the switches are missing or not aligned. With a lack of up-to-date drawings, it is not known if the original function of these switches is still necessary. Since the miter gates are operating as intended, the absence of these switches appears to make little, if any, difference, except as noted in the mechanical operation portions of the report such as Sections 3.2.3.2 and 4.1.

Photo 4-4 Limit Switch Not Making Contact

4.2.2.4 Lighting

Because the locks are generally in operation only during the summer months (when the days are longer) and then only during the daytime, the lighting system was examined only briefly. Should the months and hours of operation change, where the lighting system would play a greater role, then it could be evaluated in detail and modified to provide more efficient and higher quality lighting than was available at the time of earlier lock modifications.

4.2.3 Power and Electrical System Recommendations

4.2.3.1 Replacement of Digital Control System

Components of the electrical system may be or may become obsolete. Most components, such as motor starters and switches, can be replaced "in kind" with a product of another manufacturer even if the original manufacturer no longer supports or manufactures these components. The prominent exception is the digital control system. A digital control system unit of one manufacturer normally cannot be used as a replacement of a similar unit of

another manufacturer. If the original manufacturer no longer supports the model in use and spare parts are not available, the system usually requires replacement. Due to the rapid advance in technology governing digital controls, systems are normally only supported for 20 years or less. Based upon the available information, the existing digital controls are estimated to be approximately 10 years old. It would, therefore, be prudent to anticipate replacing the existing digital controls within the next 10 years or so, assuring its performance for the 20-year period of this study.

Photo 4-5 Existing Control Panel

4.2.3.2 Fuel Tank for Standby Generator

The primary purpose of the standby generator is to provide power to the locks during power outages. At the present time, this generator apparently is not available for emergency use, due to the removal of the fuel tank. If this is the case, the fuel tank should be replaced. Once the generator is operational, a schedule of regular preventive maintenance and generator exercising should be established. Not only will the maintenance and exercising assure the operator of a dependable source of standby power during an outage, but it will significantly increase the useful life of the standby generator unit.

A fuel tank replacement can be procured from a local source, including installation and commissioning. The cost of this would be a function of the size of fuel tank required.

4.2.3.3 Diesel Engine for Standby Generator

The condition of the diesel engine, used to drive the standby generator, is unknown. Long periods of inoperation can be damaging to the internal parts. Conditions such as rust, sludging of the oil, and clogging of injectors can occur. If it has not been operated since the major flood in 1996, damage could be extensive. Inspection of the diesel engine by a person experienced with such equipment is recommended.

4.2.3.4 Improvement of Electrical System Documentation

It is strongly suggested that a complete set of electrical drawings be prepared, showing the system in its present state. This effort will aid in the maintenance of the system, and will greatly assist anyone assessing the present condition for addition or modification.

4.2.3.5 Testing and Correction of Grounding System

It was reported that there may be a problem with the grounding of the electrical system. The most common cause for such problems is corrosion. Repair or replacement of the grounding electrode system is fairly simple to achieve during normal maintenance. Maintenance electricians can measure the ground resistance at various points and provide the components necessary to correct any areas with inadequate grounding. Due to the safety provided through proper grounding, the testing and correcting of the grounding system should be given a high priority. This testing and correction is considered to be part of routine maintenance, not large-scale capital improvements.

5.0 OPINIONS OF PROBABLE COSTS

5.1 Opinions of Probable Costs for Structural/Mechanical Large Scale Capital Costs

5.1.1 Replacement of Missing Stones in the Ashlar Masonry Lock Walls

A range of alternatives were investigated for replacement of the missing stones in the ashlar masonry, from materials that are historically accurate for the original construction to modern materials and placement methods. The replacement alternatives which used cementitious materials (concrete and shotcrete), were evaluated with and without color added and with and without textured surfaces. For all alternatives, the largest contribution to the cost was the equipment necessary to access the work locations, i.e. scaffolding, personnel lifts, and cranes. Providing, coloring, and texturing the cementitious materials contribute very little cost to the total replacement program. Quarrying the natural stones is more expensive, but it is still a minor contributor to the overall cost of the replacement program.

Our opinions of probable costs for the various stone replacement alternatives, in 2007 dollars, are shown in the table below. These costs are approximate totals for replacement of all currently missing stones in the existing lock walls.

Alternative	Mobilization	Material	Equipment	Labor	Total
Shotcrete	$10,000	$1,000 or less	$3,000	$13,000	**$27,000**
Concrete	$10,000	$1,000 or less	$3,000	$13,000	**$27,000**
Quarried Stone	$10,000	$6,000	$6,000	$15,000	**$37,000**

There is a local stone mason, Pete Wilson, whose work can be seen at www.petewilsonstoneworks.com. This website also has contact information.

As discussed in Section 2.5.3, replacement of the lock wall masonry in a way that replicates the construction methods used historically would be cost prohibitive, as it would require removal and reconstruction of large portions of the existing wall. Historically, the stones were held in place by inter-stone contact forces. The quarried stone alternative shown above assumes that the replacement stone will be grouted into place, which should provide a slightly different but similar appearance.

5.1.2 Replacement of Lock Wall Timber Lining and Framing

Material quantity calculations and production rates were estimated for the replacement of lock wall lining and timber support framing for each lock chamber wall. The production rates included both labor and the equipment necessary to support the crews. Estimates of the production rates and duration of the repair were based on a desire to minimize the time the lock was out of service to the extent practical. A work schedule of (6) 12-hour days per week for the framing and lining replacement crews was assumed. This is a common work

schedule for tasks that must fit in a short construction window and is a good balance of increased crew output versus increased hourly cost. The opinions of probable cost for the two different types of replacements are tabulated below, in 2007 dollars, for replacement of timber elements at the lock wall faces of one lock chamber.

Alternative	Mobilization	Material	Equipment	Labor	Total
Lining only	$24,000	$52,000	$102,000	$73,000	**$251,000**
Lining and Framing	$24,000	$144,000	$212,000	$151,000	**$531,000**

It is likely that the wall lining in two chambers and the framing and lining in one chamber will need to be replaced within the planning horizon. For economic modeling of the present value of the repair costs, we suggest the following replacement schedule:

Year	Replacement
2012	Wall Lining
2017	Wall Framing and Lining
2022	Wall Lining

The dates and extent of replacement are rough estimates but could be refined if additional wall evaluation is completed, as recommended in Section 6. ***In 2007 dollars, the total cost of this timber replacement work is estimated to be approximately $1 million.***

5.1.3 Miter Gates and Operating Machinery

The estimated probable costs, in 2007 dollars, are shown below for the large-scale capital requirements at the miter gates, valves, and associated operating machinery anticipated over the 20-year planning horizon:

Item #	Description	No. Req'd	Estimated Cost per Unit	Total for 20-Year Period
	Optional			
1	Add polyurethane sleeves to all linkages at all miter gates			$20,000, engineering
1				$70,000, construction
Total for Optional Item				**$90,000**
	Required			
2	Repair linkages/anchorages	4	$70,000	$ 280,000
3	Repair F/E valve (1) operator	8	$15,000	$ 120,000
4	Refurbish gates (#1, #3, and #7)	3 gates 2 dewatered	$480,000/gate $350,000/dewater	$1,440,000 $ 700,000
Total for Required Items				**$2,540,000**

The following notes provide further information and assumptions for the items listed in the table of estimated miter gate and operating machinery costs shown above:

- Item #1 is listed and estimated as an optional solution to the banging, which has accompanied operation of the lock miter gates in the past. Where frequency of gate operation is moderate to low, the banging may be acceptable. Inspection of anchorage and linkages is required if the banging is not eliminated, but anchorage/linkage replacement rates may be tolerable. Item #1 is optional but, if done, it may reduce future linkage/anchorage issues and the cost of Item #2.
- Item #2 is an approximate estimate of the frequency and cost of anchorage replacement.
- Item # 3 assumes that the filling and emptying valve operators are replaced in a dewatered lock, without removing the gate. As valves become inoperable, system performance (the length of time required to fill/empty a lock increases and the turbulence experienced by boats in the lock increases as fewer filling/emptying valves are used) declines. Excessive turbulence could lead to safety problems. Therefore, repair of fill/empty valve operators that are not working is required for continued, safe operation of the locks.

- Item #4 recognizes that periodic miter gate refurbishment has been required, and ongoing refurbishment will be required in the future. Most gates have been refurbished within the last 15 years. It is not known when gate #33 was last refurbished, so an approximate gate refurbishment cost has been estimated for gate #3. Gate #3 is easily dewatered as it is protected by nearby locks. Refurbishment of the gate #3 includes:
- Replacement of the J-seals on the fill/empty valves and on the bottom of the miter gate
- Replacement of the gudgeon pin and bushings
- Replacement of the pintles, collars and heel bushings
- Repairs of miscellaneous barge-damaged surfaces
- The timber quoin and miter posts might also need replacement at gate #3. The timber facing on the miter gates appears to have been replaced as part of routine maintenance and looks new. So, it may not need to be replaced during the periodic refurbishment. It can be done without removing the gate, and would be a relatively small additional cost if required. Timber facing could be replaced with recycled plastic lumber if desired, depending on environmental and historic considerations.
- Cleaning and repainting the steel gate surfaces

The cost of periodic refurbishment depends upon the amount of repair required and the time between overhauls.

USACE Engineering Regulation ER 1110-2-8157, Engineering and Design - Responsibility for Hydraulic Steel Structures (HSS), requires HSS inspection every 25 years. It is cost effective to time major rehabilitation of the miter gates to coincide with the HSS inspections of these gates. Because of the long history of operation in this location and the low head, a 30-year cycle of inspection and refurbishment may be acceptable. Also, the coating life may be greater than 25 years based upon EM 1110-2-3401, Engineering and Design-Thermal Spraying: New Construction and Maintenance, Table 4-1. If the refurbishment work is completed on a 30-year cycle, then gates #1 and #7 should also be refurbished in the next 20 years, in addition to gate #3 that was discussed above.

Gates #1 and #7, at the ends of the locks, are more difficult to dewater because there is no upstream or downstream bulkhead or closure gate. Therefore, the cost of renovation would include the cost of cofferdams at each end. Installation of the cofferdam, bypass pumping, and removal is estimated at $350,000 for each end, totaling $700,000 in 2007 dollars, in addition to the cost of gate refurbishment.

Finally, if some of the miter gate repairs are completed during the upcoming, required HSS inspections (anticipated to occur in 2007 or 2008), then the miter gate rehabilitation costs anticipated in the next 20 years may be reduced somewhat from the gate refurbishment cost shown in the table above.

5.2 Opinions of Probable Costs for Electrical/Power Large Scale Capital Costs

5.2.1 Replacement of Existing Digital Controls with New PLC Components

In preparing the cost of replacing the existing digital controls with new PLC components, a number of assumptions were made. These assumptions are based upon observation of the lock operation and limited existing drawings. Assumptions made were:

- Each gate consists of two leaves. Open – Close for each leaf.
- The slide gates on each leaf are operated in tandem. Raise – Lower for slide gates. (Operate together per leaf.)
- On – Off for hydraulic power unit.
- Status lights for gates.

Each gate has a total of 6 inputs and 12 outputs.

There are three control stations; each control station will have a PLC. Station 1 controls Gates #1, #2, and #3. Station 2 controls Gates #4 and #5, and Station 3 controls Gates #6 and #7.

Each control station controls traffic lights, Red – Green for upstream and downstream traffic. Two inputs and four outputs per station.

PLC for control station 1 (worse case) requires 20 inputs and 40 outputs. Add to this a contingency of 20 percent to allow for unknown control functions requires a total of 24 inputs and 48 outputs.

Based upon Allen-Bradley MicroLogix PLC, requires 2-16 point inputs and 3-16 point outputs.

Per North Coast Electric, budgetary prices for this PLC are:

1 – MicroLogix Processor		$252.00
1 – MicroLogix Base		$553.00
2 – 16 point Input Module	$291.00 ea	$582.00
3 – 16 point Output Module	$413.00 ea	$1,239.00
1 – Right End Cap/Terminator		$34.00
1 – EEPROM Memory Back-Up		$128.00
Total estimated cost		$2,788.00

To purchase all three units would be approximately $8,364.00.

It is also assumed that these PLC units can be installed as direct replacements for the existing digital controls, requiring only moving the wiring from one device and reinstalling it on the other. If this is possible (lack of documentation prevents verification of this), the installation time and cost would be minimal. Estimate 1 day per unit at $150.00 per hour, for a labor cost of $1,200.00 per PLC.

The total estimated cost, based upon the above assumptions, is approximately $12,000, based upon 2007 dollars.

5.2.2 New Standby Generator Fuel Tank and Replacement or Refurbishment of Standby Generator Diesel Engine

A 75 kVA standby diesel engine driven generator has been provided to permit backup operation of the locks, during a power outage or similar event. It was reported that the fuel tank has been removed and has not been replaced. As a result of inoperation, the diesel engine for the generator may also need refurbishment or replacement. The cost of refurbishing or replacing the standby generator, replacing the fuel tank, and maintaining the standby generator should be evaluated relative to the anticipated infrequent need for a standby generator. It may be determined that these costs shown in Sections 5.2.2.3 and 5.2.2.4 are optional, not required, large-scale capital costs.

5.2.2.1 Size of New Fuel Tank

According to Cummins, a diesel engine of this type will burn 0.07 gallons of fuel per hour per standby rated kVA. That equates to 5.25 gallons per hour at full load.

This is not a legally required standby generator, so there is no specified minimum operating time. During a power outage, the only use of this generator will be to permit traffic to exit or allow urgent traffic to pass through the locks. Either way, the generator will not be operated at full load and will not operate for an extended period of time, so fuel storage may be minimal.

This generator should be exercised on a regular basis, once a month at a minimum to keep it in good working order. Each exercise period should be a minimum of 30 minutes, and a nominal load should be placed on the generator, so 2 or 3 gallons per month can be expected to be used for exercising the unit. As fuel can be stored for 1½ to 2 years without degrading, it is advisable to allow for about 48 gallons per 2-year period for exercising.

It is more economical to purchase a standard size fuel tank than to have a custom tank manufactured. As such, a standard size tank of approximately 75 gallons would allow for both exercising and reserve supply for standby operation of the unit.

5.2.2.2 Installation of New Fuel Tank

An above ground storage tank would be the least costly to install. This type of tank, manufactured with double wall construction and meeting environmental requirements, needs only a concrete slab for installation. Code required alarms and fuel connections would be the only other consideration.

Fuel tank installation, not including the concrete pad, should take approximately two days or less.

5.2.2.3 Estimated Cost of New Fuel Tank

Assuming a 75-gallon fuel tank, ready to install and meeting all codes and regulations, the probable cost would be between $4,000 and $5,000, and the probable cost of installation would be approximately $5,000, for a total estimated installed cost of approximately $9,000 to $10,000 in 2007 dollars.

5.2.2.4 Estimated Cost of Standby Generator

The cost of refurbishment of the diesel engine for the standby generator cannot be determined without additional evaluation. The cost of a potential overhaul of the diesel engine should be weighed against the cost of a new standby generator unit. A new 75 kW generator set is estimated to cost approximately $40,000 in 2007 dollars, including labor and materials. This cost is in addition to the fuel tank cost, shown in Section 5.2.2.3.

5.2.3 Electrical and Power System Documentation

To produce a complete, up-to-date set of electrical drawings would require the following:

- A review of all available electrical drawings. As mentioned above, the existing drawings reviewed during the site visit do not currently match the existing conditions but would constitute a starting place. This effort would require an estimated 2 days of work.

- A detailed field inspection, where the wiring would be checked against existing drawings and all exceptions noted. This effort would require an estimated 2 days of work.
- A complete survey of the digital control system with all inputs and outputs identified and documented. If available, the program for the digital control system would be copied and documented as a part of the drawings for future reference. This effort would require more time due to lack of documentation. Much of the wiring is not as straightforward as the remaining control system, and an estimated 5 days of work would be required.
- It is anticipated that lighting system documentation would not be produced unless it was determined to be beneficial.
- New drawings, utilizing CADD, would be produced. These drawings would be checked against the notes, existing drawings, and system operation for accuracy and completeness. The effort required for this portion of the work depends upon the agreed upon scope. To prepare a one-line diagram, wiring drawings and schematics of the motor controls would require an estimated 3 drawings. An additional 2 drawings would be required for the existing control panels, and an estimated 3 drawings would be required for the digital control system. One additional drawing for details and general notes brings the total to 9 drawings. It is estimated that approximately 6 workweeks would be required to produce this CADD drawing set.
- For the operation and maintenance of the standby generator, instructions could be produced with an estimated 20 hours of effort.

An electrical system drawing set and standby generator instructions would take an estimated total of 8 to 9 workweeks, including field and office time, for a total cost of approximately $52,000 in 2007 dollars.

5.3 Opinions of Probable Costs for Flood Recovery Large Scale Capital Costs

As noted in Section 2.7, it is unlikely that a damaging flood will occur within the study planning horizon, from 2007 to 2027. The upgraded electrical equipment is anticipated to survive an overtopping flood. The clean up effort would require removal of some quantity of silt, and this removal is estimated to cost approximately $50,000 in 2007 dollars, assuming excavation, removal, and disposal of up to 500 cubic yards of material. The largest portion of this cost is for mobilization of a barge capable of vacuum dredging or clamshell excavation.

6.0 RECOMMENDATIONS AND SUMMARY

6.1 Recommendations for Additional Evaluation

As discussed in Section 2.4, while this study included a substantial review and observation effort, it also had significant limitations and additional evaluation is recommended. The results of this evaluation may affect the assessment of large-scale capital costs, as documented in this engineering study. Recommendations for additional evaluation include the following items:

1. A program of subsidence monitoring on the landside lock walls is recommended to be undertaken or continued. We observed a number of survey points adjacent to the land side walls and a survey marker on the lower riverside wall. While it is standard operating procedure to monitor movement of the lock features, we recommend expanding the monitored region to include the areas of soil backfill adjacent to the lock wall.

2. A full record search to determine the age of the timber elements of the lock walls is recommended. We anticipate that the wall lining and timber wall framing have been replaced, possibly many times, in the past. We recommend recovering and analyzing the records of these replacements, determining the average time between major deterioration or loss of timber members, and the cost of replacement. We anticipate that the timber lining has been replaced more frequently than the timber framing; we also anticipate that the timber in the lower chambers have been replaced more often than the timber in the upper chambers.

3. A thorough condition assessment of the wall lining and timber framing is recommended, in order to evaluate the remaining life and time to replacement. This evaluation should include determination of likely areas of concentrated deterioration, testing for member section loss and connector deterioration, loss of fasteners, and correlation of the field work test results with the results of the record search of the member replacement history.

4. A hydraulic steel structure inspection is recommended and is also believed to be required based on Corps guidelines. During this inspection, the timber lining on the downstream face of the miter gates will need to be removed. At this time, it will be important to determine whether there is any significant cracking of the miter gate members and to examine the diagonals and welds in particular. Any deficiencies identified, if any, that need to be performed before the locks can be dewatered will need to be repaired. It is recommended that required repairs be completed while the gates are removed for inspection. This approach will minimize contractor mobilization and gate removal costs. After repairs are completed, dewatering of at least one lock chamber will be required in order to repair or replace some of the lock piping that currently crosses a lock chamber floor. While the lock is dewatered, observation of the lock wall faces, pintles, and sills in dewatered lock is recommended. Observation of other dewatered lock chambers would also be useful.

5. Anchorages and linkages are temporarily overstressed by the miter gate bumping that occurs, but they do not appear to be in immediate danger of failure. Additional evaluation, through regular periodic inspections of the Willamette Falls Locks, is recommended in order to prevent failure. On the order of every 500 lockages or every 2 years, whichever comes first, performance of a periodic inspection is recommended, including a report documenting the status of structures or equipment that is currently being monitored and any new items of concern that are identified.

6. Inspection of the standby generator diesel engine is recommended to determine whether refurbishment (and the extent of repairs) or replacement may be required if it is determined that it is desirable to continue to own, operate, and maintain a standby generator for emergency operation of the Willamette Falls Locks.

6.2 Site Visit Observations

Overall, based on a review of applicable engineering and inspection reports and a site visit on April 19, 2007 that included observation of the operation of all lock miter gates, the Willamette Falls Locks were found to be in significantly better condition than would be expected for locks opened in 1873. The locks have been periodically inspected and maintained by the U.S. Army Corps of Engineers. The reduction in lock usage and the conditions of operation also serve to extend the design life of the critical lock structures.

The lock miter gates are one of the most critical elements of lock operation and lock integrity and also require the highest level of capital investment. No record of refurbishment was found for lock miter gate #3. If this gate has not been refurbished since it was installed in 1968, then its condition is of significant concern. A Hydraulic Steel Structure (HSS) inspection of all of the lock miter gates is recommended before the 2008 summer season. While each miter gate is removed for HSS inspection, evaluation and repair of each of the miter gate leaves is recommended, including gate #3. Based on this evaluation, the general condition of gate #3 and urgency of refurbishment of this gate can be determined more accurately. If gate repairs are budgeted and timed to be completed during the HSS inspection and subsequent dewatering of lock chambers, it should reduce the long-term capital investment costs by reducing the number of contractor mobilizations and the total amount of dewatering required. During lock chamber dewatering, after the HSS inspections, miter gate #3 pintles should also be examined, determining whether they have been replaced since they were installed in 1968. If they have not been replaced since 1968, then pintle replacement is likely to be required within the next 5 years.

However, there is some reason to believe that gate #3 may have been refurbished since 1968. It had a timber miter post replaced in 1974, and the timber facing on gate #3 is in good condition and does not appear to be the original timbers placed in 1968. The actual condition of miter gate #3 steel members and supporting pintles is unknown.

As discussed, more information is needed on the condition of gate #3. However, the other six lock miter gates have all been refurbished within the last 15 years. Due to the relatively recent and extensive refurbishment of these miter gates, it is anticipated that the majority of the miter gate leaves are in relatively good condition with the exception of less critical items such as the fill/empty valve operators and seals. Routine maintenance of these and other items will be required in order to keep the locks in good operating condition and minimize escalation of this work into large-scale investments.

The rock and masonry lock walls appear to be in relatively good condition, considering the age of the Willamette Falls Locks. Minor to moderate loss of materials, as found, is to be expected over time, and there did not appear to be a systemic reason for material loss. The timber lock wall lining and framing are in better condition than anticipated, given the age, materials, and lock operating conditions. Most likely, a good maintenance program and reduced usage of the locks have extended the design life.

6.3 Summary of Large Scale Capital Costs

The largest capital costs anticipated over the 20-year planning horizon for this study are for miter gate refurbishment, miter gate linkage and anchorage repairs, and timber wall lining/framing replacement. It is anticipated that the largest of these costs, which is the refurbishment of gates #1 and #7, will be required towards the end of the 20-year timeframe and that initial costs will be relatively moderate. In 2007 dollars, it is estimated that approximately $560,000 will be required between 2007 and 2012 for large-scale capital investments at Willamette Falls Locks, unless miter gate #3 refurbishment is determined to be needed before 2012. If it is needed, then an additional amount of approximately $480,000, in 2007 dollars, will be required.

The following summarizes an estimate of large-scale capital costs, in 2007 dollars, that are reasonably likely to be required between 2007 and 2027 at the Willamette Falls Locks:

Large Scale Capital Requirement	**Approximate Year of Capital Cost**	**Opinion of Probable Cost 2007 Dollars**
Documentation of Electrical/Power System	2008 or 2009	$ 50,000
Replacement of Standby Generator and New Fuel Tank (Optional)	2008 or 2009	$ 50,000
Repair 2 Fill/Empty Valve Operators	2011	$ 30,000
Repair 2 Gate Linkages/Anchorages	2012	$ 140,000
Replacement of a Portion of Lock Wall Timber Lining	2012	$ 250,000
Replacement of Missing Lock Wall Stones	2012	$ 40,000
Repair 2 Fill/Empty Valve Operators	2015	$ 30,000
Refurbish Gate #3	Unknown	$ 480,000, if required
Replacement of a Portion of Lock Wall Timber Lining and Framing	2017	$ 530,000
Replacement of Digital Controls	2018	$ 12,000
Repair 2 Fill/Empty Valve Operators	2019	$ 30,000
Repair 2 Gate Linkages/Anchorages	2022	$ 140,000
Replacement of a Portion of Lock Wall Timber Lining	2022	$ 250,000
Repair 2 Fill/Empty Valve Operators	2023	$ 30,000
Refurbish Gate #1 and Gate #7	2023	$ 1,660,000
Possible Flood Recovery Cost	Unknown	$ 50,000
		$ 3,772,000 Total

The probable large scale capital costs, shown above, do not include the cost of recommended additional evaluation work described in Section 6.1, and they do not include the cost to repair or replace other items or deficiencies that may be identified as a result of the additional evaluations. In addition, the above costs assume only limited repair and replacement of miter gates, operating machinery, and timber members. It is possible that a greater extent of repair and/or replacement work may be required.

As a historic water resources structure opened in 1873, Willamette Falls Locks is on the National Register of Historic Places and is designated as a State Historic Civil Engineering Landmark by the American Society of Civil Engineers. At the same time, the locks are operating structures which must meet applicable operation, safety, and environmental requirements. The locks have been adapted, as needed, in order to continue operation. This work has included replacement of the original timber miter gates with steel miter gates, replacement of the original manual operation of the gates with hydraulic operating machinery, and replacement of the analog electrical system with digital controls.

When developing concepts and major capital costs for Willamette Falls Locks, various considerations must be balanced, including the use of historically appropriate materials, environmental issues, and costs for different materials and construction methods. When a capital improvement is located where it is highly visible to the public, historic preservation considerations are of particular concern. The opinions of probable costs, shown on the previous page, are based on large scale capital improvements that retain the essential historic character of the Willamette Falls Locks.

Appendix A

Quantity Calculations and Other Supporting Materials

ENGINEERS INC.

Job No 07-015

Client/Co: USACE - Willamette Falls Lock

Phase/Sub: Summary

Design To: Quantity Take Off

Made By CKW Date 5/10/2007 Checked By _____ Date _____

Replacing the missing stones (2' x 2' x 2'): Say 20 stones

Method 1: Shotcrete

Item	Labor Hrs	Labor Cost	Quantity		Labor		Equipment		Material		Total
	# of hrs	$/hr	# of unit	uint meas	Cost per SF	Cost	rent per day	# of day	unit price	cost	
Gunite			5.9	CY					75.00	444.4	444.4
Color and Texture Finish Coat 2-3"thick			80.0	SF					2.00	160.0	160.0
1 Foreman	24	25									600.0
2 Operator	24	21									1008.0
2 Labor	24	20									960.0
Crane Cost							1500	3			4500.0
Concrete pump, truck, shotgun							1000	3			3000.0
Form Work (Plywood)							1000	3			3000.0
											16406.9

Method 2: Cast-in-place concrete using multi-use flexible form liners

Item	Labor Hrs	Labor Cost	Quantity		Labor		Equipment		Material		Total
	# of hrs	$/hr	# of unit	uint meas	Cost per SF	Cost	rent per day	# of day	unit price	cost	
Cast in Place Concrete (ready-mixed)			5.9	CY					63.00	373.3	373.3
Color and Texture Finish Coat 2-3"thick			80.0	SF					2.00	160.0	160.0
1 Foreman	24	25									600.0
2 Operator	24	21									1008.0
2 Labor	24	20									960.0
Crane with basket							1500	3			4500.0
Concrete pump, truck							1000	3			3000.0
multi-use form liners with mortar							1000	3			3000.0
											16321.6

Method 3: Replacing quarried stone with or without mortar

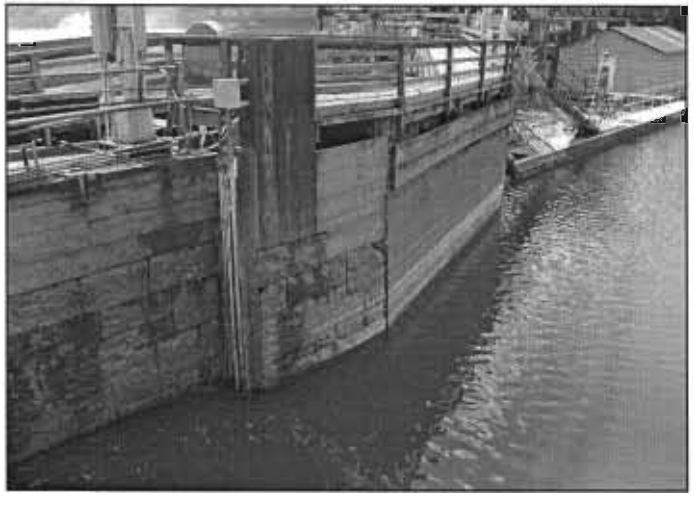
Item	Labor Hrs	Labor Cost	Quantity		Labor		Equipment		Material		Total
	# of hrs	$/hr	# of unit	uint meas	Cost per SF	Cost	rent per day	# of day	unit price	cost	
quarried stones			14.8	ton					300.00	4444.4	4444.4
grout			20.0						5.0	100	100.0
mortar										80.0	80 0
1 Foreman	40	25									1000.0
2 Operator	40	21									1680.0
2 Labor	40	20									1600.0
Crane with basket							1500	5			7500.0
Hydraulic Jack, anchor rod							1000	5			5000.0
											25685.3

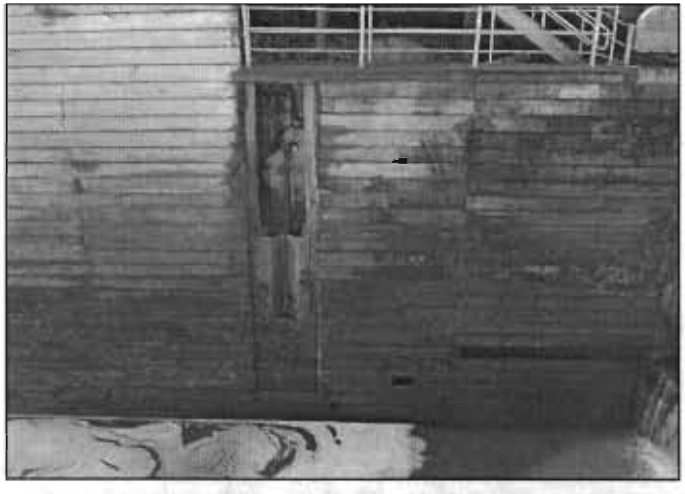
Timber lining replacing

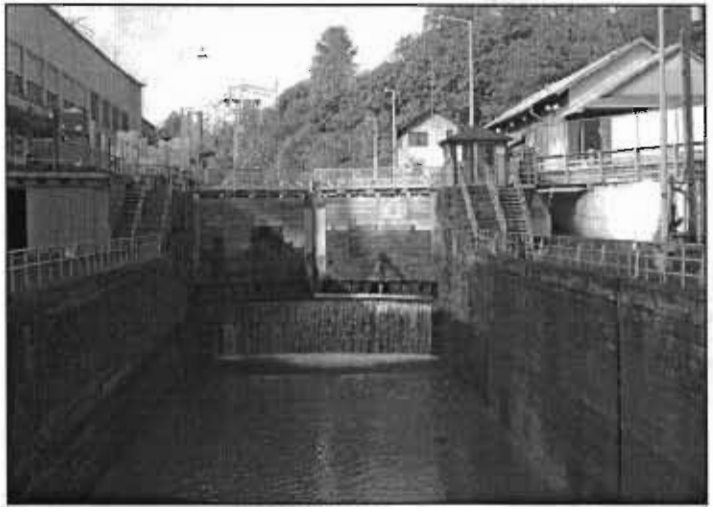
Method 1: Replacing the missing 3" x 12" lining

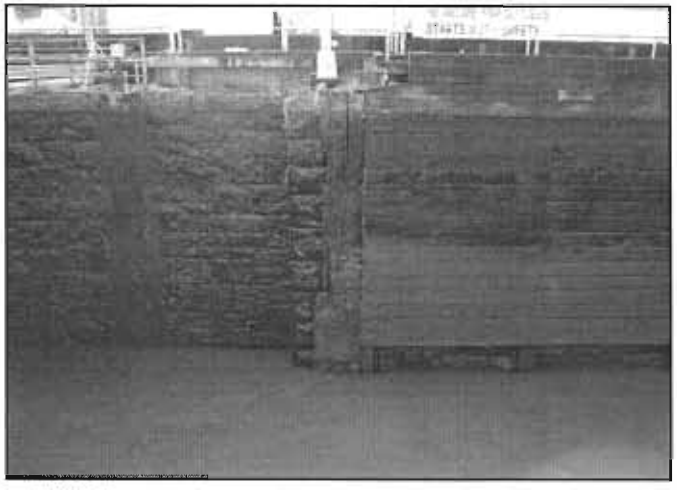
Item	Labor Hrs	Labor Cost	Quantity		Labor		Equipment		Material		Total
	# of hrs	$/hr	# of unit	uint meas	Cost per SF	Cost	rent per day	# of day	unit price	cost	
3" x 12" lining			1260.0	BF					0.30	378.0	378.0
1 Foreman	40	25									1000.0
2 Operator	40	21									1680.0
2 Labor	40	20									1600.0
Crane with basket							1500	5			7500.0
Misc. equipment							300	5			1500.0
											16389.6

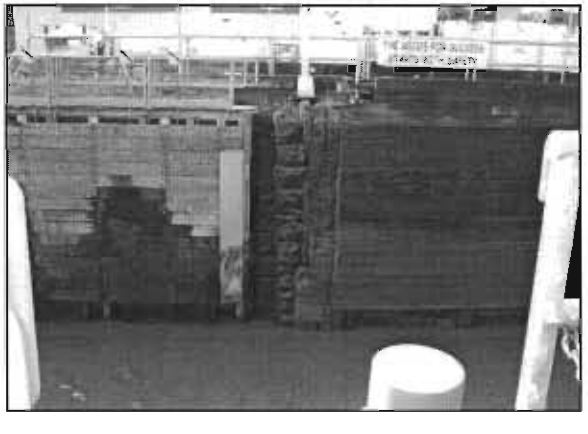
Missing Wall Lining





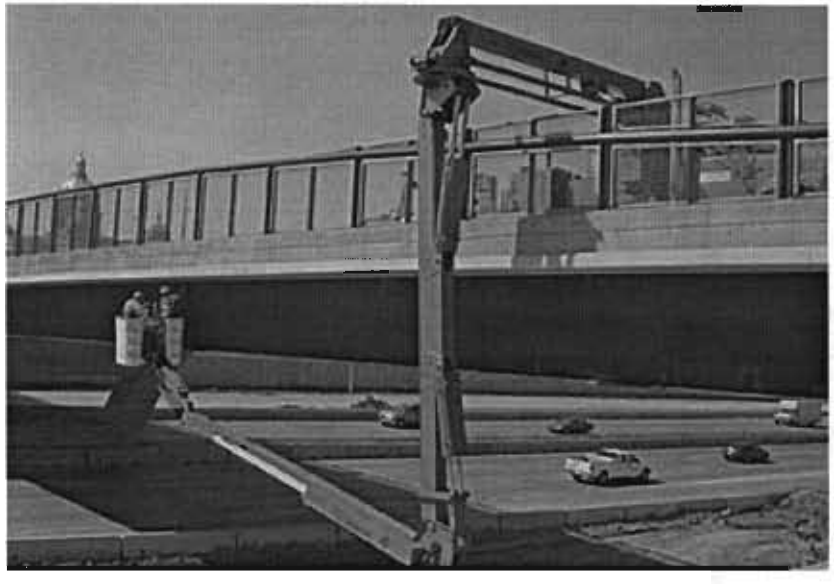


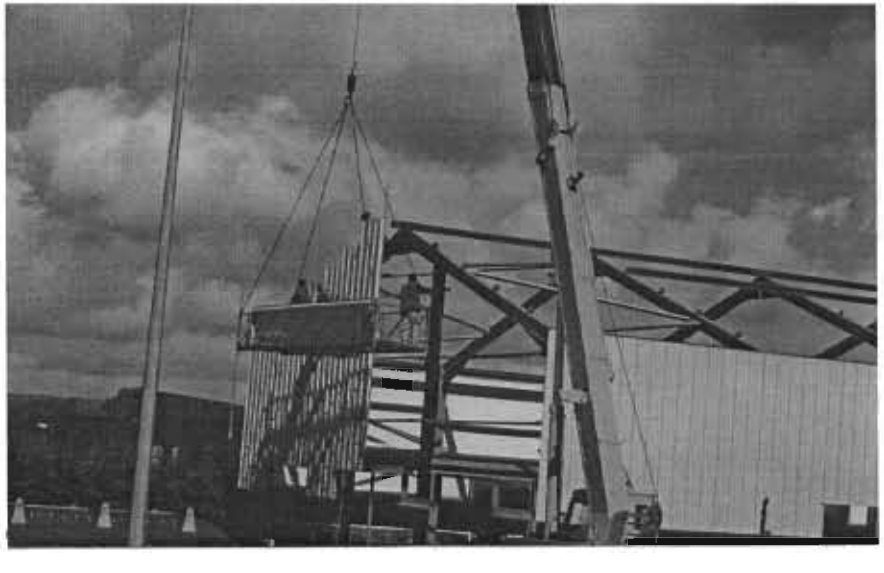


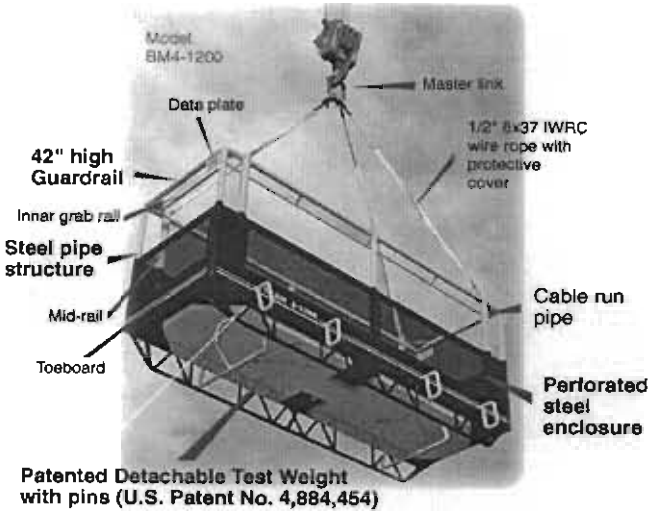


Missing Stone

Others






Model
BM4-1200
Master link
Data plate
1/2" 6x37 IWRC
wire rope with
protective
cover
42" high
Guardrail
Inner grab rail
Steel pipe
structure
Cable run
pipe
Mid-rail
Toeboard
Perforated
steel
enclosure
Patented Detachable Test Weight
with pins (U.S. Patent No. 4,884,454)

ENGINEERS INC.

Job Number 07-015
Volume/Sheet No. _____ of _____

Client/Contract USACE - Willamette Falls Lock
Phase/Subject Typical Wall Section
Design Topic Quantity Take Off
Made By CKW Date 5/8/2007 Checked By _____ Date _____ Page No. _____

Typical Wall Section

Post Height	26	Length	210 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4568 BF
Transverse Struct	12 in	12 in	5.44 ft	114	7466 BF
Longitudinal Struct	8 in	12 in	10.00 ft	109	8737 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	26.00 ft	22	6865 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	546	16382 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Lock Chamber No. 1				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Task:

Calculate the quantities for lock chamber 1

Reference Drawings:

UWR-114-105/1	General Plan
UWR-114-110/1	Wall Lining
UWR-114-110/2	Wall Lining Detail

Calculations:

Land Side (Left Wall)

Post Height	32.39	Length	210.32 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4574 BF
Transverse Struct	12 in	12 in	5.44 ft	143	9313 BF
Longitudinal Struct	8 in	12 in	10.00 ft	136	10900 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	32.39 ft	22	8563 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	681	20437 BF

Summary

Wall Lining	20437 BF
Framing	33850 BF

River Side (Right Wall)

Post Height	32.39	Length	210.32 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4574 BF
Transverse Struct	12 in	12 in	5.44 ft	143	9313 BF
Longitudinal Struct	8 in	12 in	10.00 ft	136	10900 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	32.39 ft	22	8563 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	681	20437 BF

Summary

Wall Lining	20437 BF
Framing	33850 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Lock Chamber No. 2				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Task:

Calculate the quantities for lock chamber 2

Reference Drawings:

UWR-114-105/1	General Plan
UWR-114-110/1	Wall Lining
UWR-114-110/2	Wall Lining Detail

Calculations:

Land Side (Left Wall)

Post Height	26	Length	210.03 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4568 BF
Transverse Struct	12 in	12 in	5.44 ft	114	7466 BF
Longitudinal Struct	8 in	12 in	10.00 ft	109	8737 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	26.00 ft	22	6865 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	546	16382 BF

Summary

Wall Lining	16382 BF
Framing	28136 BF

River Side (Right Wall)

Post Height	26	Length	210.03 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4568 BF
Transverse Struct	12 in	12 in	5.44 ft	114	7466 BF
Longitudinal Struct	8 in	12 in	10.00 ft	109	8737 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	26.00 ft	22	6865 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	546	16382 BF

Summary

Wall Lining	16382 BF
Framing	28136 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Lock Chamber No. 3				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Task:

Calculate the quantities for lock chamber 3

Reference Drawings:

UWR-114-105/1	General Plan
UWR-114-110/1	Wall Lining
UWR-114-110/2	Wall Lining Detail

Calculations:

Land Side (Left Wall)

Post Height	19	Length	209.69 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4561 BF
Transverse Struct	12 in	12 in	5.44 ft	83	5447 BF
Longitudinal Struct	8 in	12 in	10.00 ft	80	6375 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	19.00 ft	22	5009 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	398	11952 BF

Summary

Wall Lining	11952 BF
Framing	21891 BF

River Side (Right Wall)

Post Height	19	Length	209.69 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4561 BF
Transverse Struct	12 in	12 in	5.44 ft	83	5447 BF
Longitudinal Struct	8 in	12 in	10.00 ft	80	6375 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	19.00 ft	22	5009 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	398	11952 BF

Summary

Wall Lining	11952 BF
Framing	21891 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Lock Chamber No. 4				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Task:

Calculate the quantities for lock chamber 4

Reference Drawings:

UWR-114-105/1	General Plan
UWR-114-110/1	Wall Lining
UWR-114-110/2	Wall Lining Detail

Calculations:

Land Side (Left Wall)

Post Height	12.83	Length	209.96 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4567 BF
Transverse Struct	12 in	12 in	5.44 ft	56	3683 BF
Longitudinal Struct	8 in	12 in	10.00 ft	54	4310 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	12.83 ft	22	3387 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	269	8081 BF

Summary

Wall Lining	8081 BF
Framing	16446 BF

River Side (Right Wall)

Post Height	12.83	Length	209.96 ft
Extra Post Height	6.5	Length	24 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	210	4567 BF
Transverse Struct	12 in	12 in	5.44 ft	56	3683 BF
Longitudinal Struct	8 in	12 in	10.00 ft	54	4310 BF
Blocking	3 in	12 in	1.50 ft	44	198 BF
Post	12 in	12 in	12.83 ft	22	3387 BF
Extra Post	8 in	12 in	6.50 ft	6	302 BF
Wall Lining	3 in	12 in	10.00 ft	269	8081 BF

Summary

Wall Lining	8081 BF
Framing	16446 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Canal Basin				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Task:

Calculate the quantities for Canal Basin

Reference Drawings:

UWR-114-105/1	General Plan
UWR-114-110/1	Wall Lining
UWR-114-110/2	Wall Lining Detail

Calculations:

Land Side (Left Wall)

Post Height	0	Length	0.00 ft
Extra Post Height	0	Length	0 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	0	0 BF
Transverse Struct	12 in	12 in	5.44 ft	0	0 BF
Longitudinal Struct	8 in	12 in	10.00 ft	0	0 BF
Blocking	3 in	12 in	1.50 ft	0	0 BF
Post	12 in	12 in	26.00 ft	0	0 BF
Extra Post	8 in	12 in	6.50 ft	0	0 BF
Wall Lining	3 in	12 in	10.00 ft	0	0 BF

Summary

Wall Lining	0 BF
Framing	0 BF

River Side (Right Wall)

Post Height	0	Length	0.00 ft
Extra Post Height	0	Length	0 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	0	0 BF
Transverse Struct	12 in	12 in	5.44 ft	0	0 BF
Longitudinal Struct	8 in	12 in	10.00 ft	0	0 BF
Blocking	3 in	12 in	1.50 ft	0	0 BF
Post	12 in	12 in	26.00 ft	0	0 BF
Extra Post	8 in	12 in	6.50 ft	0	0 BF
Wall Lining	3 in	12 in	10.00 ft	0	0 BF

Summary

Wall Lining	0 BF
Framing	0 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Guard Lock				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Task:

Calculate the quantities for Guard Lock

Reference Drawings:

UWR-114-105/1	General Plan
UWR-114-110/1	Wall Lining
UWR-114-110/2	Wall Lining Detail

Calculations:

Land Side (Left Wall)

Post Height	0	Length	0.00 ft
Extra Post Height	0	Length	0 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	0	0 BF
Transverse Struct	12 in	12 in	5.44 ft	0	0 BF
Longitudinal Struct	8 in	12 in	10.00 ft	0	0 BF
Blocking	3 in	12 in	1.50 ft	0	0 BF
Post	12 in	12 in	26.00 ft	0	0 BF
Extra Post	8 in	12 in	6.50 ft	0	0 BF
Wall Lining	3 in	12 in	10.00 ft	0	0 BF

Summary

Wall Lining	0 BF
Framing	0 BF

River Side (Right Wall)

Post Height	0	Length	0.00 ft
Extra Post Height	0	Length	0 ft

Description	Nominal Dimensions d1	d2	Length	Number	Volume
Decking	3 in	12 in	7.25 ft	0	0 BF
Transverse Struct	12 in	12 in	5.44 ft	0	0 BF
Longitudinal Struct	8 in	12 in	10.00 ft	0	0 BF
Blocking	3 in	12 in	1.50 ft	0	0 BF
Post	12 in	12 in	26.00 ft	0	0 BF
Extra Post	8 in	12 in	6.50 ft	0	0 BF
Wall Lining	3 in	12 in	10.00 ft	0	0 BF

Summary

Wall Lining	0 BF
Framing	0 BF

ENGINEERS INC.

Job No 07-015

Client/Contract	USACE - Willamette Falls Lock				
Phase/Subject	Summary				
Design Topic	Quantity Take Off				
Made By	CKW	Date	5/8/2007	Checked By	Date

Summary:

Land Side (Left Wall)

	Total
Wall Lining	56853 BF
Framing	100322 BF

River Side (Right Wall)

	Total
Wall Lining	56853 BF
Framing	100322 BF

This is a scratch worksheet that takes items from the balance of the workbook and translates them into the supporting documentation for the probable cost estimate.

Framing, Treated Lumber	Incl O&P	
Means 06100 575 0210	$ 1,530	MBF
	$ 1.53	BF

For chambers with timber lining:

Chamber	Lining (1)	Framing (1)
1	40874 BF	67700 BF
2	32765 BF	56271 BF
3	23905 BF	43782 BF
4	16163 BF	32891 BF
Total	113706 BF	200644 BF
Average	28426 BF	50161 BF

Replacing the wall lining in the average chamber, river and land sides.

Item	Description	Unit	Unit Price	Qty	Contingency	Total
1	Mob/Demob	LS	$ 20,000.00	1	20%	$ 24,000
2	Lining Material	BF	$ 1.53	28,426	20%	$ 52,191
3	Equipment	DAY	$ 1,800.00	47	20%	$ 102,335
4	Labor	HR	$ 107.00	569	20%	$ 72,999
						$ 251,525

Replacing the wall framing and lining in the average chamber, river and land sides.

Item	Description	Unit	Unit Price	Qty	Contingency	Total
1	Mob/Demob	LS	$ 20,000.00	1	20%	$ 24,000
2	Material	BF	$ 1.53	78,587	20%	$ 144,287
3	Equipment	DAY	$ 5,400.00	33	20%	$ 212,186
4	Labor	HR	$ 107.00	1179	20%	$ 151,359
						$ 531,832

Excerpt from Price.xls, the workbook used to estimate Opinion of Probable Cost for stone and lining replacement.

Method 1: Replacing the missing 3" x 12" lining

Item	Labor Hrs	Labor Cost	Quantity		Labor		Equipment		Material		Total
	# of hrs	$/hr	# of unit	uint meas	Cost per SF	Cost	rent per day	# of day	unit price	cost	
3" x 12" lining			1260.0	BF					0.30	378.0	378.0
1 Foreman	40	25									1000.0
2 Operator	40	21									1680.0
2 Labor	40	20									1600.0
Crane with basket							1500	5			7500.0
Misc. equipment							300	5			1500.0
											16389.6

Estimated production rate 50 BF/Crew Hr

Calculated production rate 31.5 BF/Crew Hr

Projected duration of chamber wall relining based on production rate

569 hours
71 days @ 8 hrs/day
3.4 months @ 165 hrs/month

47 days @ 12 hrs/day
8 weeks @ 6 days/week
2.0 months @ 4 weeks/month

For replacing the framing and lining simultaneously there will be an efficiency of scale.
Use 3 crews and assume they are doing the work of 4.

Estimated production rate 67 BF/Crew Hr

Projected duration of chamber wall replacement based on production ra

393 hours
33 days @ 12 hrs/day
5.5 weeks @ 6 days/week
1.4 months @ 4 weeks/month

Records

All-time one-day precipitation records were set at many locations. Some of these included:

Locations	**Amount** *(in)*	**Records Began**	**Old Record** *(in)*	**Year Set**
Corvallis	4.45	189	4.28	1965
North Bend	6.67	1931	5.60	1981
Portland	2.70	1939	2.48	1948
Redmond	2.38	1948	1.81	1969
Roseburg	4.35	1931	3.28	1965

Daily and monthly records were set at many sites as well. At Portland Airport, 3.86 inches was recorded between 4 p.m. on the 18th and 4 p.m. on the 19th. This broke the November 24-hour total of 2.82 inches, which was set November 10-11, 1995. Doubtless when more observations are received, many additional records will become apparent.

George Taylor
State Climatologist
Oregon Climate Service

Chris Hannan
Research Assistant
Oregon Climate Service

The Great Flood of 1996

by George H. Taylor, State Climatologist

A series of intense surges of subtropical moisture inundated western Oregon during the period February 5-9. The combination of record-breaking rain, warm temperatures, and a deep snowpack led to severe flooding throughout northern sections of the state. River flood stages were comparable in magnitude to the December, 1964 flood, the largest in Oregon since flood control reservoirs were built in the 1940's and 1950's.

The first precursor to the flooding was an unusually wet winter, causing soils to be saturated and streams and reservoirs to be at high levels. Most of northwest Oregon received at least 125% of normal precipitation for the first four months of the Water Year (October - January). Table 1 lists a few northwest Oregon stations' observed and normal seasonal precipitation for October 1995 - January 1996:

Table 1. Observed and normal seasonal precipitation, October 1995-January 1996

Location	Observed	Normal	Percent of Normal
Laurel Mountains	108.66	59.10	184
Portland	27.46	19.50	141
Eugene	41.55	28.13	148
Govt. Camp	71.42	46.16	155

Fall and winter had had very little snowfall. By mid-January, the snow water average for high-elevation sites (NRCS SNOTEL stations) in the Willamette drainage was only 29% of average. Beginning in mid-January, however, unusually high amounts of snow fell in the middle and high elevations of the Cascades and Coast Range (in many locations, several feet per day were reported for many days). By January 31, the average snowpack for the Willamette drainage had risen to 112% of average.

An intense cold spell during the week of the 29th resulted in very low temperatures in the northern half of the state. Many Willamette Valley stations had lows in the teens for 4 or 5 consecutive days. A number of eastern Oregon locations had lows well below zero. A moderate storm on February 3rd dropped rain on top of frozen soil and roads, causing a major freezing rain episode throughout the Willamette Valley. Traffic was slowed or completely halted in many locations. The hardest hit was the Portland area, where icy conditions lasted for three days, and which also experienced wind chill factors of -20F or lower.

Then on February 6th, a strong subtropical jet stream reached Oregon. This warm, very humid air mass, which originated near the Equator in the western Pacific (near the Date Line), brought record rainfall amounts to northern sections of the state. Although such subtropical storms are by no means rare, it is unusual for them to persist with such intensity for such a long period of time (3-4 days). Table 2 shows 4-day total precipitation for northwestern Oregon locations, as well as the all-time 4-day records (some of them now surpassed -- new records are in bold). The most spectacular total was at Laurel Mountain in the Coast Range. The four-day total was 27.88 inches (8.20, 7.90, 7.05, and 4.73 for February 6-9, respectively).

Table 2. Maximum 4-day precipitation totals for western Oregon locations

Site Name	**4-Day Total** *(in)*	**Record** *(in)*	**Year**
Astoria	8.88	8.24	1975
Corvallis	8.10	7.84	1974
Eugene	9.14	10.30	1964
Government Camp	11.30	13.84	1964
Hillsboro	6.70	5.91	1974
Hood River	7.50	8.67	1964
Newport	9.81	10.17	1965
Oregon City	7.51	7.29	1964
Portland Airport	7.00	5.10	1994
Salem	8.18	8.69	1937

In addition to the wet conditions, temperatures were unusually mild. In the Willamette Valley, daily minimum temperatures were higher than normal maximum values for early February. Nighttime lows in the mid-50's were quite common. The freezing level quickly moved upward, to 7,000 - 8,000 feet. Rain fell even at mountain pass level. The warm rain and air temperatures quickly began to erode the snowpack. In addition to large amounts of rain, high elevation sites saw significant reductions in snow water equivalent (SWE). Table 3 lists total precipitation and SWE for the period February 5-9 for NRCS SNOTEL stations in Oregon (courtesy NRCS, Portland).

Table 3. Total precipitation and SWE loss, SNOTEL stations, February 5-9, 1996

Site Name	Precipitation *(in)*	SWE Loss *(in)*	Total *(in)*	River Basin	Elevation *(ft)*
Blazed Alder	18.3	1.8	20.1	Willamette	3650
Daly Lake	10.1	6.1	16.2	Santiam	3360
Greenpoint	9.2	2.2	11.4	Hood	3200
Hogg Pass	9.7	5.1	14.8	Santiam	3500
Holland Meadows	3.9	6.9	10.8	Willamette	4900
Jump-Off-Joe	9.8	2.4	12.2	Santiam	3500
King Mountain	3.0	8.9	11.9	Umpqua	4000
Little Meadows	17.6	9.9	27.5	Santiam	4000
Marion Forks	11.1	12.2	23.3	Santiam	2600
Mckenzie	10.8	3.1	13.9	McKenzie	4800
Mt. Hood	11.3	3.4	14.7	Sandy	5400
New Crescent	2.4	3.4	5.8	Deschutes	4800
Ochoco Meadows	1.3	2.9	4.2	Crooked	5200
North Fork	12.1	8.5	20.6	Bull Run	3120
Peavine Ridge	10.6	5.5	16.1	Clackamas	3500
Quartz Peak	1.4	4.5	5.9	Klamath	5700
Red Hill	14.5	5.4	19.9	Hood	4400
Saddle Mountain	20.4	14.0	34.4	Tualatin	3250
Salt Creek Falls	10.2	3.0	13.2	Willamette	4000
Seine Creek	14.0	8.0	22.0	Tualatin	2000
Three Creeks	6.5	2.4	8.9	Deschutes	5650

Streams rose quickly on the 6th and 7th, reaching flood stage in many locations. At Vida on the McKenzie River, the flow jumped from 4,000 cfs on the 5th to over 20,000 cfs on the 6th. Major and minor tributaries throughout western Oregon jumped their banks. Gradually the levels in the major tributaries and the main stem rivers increased as well. Several set all-time flood stage records. Table 4 is a summary of 1996 crests, as well as all-time records, for rivers throughout northern Oregon; new record levels are in bold (courtesy Oregon chapter of American Meteorological Society).

Table 4. Summary of flood crests for Oregon rivers and streams

River Site	Flood Stage *(ft)*	1996 Crest *(ft)*	All-Time Record *(in)*	Year
WESTERN OREGON				
Columbia at Vancouver	16.0	27.2	31.0	1948
Willamette at Portland	18.0	28.6	33.0	1894
Willamette at Salem	28.0	35.1	47.0	1891
Willamette at Corvallis	20.0	23.5	32.4	1891
Sandy near Sandy	-	22.6	22.3	1964
Clackamas at Estacada	10.0	17.4	18.4	1964
Johnson Cr. at Sycamore	11.0	13.8	14.7	1964
Tualatin at Farmington	32.0	37.2	37.0	1933
Molalla at Canby	13.0	14.6	16.8	1964
Pudding at Aurora	22.0	30.5	30.0	1923
S. Yamhill at Whiteson	38.0	47.5	47.2	1964
N. Santiam at Mehama	11.0	13.4	17.5	1923
Santiam at Jefferson	15.0	23.2	24.2	1964
Luckiamute at Suver	27.0	33.0	34.5	1964
Nehalem at Foss	14.0	27.4	24.9	1990
Wilson at Tillamook	13.0	18.1	n.a.	n.a.
Nestucca at Beaver	18.0	18.2	n.a.	n.a.
Siletz at Siletz	16.0	24.5	31.6	1921
EASTERN OREGON				
John Day at Service Creek	11.5	14.0	n.a.	n.a.
Umatilla at Pendleton	7.8	11.0	n.a.	n.a.
Grande Ronde at Troy	10.0	13.6	11.3	1964
Deschutes at Moody	8.0	12.0	n.a.	n.a.

Comparisons with 1964 are inevitable, since that flood event is considered the largest in this area since flood control dams were completed following World War II. In the Willamette Valley and north coast, some of the current flood levels exceeded those observed in 1964, while others were slightly lower. The 1964 event was larger in extent, stretching from Northern California northward through most of Washington, and from the coast eastward into Idaho. The 1964 flood also began with much more low-elevation snow; Portland Airport, for example, had 11 inches of snow on the ground when the warm rains began in 1964.

George Robison, hydrologist with the Oregon Department of Forestry, circulated an internal memo with some preliminary flood perspectives. Below is an excerpt from George's well-written and very informative memo.

"Some preliminary gage data indicates that the following streams had floods of record that are equivalent to a 75+ year event."

1. S. Yamhill River near Whiteson
2. Pudding River
3. Tualatin River (2 gages)
4. Sandy River
5. Nehalem River
6. Grande Ronde River at Troy (Stage 2 feet higher than previous record!)
7. Deschutes River at Moody (Note peak flow recordings since 1897!)

"As information comes in there will be many more gages that will have floods of record. There were also many gages within the area of the flood's influence that had flows indicative of a 10-year event (for instance the Little Luckiamute River west of Salem had three ten year peak flows in three days). The flows on the Willamette were also indicative of a 10-year flood flow due to the effective use of flood control reservoirs. I t appears that most streams in the northwest corner of the state (especially Columbia County) experienced a flood of record even larger than the 1964 flood. From the air, there was widespread high water related damage with a lesser relative role of landslide activity. Along the western Cascades north of Eugene, some streams experienced floods of record as well. It could be that some of the small streams around Mapleton also had floods of record although there is no streamflow gage data to show this yet. Along the Columbia Gorge around Hood River there are also pockets of damage and high flows indicative of floods of record."

The 1996 flood caps a most unusual weather year in Oregon. A very wet November, big windstorm in December, and the snow and ice of January merely set the stage for the flood event. Doubtless we will look back on this as one of the most interesting (and damaging) winters in the history of Oregon.

Willamette Falls Locks Reopen

Portland, Ore. -- The Portland District, U.S. Army Corps of Engineers, announced today that the Willamette Falls Locks will reopen to all river traffic on June 21. The locks, located south of Oregon City at West Linn on the Willamette River, operate daily from 7 a.m. to 11 p.m.

The locks were open to both commercial and recreational river traffic briefly earlier in the week to test the repairs that had been completed over the past several months. Four commercial vessels were allowed to lock through June 6 and 7 in an effort to restart the commercial shipping traffic and to test the repairs.

The locks were flooded and closed Feb. 9 because of the devastating floods felt across the region. When river levels flowed over the lock gates, [redacted] caused considerable electrical damage, deposited a large amount of silt in the lock chambers and damaged the docks on the upriver and downriver sides of the locks. Total cost of the [redacted]

The Willamette Falls Locks were constructed in the early 1870s by the People's Transportation Company to move river traffic around the falls. The Corps purchased the locks in 1915. In 1974 the project was placed on the National Register of Historic Places. Willamette Falls Locks holds the distinction of being Oregon's first water resource development project.

Visitors are welcome to visit the Historical Information Center, located in the original lock master's office. Displays include exhibits describing life on the Willamette before and after construction of the locks. The center is open daily from 8 a.m. to 5 p.m.

Annually, 4,800 commercial and 2,500 recreational vessels lock through Willamette Falls Locks. Also, 60,000 visitors tour the project each year.

-30-

Appendix B

USACE Inspection Reports and Willamette Falls Locks Annual Report, 2006

014

US Army Corps
of Engineers
Portland District

Periodic Inspection Report No. 1
Inspected 29 March 1994

Willamette Falls Locks

Willamette River, Oregon

1110-2-1150a
Willamette Falls Locks
July 1994

COFF:

DEST: Perm.

July 1994

CENPD-PE-GE (CENPP-PE-GC/29 July 94) (1110)
Mr. Munger/mt/503-326-3867 26 AUG 1994
SUBJECT: Willamette Falls Locks, Report of Periodic Inspection and Evaluation, First Report

CDR, North Pacific Division, Corps of Engineers, P.O. Box 2870, Portland, OR 97208-2870

FOR Commander, Portland District (CENPP-PE-GC)

Periodic Inspection Report No. 1 for the Willamette Falls Locks is approved.

FOR THE COMMANDER:

W E Daughtry

DAVID A. GEIGER, P.E.
Acting Director of Planning and Engineering

Encl (5 copies)
Wd encl (3 copies)

CF: (w/encl):
CECW-EP (2 copies)

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

CENPP-PE-GC (1110)

27 July 1994

CAMPBELL/6464/Samson

MEMORANDUM FOR Commander, North Pacific Division
ATTN: CENPD-PE-GT

SUBJECT: Willamette Falls Locks, Report of Periodic Inspection and Evaluation, First Report

In accordance with ER 1110-2-100, five copies of subject report are forwarded herewith for review and approval.

FOR THE COMMANDER:

Encl (5/c)
as

FOR/ STEVEN L. STOCKTON, P.E.
Chief, Planning and Engineering Division

WILLAMETTE FALLS LOCKS PROJECT
PERIODIC INSPECTION REPORT NO. 1

TABLE OF CONTENTS

Note: These drawings (gate 3, chamber 2) are considered to be typical and representative of other gates and chambers.

PROJECT DESCRIPTION AND INSPECTION SUMMARY

Project Location and Description. Willamette Falls Locks Project is located on the west bank of the Willamette River at West Linn, Oregon. The downstream entrance of the locks is 26 miles above the point where the Willamette and Columbia rivers join just north of Portland, Oregon.

The project includes four locks, a canal basin, and an upstream guard lock used to prevent flooding when river levels are high. Each lock is 40 feet wide and 210 feet long. Lock gates are numbered 1 through 7 starting at the downstream end. Approach guides extend 150 feet downstream from the lower gate and more than 300 feet upstream from the upper gate to direct vessels into the locks. The locks operate by gravity flow, draining 850,000 gallons of water from one lock chamber into the next through slide gates located in the lower portion of the miter gates. The lower two locks are entirely excavated from natural basalt, with wood planking on the walls. The upper two locks and the guard lock have walls of wood and masonry extending up from the excavated rock.

Inspection Summary. The lock structure was generally in good condition. Project staff replaces approximately 100 timbers every year on the lock gates and walls as a continuing maintenance item. The sills at each lock gate receive a lot of abuse from barge traffic, due to the the maneuvering needed to fit the barge and tug combinations into each chamber. Some of the sills have worn back into the stonework to an extent that repairs are recommended. Also, there are several masonry stones missing from various places in the sills and lock walls. The stones should be replaced or the gaps filled with concrete to prevent further loosening of adjacent stones. The miter gates appeared to be in generally good condition, although the timber lagging on the downstream faces prevented a thorough inspection of the main structural members. Problems noted with many of the gates included loose gudgeon anchors, loose gate operating cylinder anchors and pins, worn guide plates for the slide gates, and wear of the miter posts due to tugs bumping and rubbing on the miter posts. See paragraph 3 of Appendix C for recommended gate repairs. A 12x12 timber column corner post in the west wall near gate 1 has been broken and bisected by a vertical split. The timber should be replaced or clamped back together.

The next periodic inspection of Willamette Falls Locks is scheduled for March 1999.

WILLAMETTE FALLS LOCKS
PERTINENT DATA

Total length	3,565 ft
Usable width	37 ft
Total lift	50.4 ft
Depth over sills	6.5 ft
Max. vessel length	175 ft
Gates 1-7, type	2 leaves, structural steel with wooden miter and quoin posts
Gates 1-7, size	gate 1: 30'-5.5" high x 20 ft wide gates 2-7: 20 ft high x 20 ft wide

Gate No.	Station	Top of Gate Elevation	Top of Sill Elevation
1	10+00	23.82	- 6.11
2	12+10	34.38	15.52
3	14+20	44.40	25.40
4	16+30	54.43	35.66
5	18+40	54.14	43.33
6	31+12	64.50	43.60
7	33+23	64.84	43.41

Gates, sliding	structural steel, 4 in each gate leaf each 27" x 41"
Sills	all gate sills are concrete on rock masonry, except No. 1, which is timber on concrete
Sumps	at gates 2, 3, and 4 are sumps in the bottom of the chamber, approx. 2 ft square, used for unwatering when necessary

Lock No.	Lock Wall Elev.	Lift of Lock
1	38.5	20.5 ft
2	42.0	10.6 ft
3	44.4	10.0 ft
4	56.5	9.3 ft

Guard lock at upstream end is used only seasonly, to maintain constant level of canal basin.

Canal Basin (between lock 4 and guard lock):

Length	1250 ft
Width	40 - 100 ft variable
Water level	maintained constant

Paper mill wharf - 850 ft along right side canal basin

River Stage Fluctuations

Above locks	10 ft (12 ft - extreme conditions)
Below locks	20 ft (30 ft - extreme conditions)

WILLAMETTE FALLS LOCKS
CHECKLIST AND RECOMMENDED ACTIONS

No.	Structure	Recommendation	Responsible Organization	Priority*
1.1	Lock 1	Replace or repair split 12x12 timber column	Project	2 (1 yr)
1.2	Locks 2,3,4	Repair damaged concrete and masonry at gate sills	Project	2 (2 yrs)
1.3	Lock Gates 2 - 5	Repair slide gate seats and loose guide blocks	Project	3
1.4	D/S Wall	Inspect for possible under-cutting of wall, at low water level conditions	CENPP-PE	2 (1 yr)

*Priority defined as follows:
(1) Immediate action.
(2) Complete within (x) years (the maximum period of time for completion to be entered by the inspection team).
(3) Routine work to be completed by regularly programmed O&M funding and at the discretion of the District Engineer.
(4) Items requiring a continuation of monitoring.

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER, OREGON
PERIODIC INSPECTION REPORT NO. 1

Inspection and Evaluation report approval, and authority for Action. Approval of this report constitutes the authority and request for each responsible organization to accomplish the necessary monitoring, continuing evaluation, and remedial work for the Willamette Falls Locks Project. Authority for remedial actions is subject to requirements necessary for funding. All applicable inspections, investigations, and remedial work will be coordinated between Operation and Planning and Engineering Divisions by the Geotechnical Engineering Branch for inclusion in the Inspection Reports. Requests for all off-site operation and maintenance funding pertinent to the Periodic Inspection and Evaluation Program will be made through the Geotechnical Engineering Branch.

1. Date of Inspection. 29 March 1994

2. Inspection Team.

Portland District

Dennis Hopman	Concrete & Dam Safety, Geotech Br.
Carolyn Campbell	Concrete & Dam Safety, Geotech Br.
Dick Gunsolus	Geology, Geotech Br.
Rick Russell	Structures, Design Br.
Tony Norris	Hydraulics, H&H Br.
Brian Schmidtke	Technical Branch, Operations

In addition, Don Erickson and Matt Hanson of Structural and Architectural Design Section conducted a detailed structural inspection of the lock gates.

Willamette Falls Project
John Wasson, Project Manager
Rex Lapp

3. History. The locks were built by the Willamette Falls Canal and Lock Company in the early 1870s to move river traffic around the 40-foot high horseshoe-shaped falls in the Willamette River. The locks opened on New Year's Day 1873.

The locks were operated by a number of owners before the federal government bought them in 1915. They have since been operated, rehabilitated, and maintained by the Corps. A complete rehabilitation was finished in 1921, when the locks were deepened to a controlling depth of 6 ft. at low water, all seven pairs of wooden gates were renewed, and timberwork and fenders along the lock walls were renewed. Additional improvements were made to walls in chambers 2, 3, and 4 during 1960-1973. The project was placed on the National Register of Historic Places in 1974. In 1978, a complete inspection of the lock was made by Portland District Engineering Division personnel, at the request of Operations Division, because of concern about the structural condition of the lock wall in chamber No. 1. Appendix A of this report documents the 1978 inspection findings. As a result of that inspection, Lock Chamber No. 1 was completely rehabilitated in 1980. Rehabilitation consisted of removing existing walls and walkways; installing rock bolts, anchors, drains; shotcreting the weak layer on the existing rock slope; constructing new walls and walkways. In July 1987, repairs were made to three leaking cavities in the concrete canal wall opposite the PGE hydropower plant. Appendix B of this report is a memorandum documenting the 1987 repair work. Lock gates No. 1 and 7 were repaired in 1993.

Because of the age and continuing deterioration of the locks, future inspections are planned on a 5-year basis.

4. Checklist and Recommended Actions. A checklist of deficiencies and the recommended action for correction can be found on page v of this report. A priority rating has been assigned to each checklist item in accordance with NPDR 1110-2-100, 15 February 1990. Definitions of each priority rating can also be found on page v.

5. Inspection Team Trip Reports. Trip reports and photographs from inspection team members are on file in Geotechnical Engineering Branch. The trip report documenting the miter gate inspection is included as Appendix C to this report.

6. General. Inspection started at the guard lock, upstream end of project. Water levels in the lock ranged from a few

inches deep up to waist deep. These conditions made inspection of some areas difficult.

Inspection details and comments follow. Information is current to the date of the report. References to right (east) and left (west) are made facing the downstream direction.

7. Lock Chamber 1. (see photos 1-2) This chamber was not dewatered; walls and gates were in good condition as viewed from the sidewalks. Gate 1 was repaired in 1993, and the entire lock chamber was rehabilitated in 1980. At the downstream entrance to lock chamber 1, the lock gates swing open into recesses in the lock chamber walls. Since the recess is about a foot deeper than the thickness of the lock gate, the lock wall at the upstream end of the recess protrudes into the chamber relative to the open gate face. Apparently, a barge hit this projection on the west side of the lock while maneuvering into the chamber. The 12x12 timber column framing this corner was broken, and bisected by a split (see photo 3). Operations needs to either replace the timber or clamp it back together with closely spaced galvanized strapping and through bolting along the approx. 15 foot split (Checklist No. 1.1). A deflector at this corner would be required to minimize future impacts. Other gate recesses have similar geometry; one corner at gate 2 was checked and found undamaged. Gate 1 is the most susceptible to barge impacts due to river currents downstream of the lock.

8. Lock Chamber 2. (see photos 4-9) Lock walls were in generally good condition. A few stone blocks were missing from both walls, and there were gaps in the masonry joints on the right side. Project maintenance will include replacing missing stones or filling the spaces with concrete to prevent loosening of adjacent stones. Gap grouting in the stone masonry will be included in the work as preventative maintenance. The sill and sumps at gate 2 have been damaged due to barge impacts, and will be included in the masonry repair work (Checklist No. 1.2). There were a few damaged wall lagging timbers noted below the waterline just upstream of gate 2. These will be replaced as part of the ongoing project maintenance.

9. Lock Chamber 3. (see photos 10-15) Lock walls were in good condition. The sill at gate 3 was damaged, with grooves worn into the stone below the concrete cap. The sump on the right side had loose stones around its outlet, and was passing approximately 30 percent as much flow as the left side sump. It appeared that a few of the stones lining the sump had moved far enough to allow the majority of the flow to bypass the intended orifice. The flow around these blocks will continue to erode the structure. Repair of the concrete on the sill and the supporting stonework masonry will be included in repairs performed in Checklist No. 1.2.

10. Lock Chamber 4. (see photos 16-23) Lock walls were in good condition except for a few damaged wall lagging timbers below the waterline just upstream of gate 4. The gate 4 sill was missing about a 6-inch section of the metal sill angle at the centerline, and the angle was loose for about 8 feet on each side of the lock centerline. Several masonry stones were missing from the sill wall under gate 4. There were gaps in the joints near the right sump outlet, toward the centerline. Repair of the sill and supporting stonework masonry will be included in work performed under Checklist No. 1.2.

11. Gate 5. (see photos 24-28) The sill was in good condition, with less wear than the sills further downstream. Gaps between masonry stones 1 to 2-inches wide were noted on both walls just upstream of gate 5. The top of each of these lock gates did not appear to be anchored firmly at the gudgeon. This allowed the top of the lock gate to tip into the channel, leaving a gap along the miter seal that increased toward the sill. Also, most of the slide gates did not seal uniformly, apparently due to blocks missing from the gate seat and worn guides on the slide gates. Missing blocks also allow the slide gate to travel beyond its intended position, resulting in leakage through the top of the gate.

Project staff reported that the concrete guide block just upstream of gate 5 on the left side moves up to 1-inch perpendicular to lock centerline, when impacted by barges and tugs. The block should be anchored securely to its foundation.

Gates 2, 3, and 4 were probably in similar condition to gate 5, but were not observed with full water upstream, and dewatered downstream, as was gate 5. The loose concrete guide block upstream of gate 5, and the slide gates in gates 2 through 5, will be repaired during routine maintenance or as part of the future gate repairs (Checklist No. 1.3).

12. Canal. (see photos 29-33) The canal is the stretch of water between lock 4 and the guard lock, and it was found to be in generally good condition. The canal had numerous gravel bars and areas of wood chips on the rock floor. The right bank is concrete and supports the PGE power station and the paper mill. The concrete wall was in good condition with the exception of a few minor leaks. One set of two adjacent 1-inch diameter leaks appeared to be left from the 1987 repair work. Generally, the 1987 repairs were holding up adequately and no further action is needed at this time. The left bank is excavated out of natural basalt, and appeared to be in stable condition. Two "holes" were noted in the basalt, located about 10 feet above the channel bottom and opposite the upstream end of the mill's dock structure. The holes were about 10 feet apart, appeared to be about 3 feet in diameter, and tapered into the bank about 6 feet. No action is needed at this time, but this area will be checked for further erosion at future inspections.

13. Guard Lock and Upstream Guide Wall. (see photos 34-38) The lock was in good condition. Minor leakage through the mortar joints of the right side masonry walls just downstream of gate 7 was not a problem. The left concrete wall had numerous concrete placement voids, creating a "rippled" appearance in the lower part of the wall. There was no leakage through the voids and no action is required.

14. Floating Dock. (see photos 39-40) The floating dock is located downstream of gate 1, on the left side. The lower ramp landing rides in a vertical guide structure. Project staff reported that the anchor bolts at the base of the guide structure continually work loose. At the inspection, 3 riverside bolts on each riverside leg were not tight; the largest space between the nut and baseplate was about 1/2-inch. Tight bolts are required for the stability of the

guide structure. Project staff have applied epoxy grout in the bolt holes and tightened down the nuts.

15. Downstream Right Wall. Project staff reported that the masonry block wall furthest downstream of gate 1, right side, appears to be severely undermined. This area was below water level in March, but will be inspected by appropriate District staff as soon as conditions permit (summer, low flow, low tide, etc.). (Checklist No. 1.4)

16. Downstream Parking Lot. The northernmost parking lot has a history of cracking asphalt, indicative of possible movement or settlement. At this inspection, there was no evidence of recent movement.

17. Conclusion. The Willamette Falls Locks are safe for continued operation. Recommended project maintenance and repair actions listed in the checklist and Appendix C, paragraph 3, should be accomplished as soon as feasible.

1. Lock chamber 1, left wall looking downstream.

2. Lock chamber 1, right wall looking downstream.

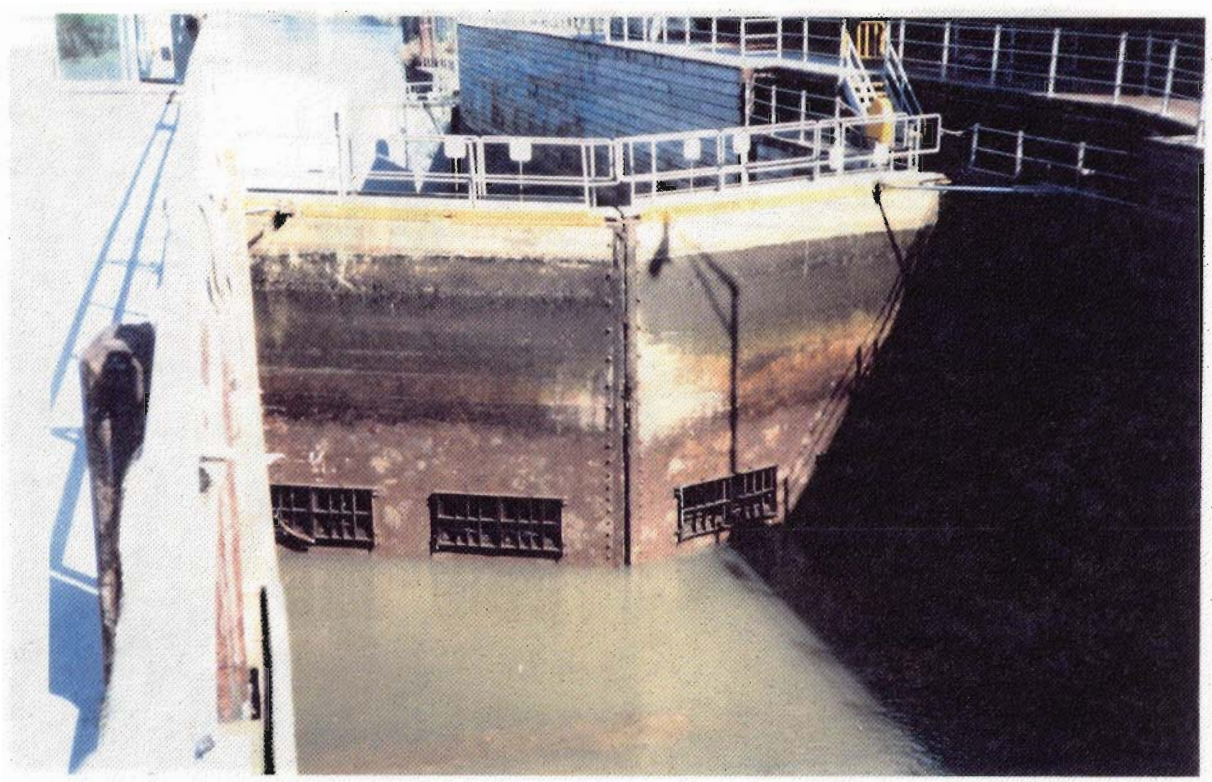
PLATE 1

3. Split timber in lock 1, corner post upstream of gate 1, left side.

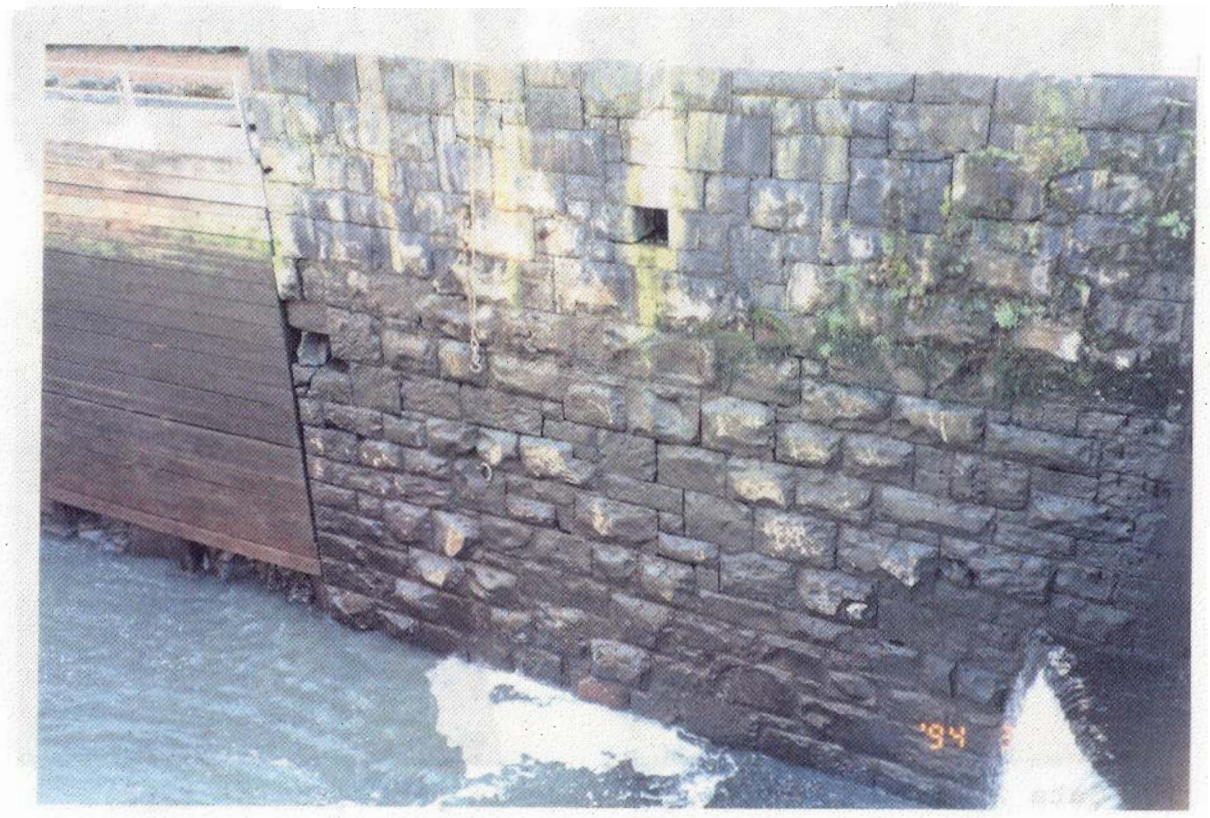
PLATE 2

4. Gate 2, left side, in open position (view d/s face).

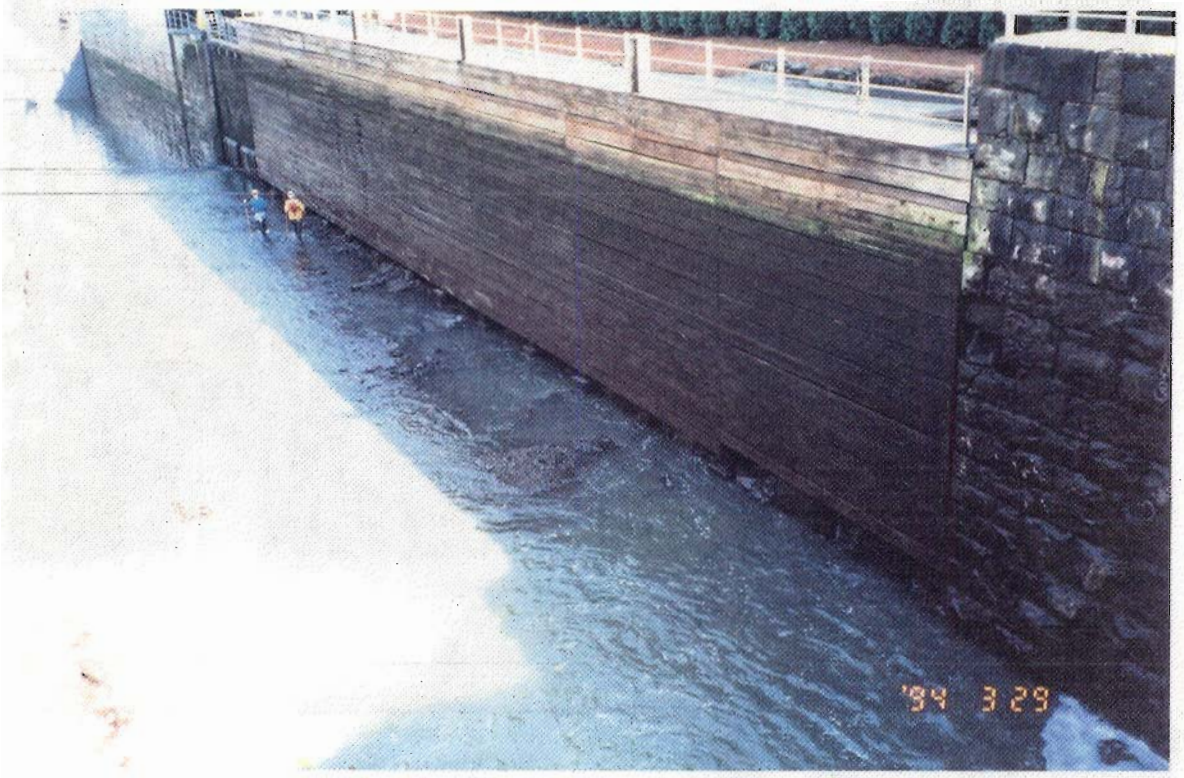
5. Gate 2, left side, gouge in quoin post (end of tape).



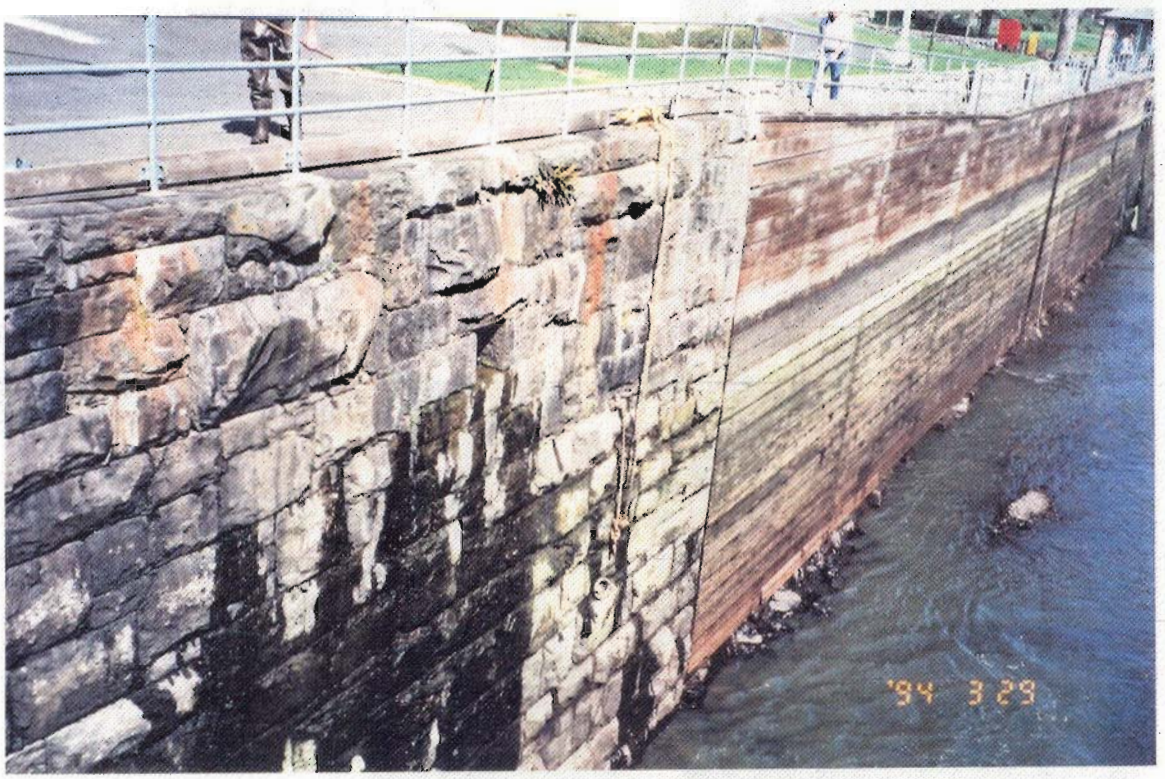
6. Gate 2, upstream side after gate closed. Note miter gap at bottom.



7. Chamber 2, right wall, upstream end near sill 3.

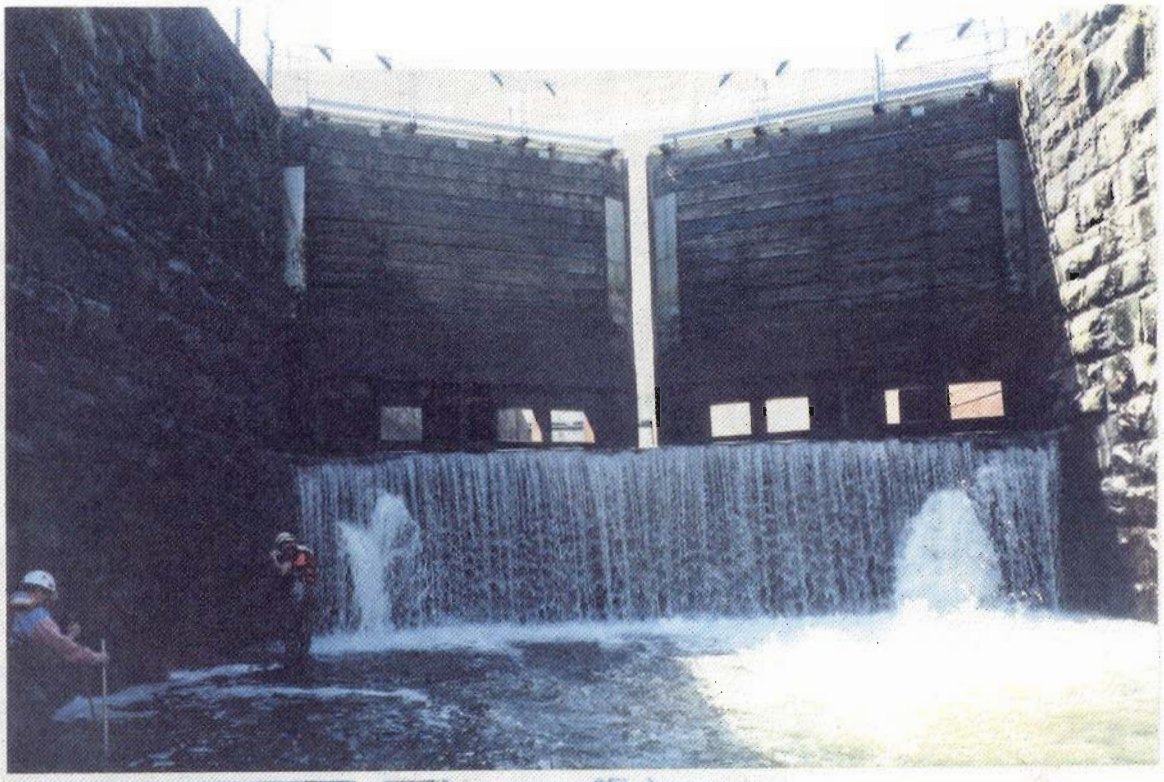


8. Chamber 2, right wall, looking downstream.

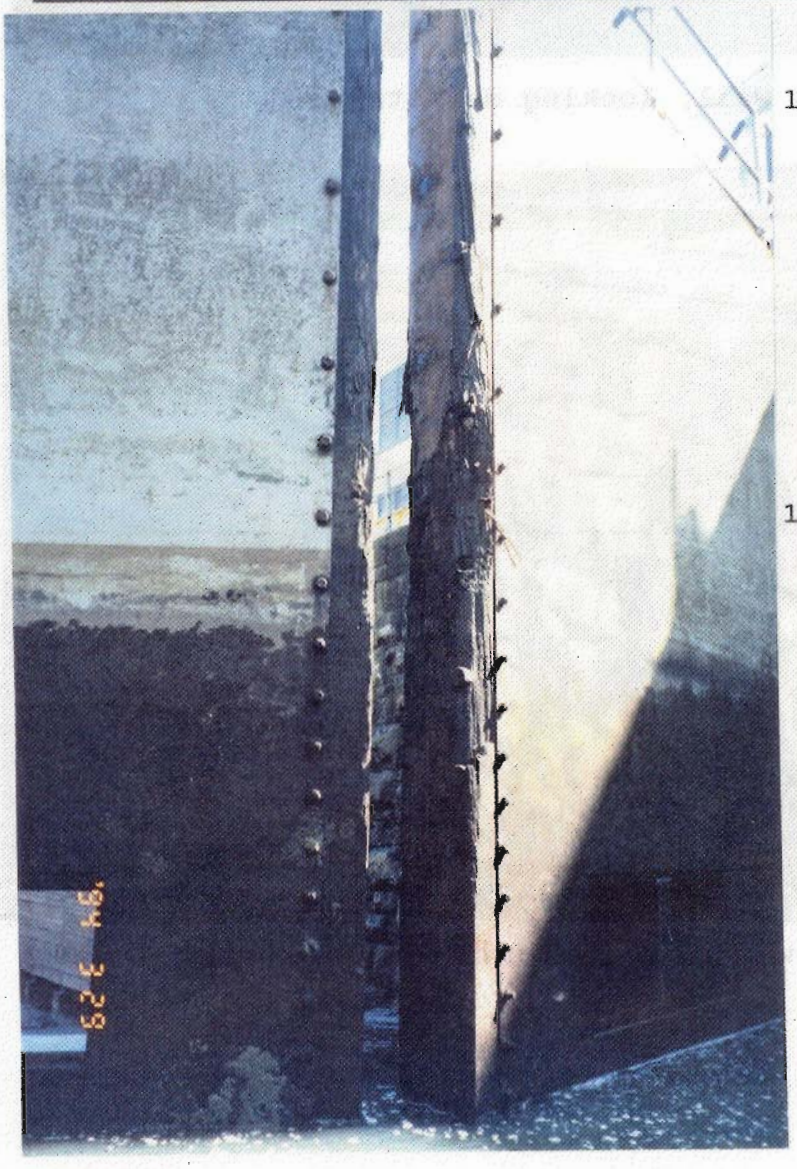


9. Chamber 2, left wall, looking downstream.

PLATE 5



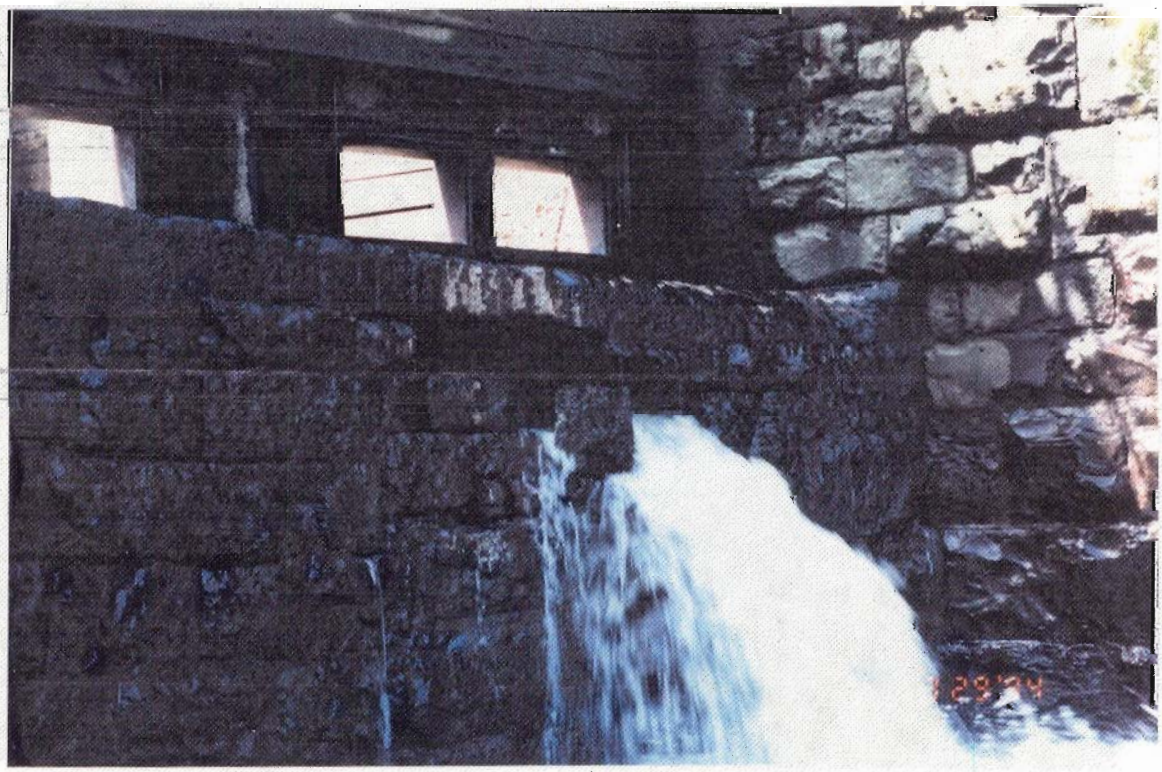
10. Looking u/s at gate sill 3, before gate closed.



11. Gate 3, impact wear on miter posts.

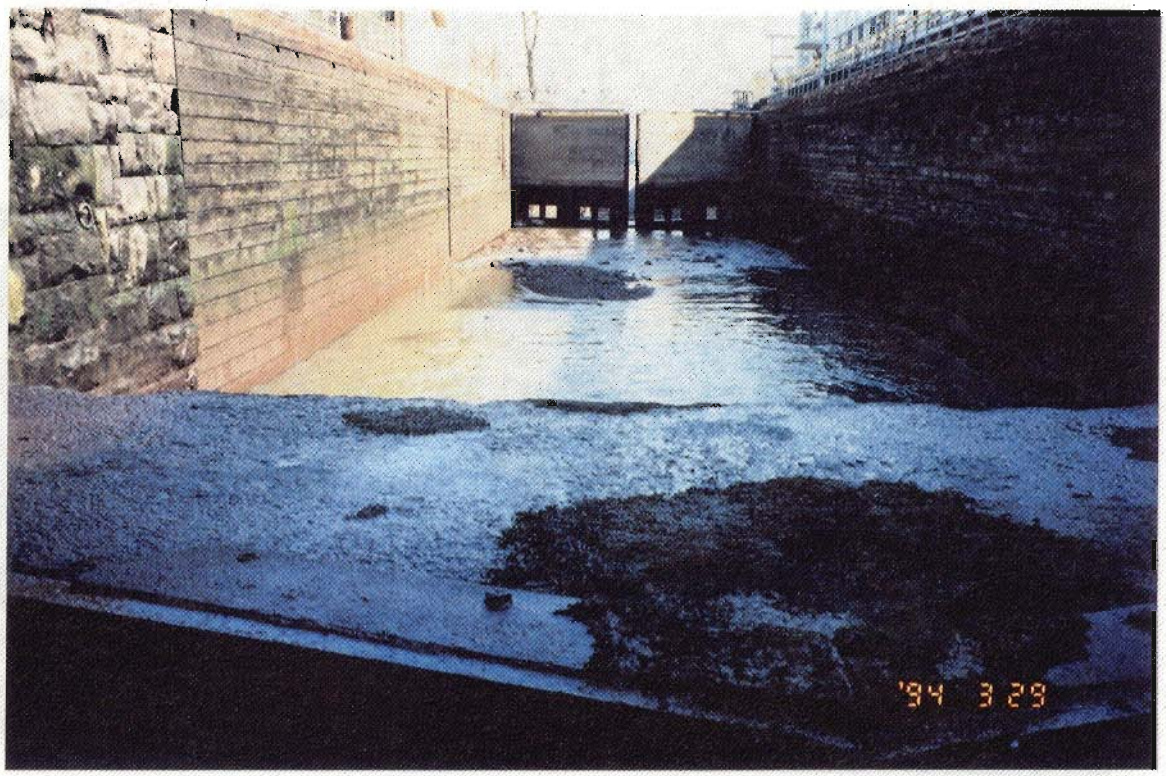
PLATE 6

12. Gate 3 sill, right side, missing blocks (bypassing sump)



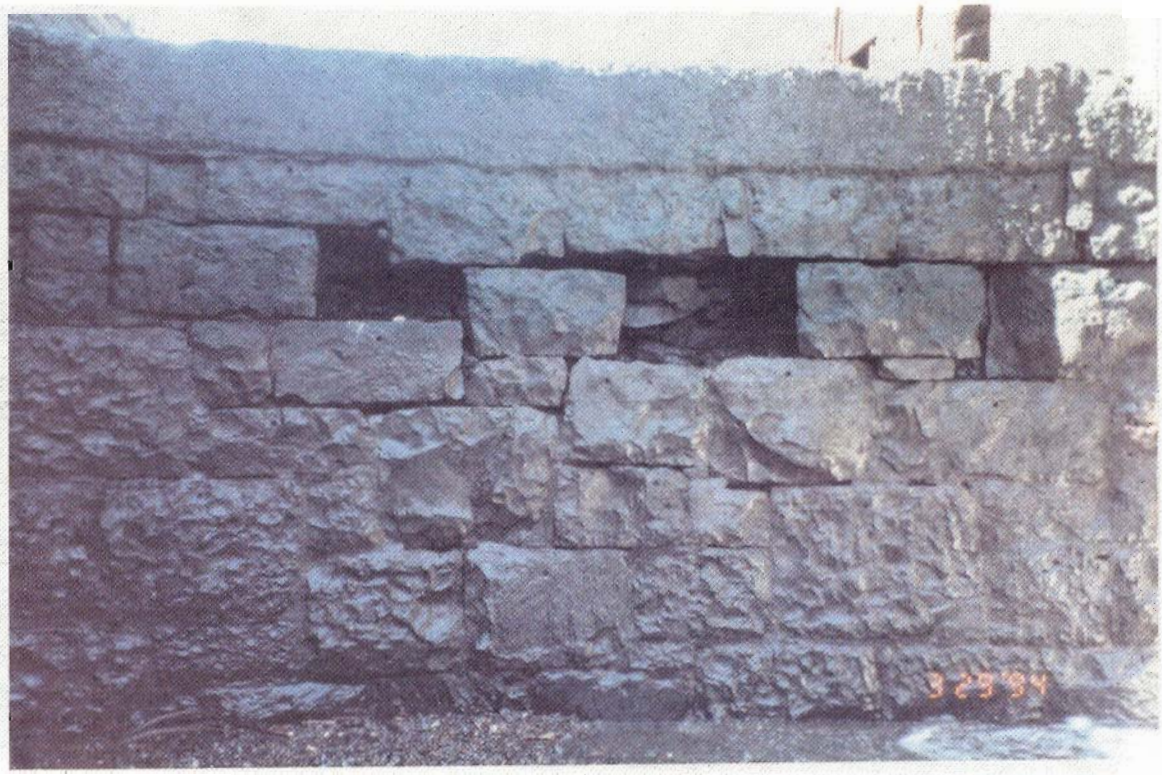
13. Gate 3 sill, left side, missing blocks.

14. Gate 3, upstream side.

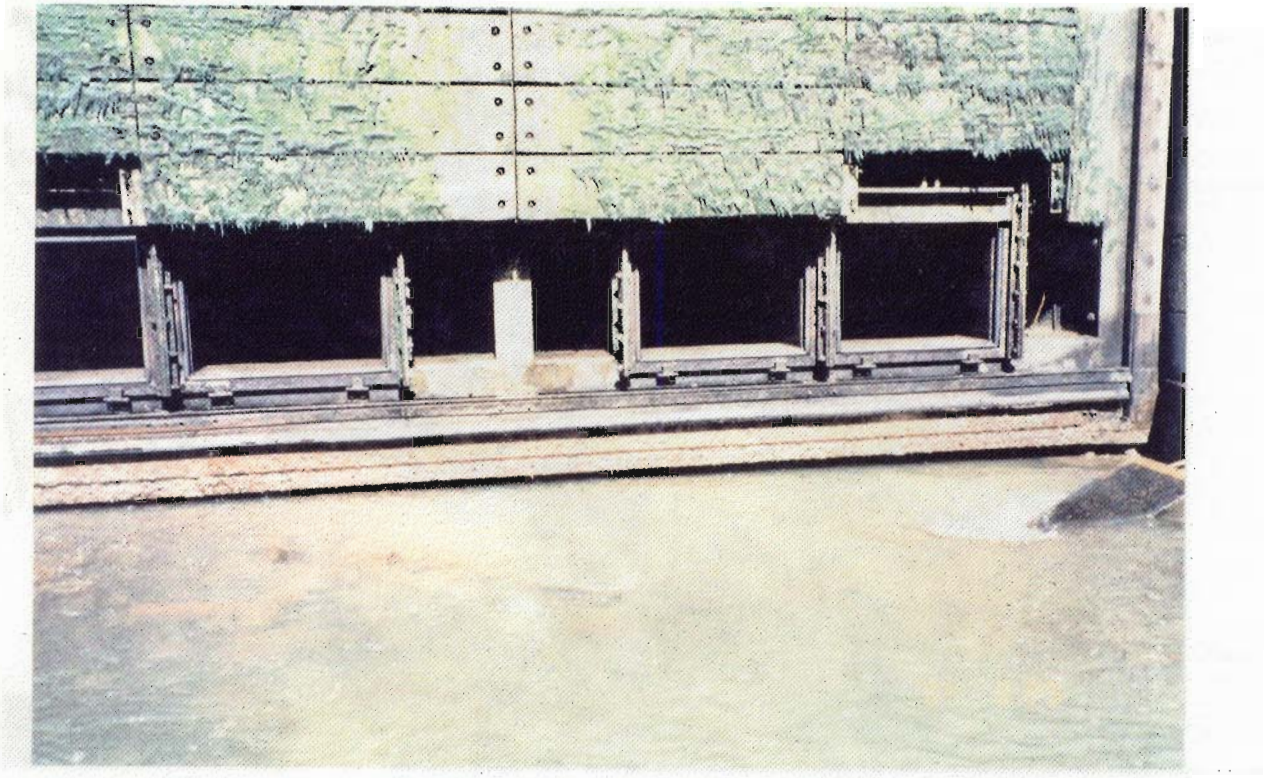


15. View of chamber 3 from gate 4 sill.

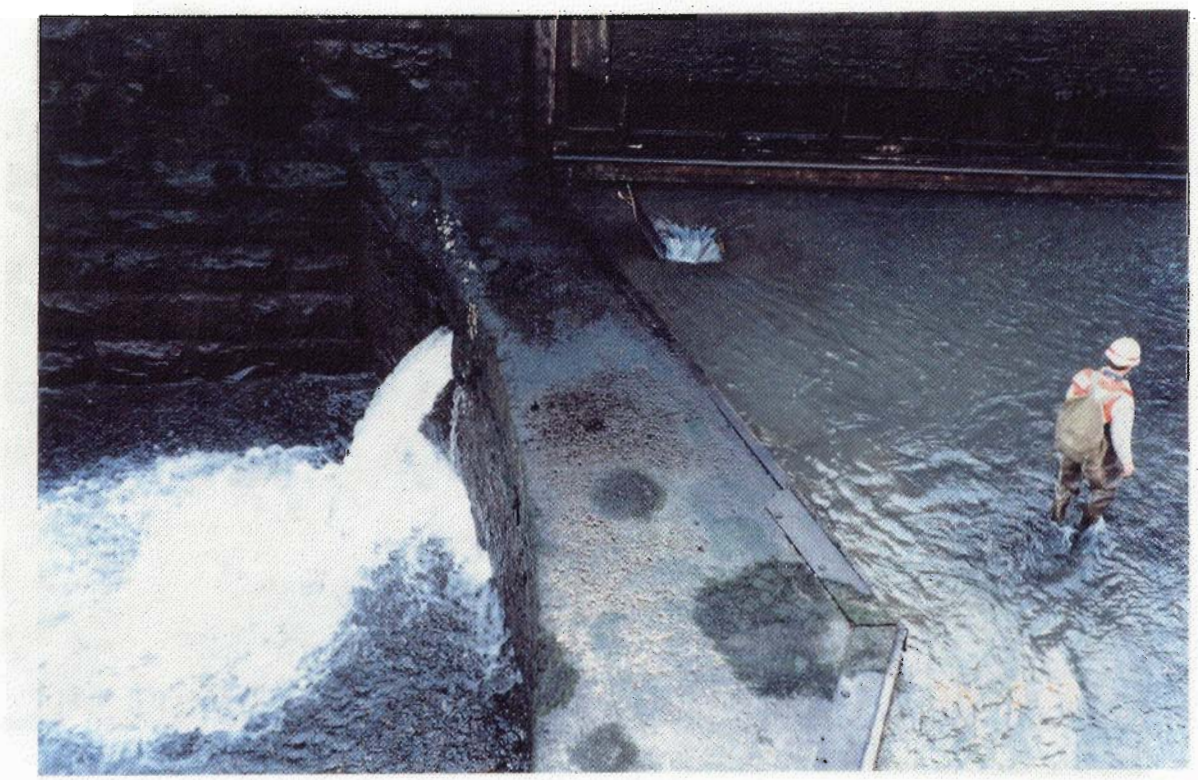
16. Gate 4 sill, view from deck.



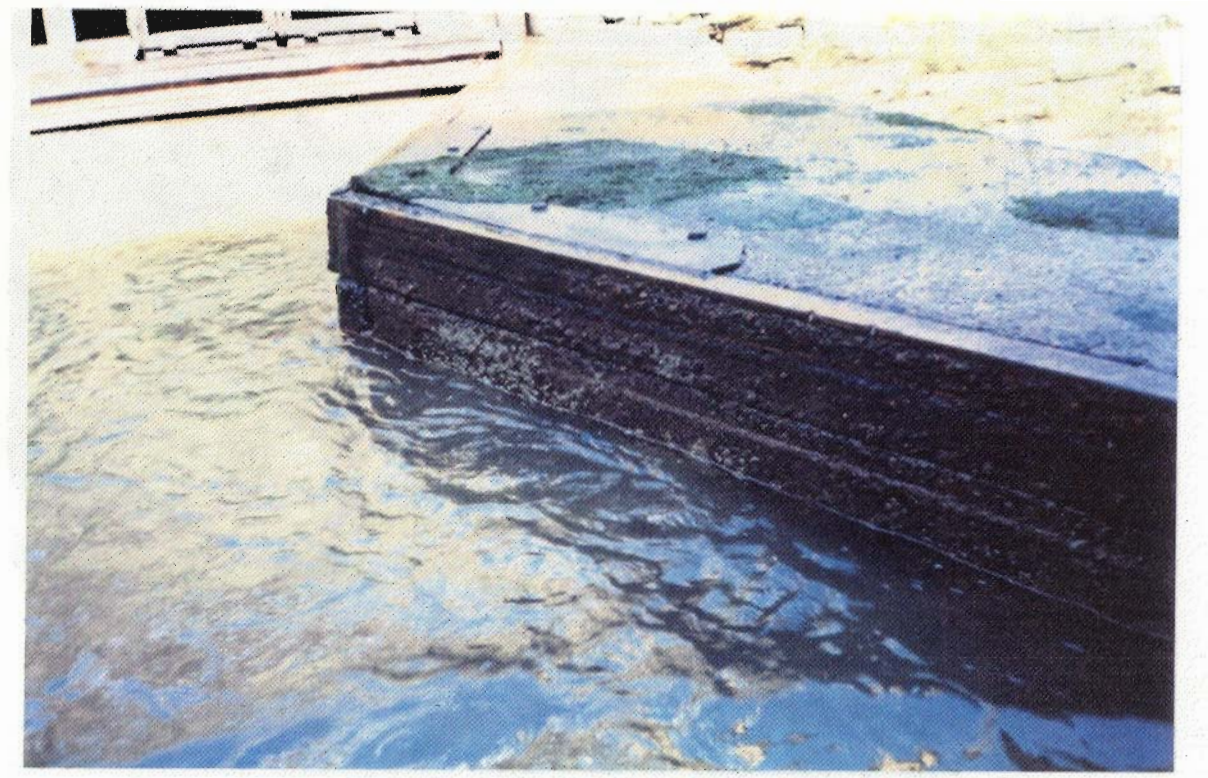
17. Gate 4 sill (blocks missing just left of centerline).



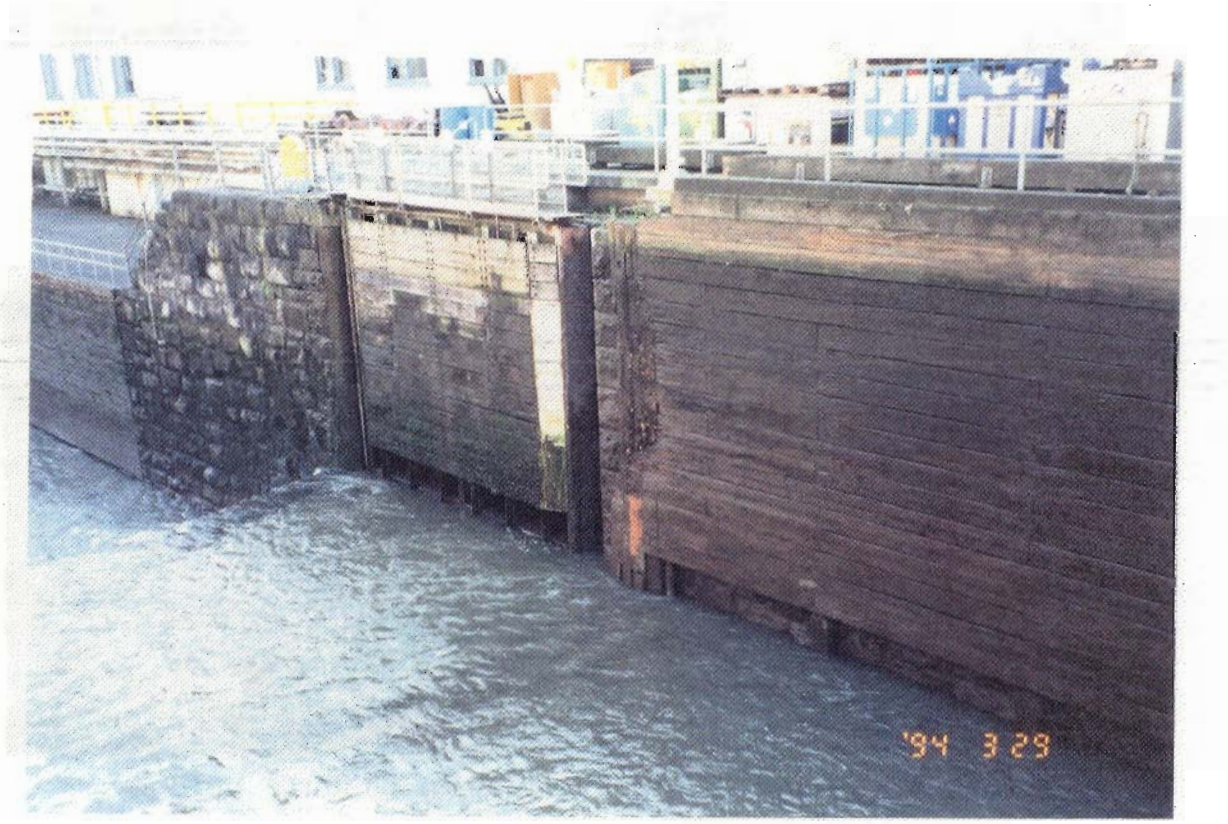
18. Gate 4, downstream side of left gate leaf.



19. Gate 4 sill, view right side sump.

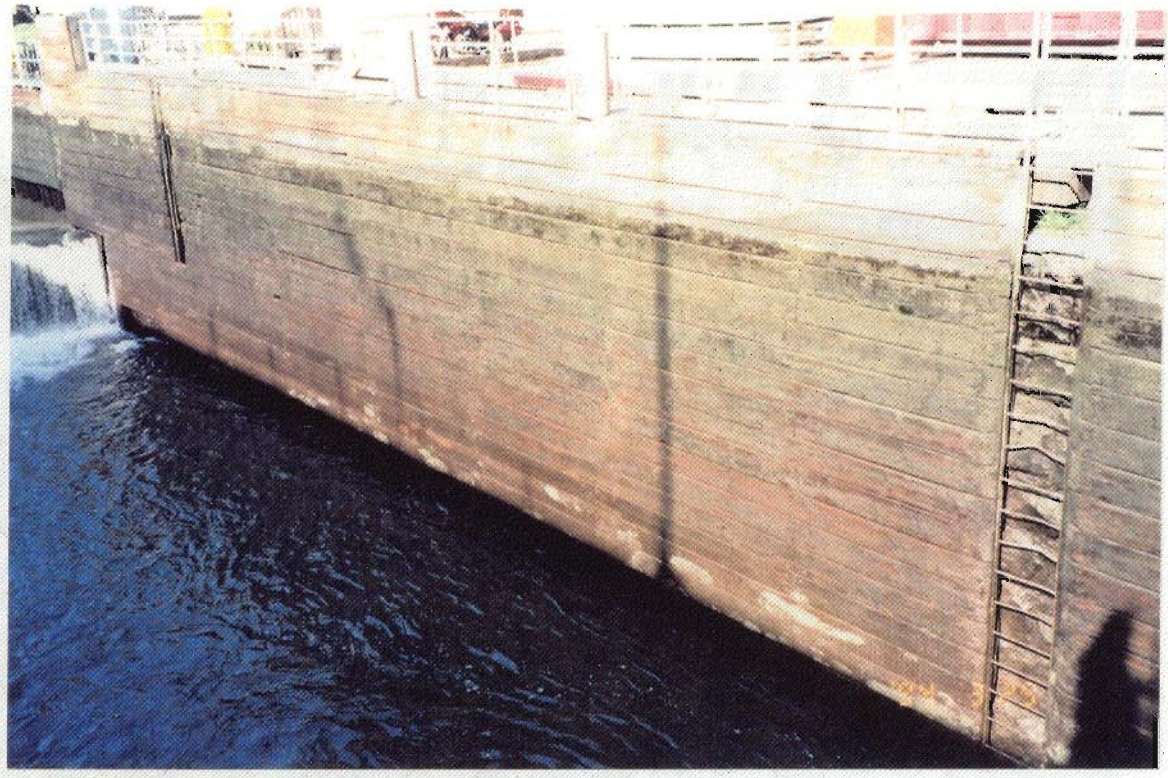


20. Gate 4, sill seal angle, loose for 8-feet each side of centerline.



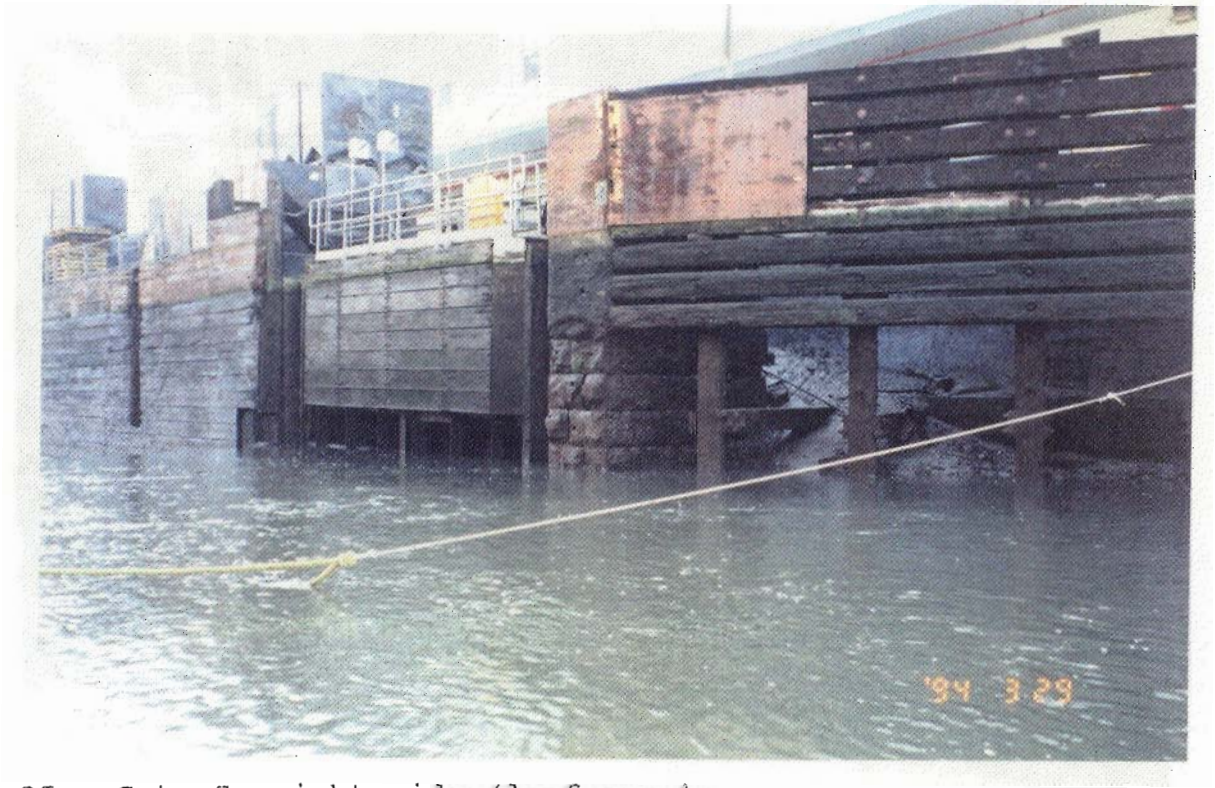
21. Gate 4 (open) and d/s right wall of chamber 4.

22. Chamber 4, right wall upstream from bascule bridge.



23. Chamber 4, left wall upstream from bascule bridge.

24. Gate 5, left side (leaf open).

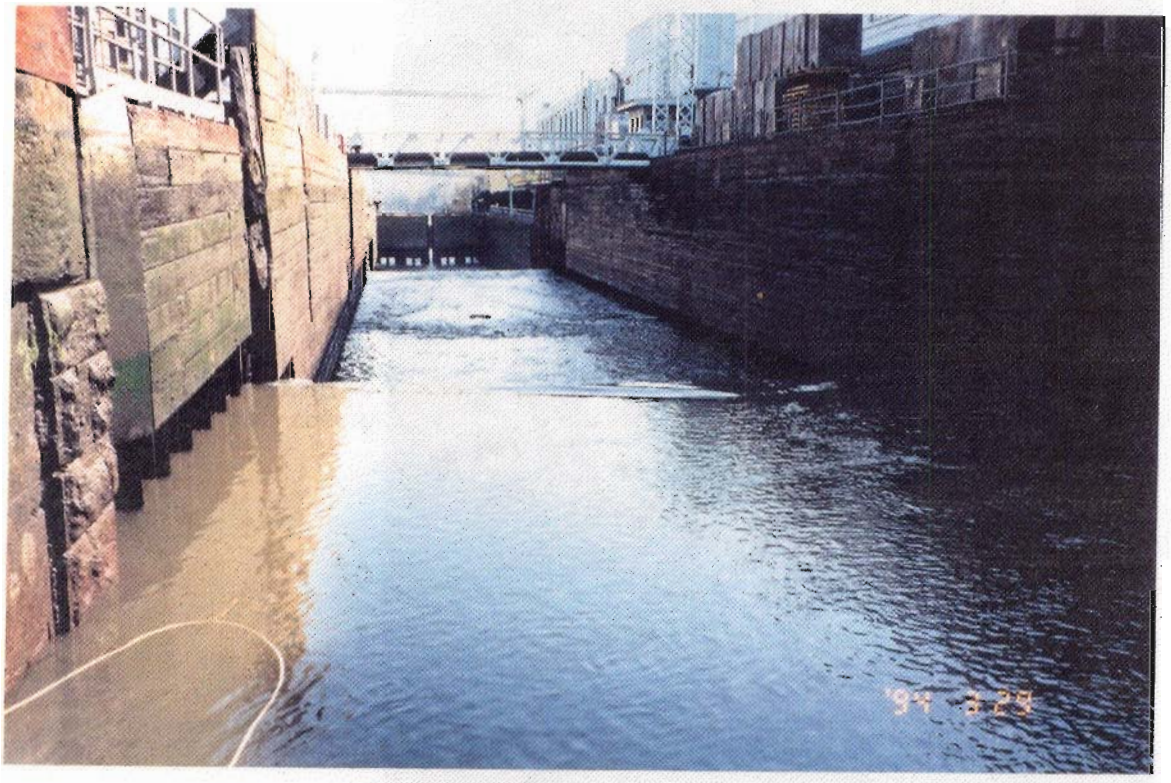


25. Gate 5, right side (leaf open).

26. Gate 5, downstream face after closing, water level rising upstream of gate.

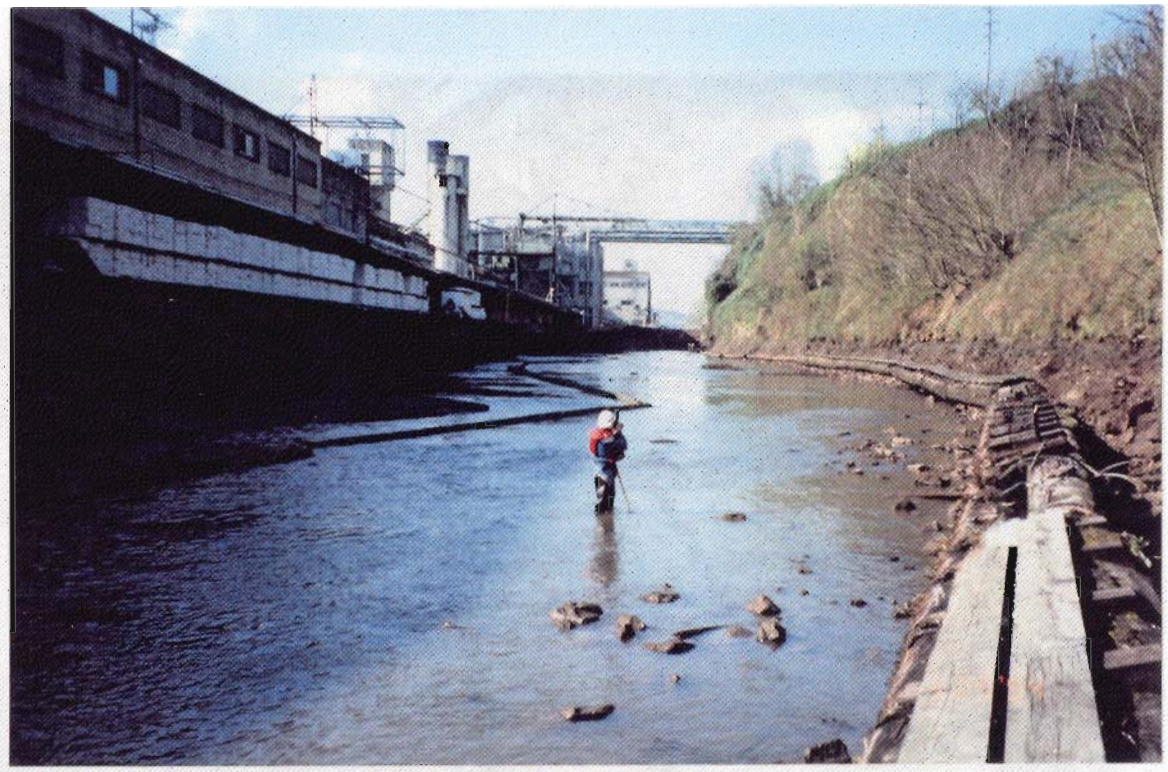
27. Gate 5, upstream face after closing.

28. Upstream of gate 5, loose concrete guide block (1/2-inch separation between block and asphalt).

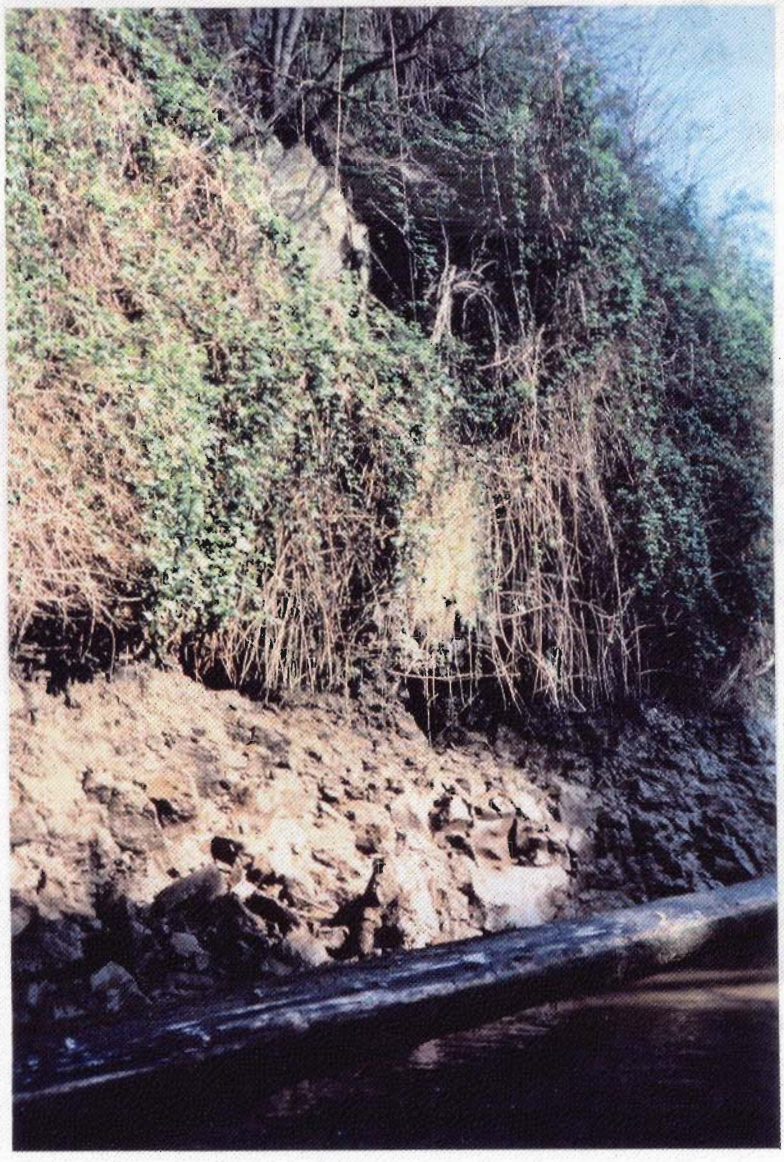


29. View looking downstream from above gate 5.

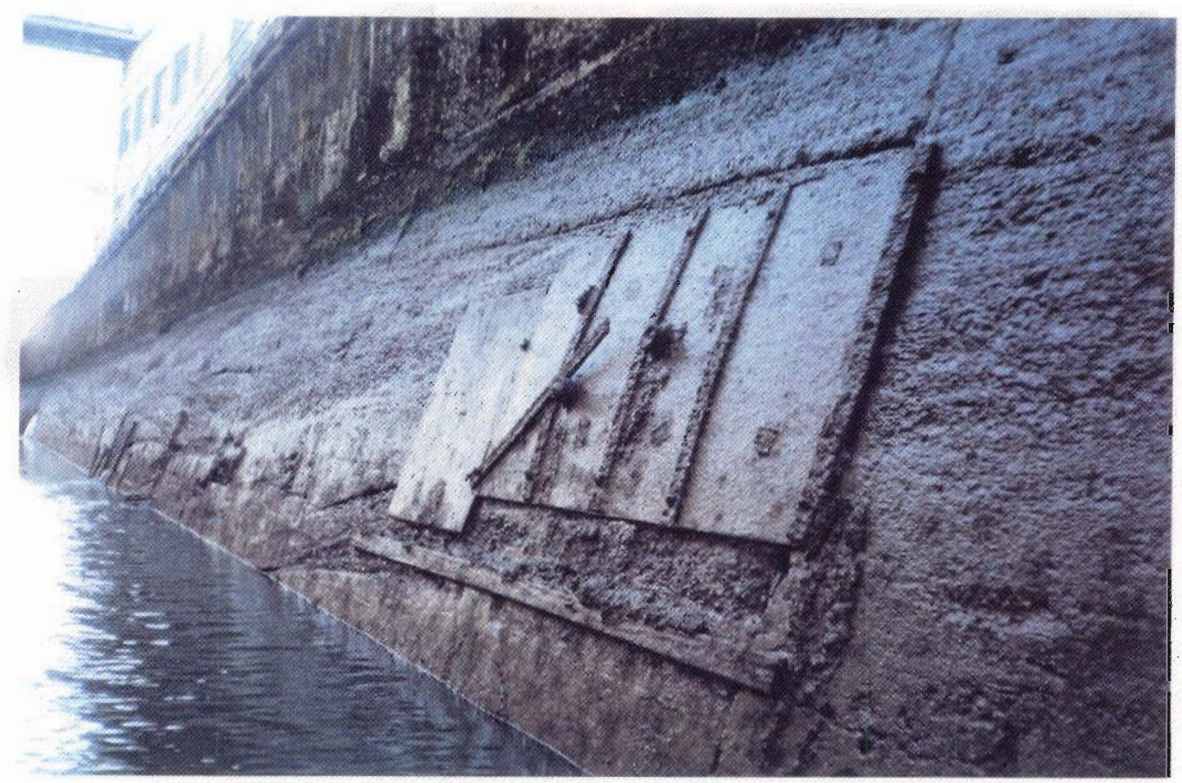
PLATE 15



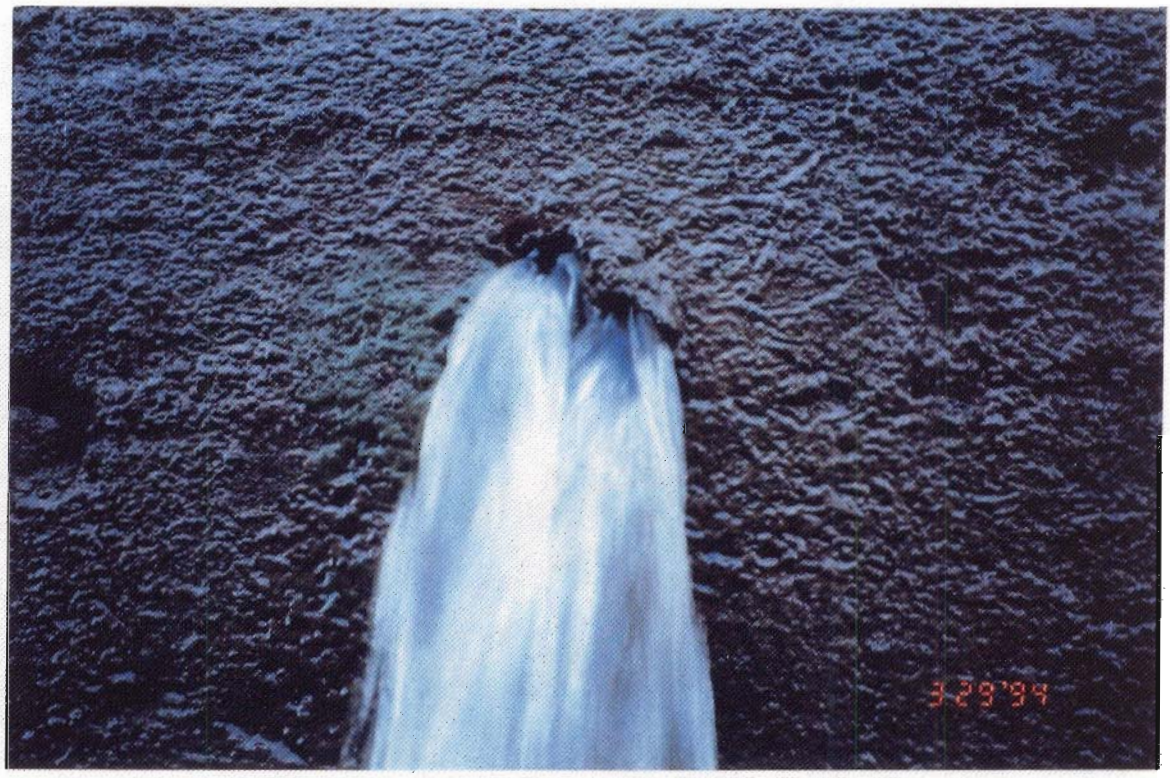
30. View of canal looking upstream from gate 5.



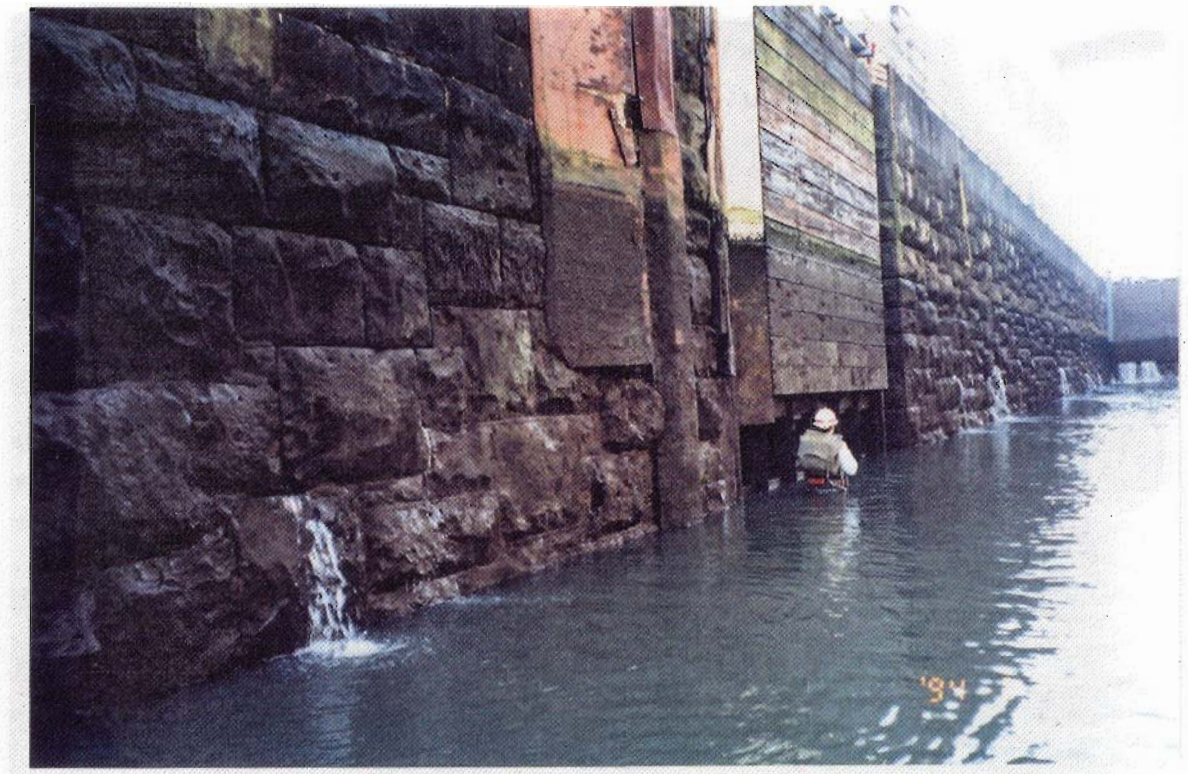
31. Left bank of canal, basalt undercut.



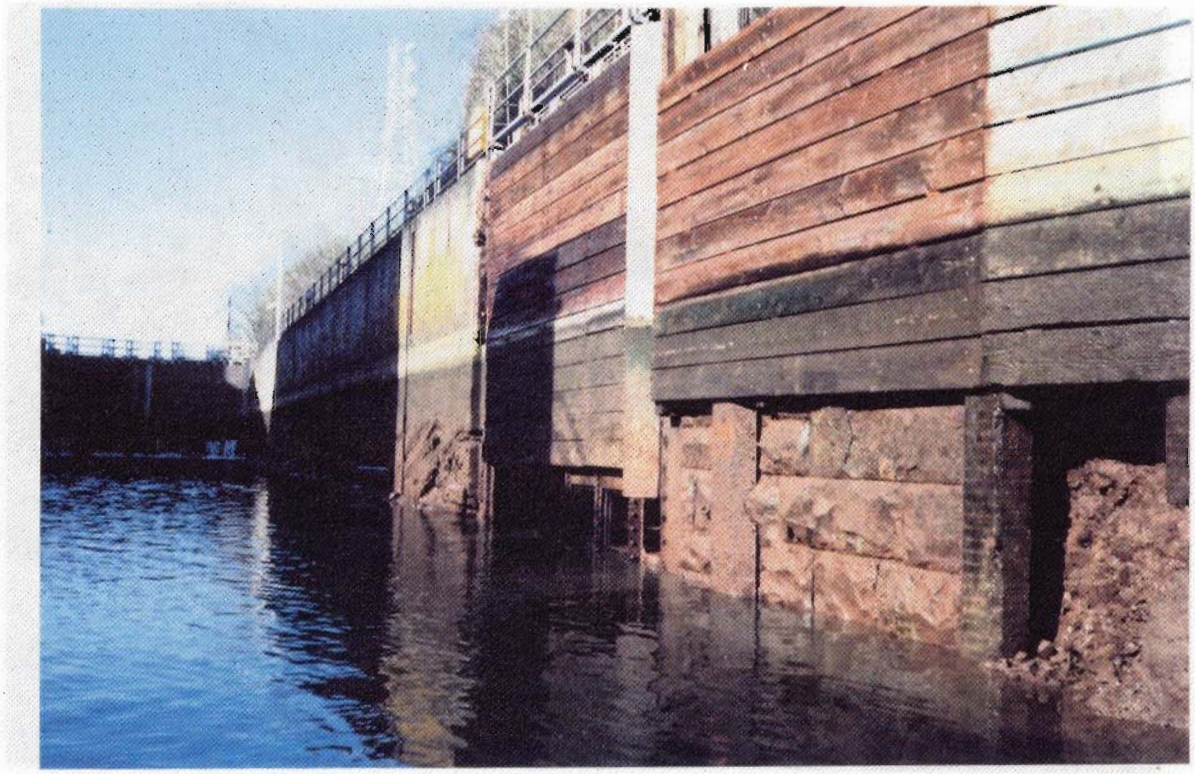
32. Concrete wall on right side of canal at PGE forebay, note former repair areas.



33. Close-up of leaks through concrete wall (left end of above photo).

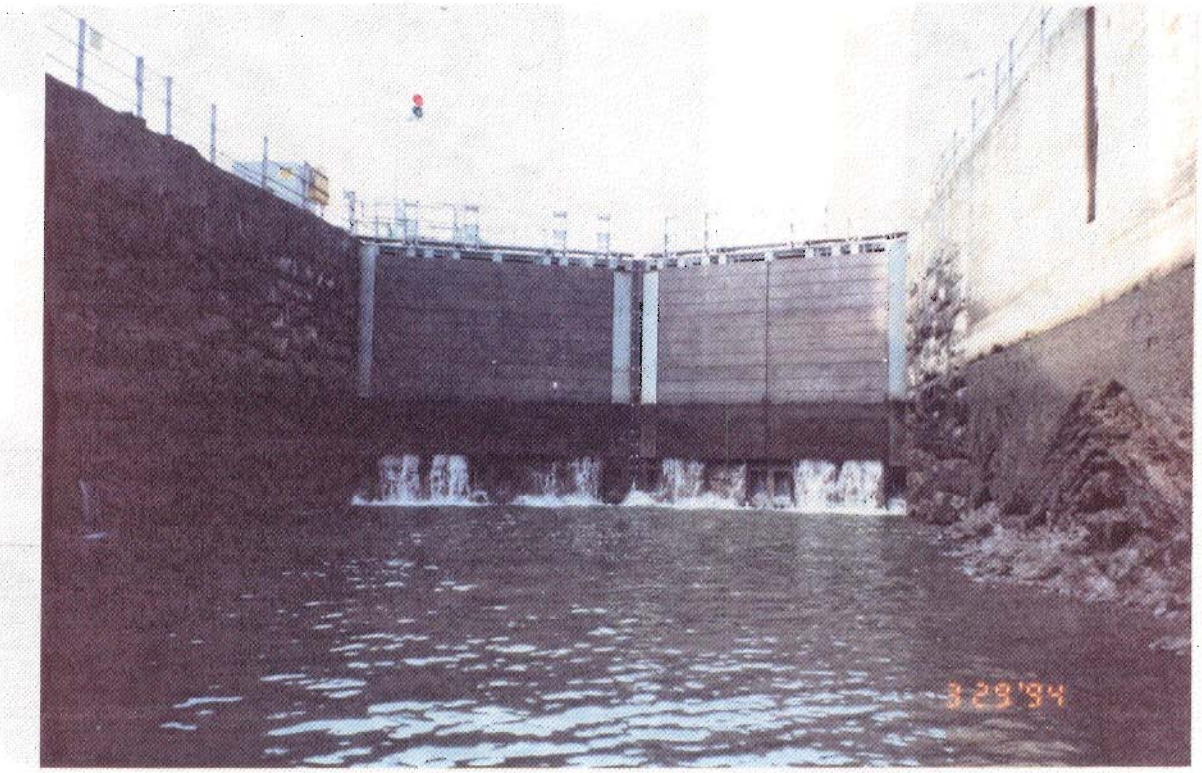


34. Gate 6 and guard lock, right side (note leaks in wall).



35. Gate 6 and guard lock, left side.

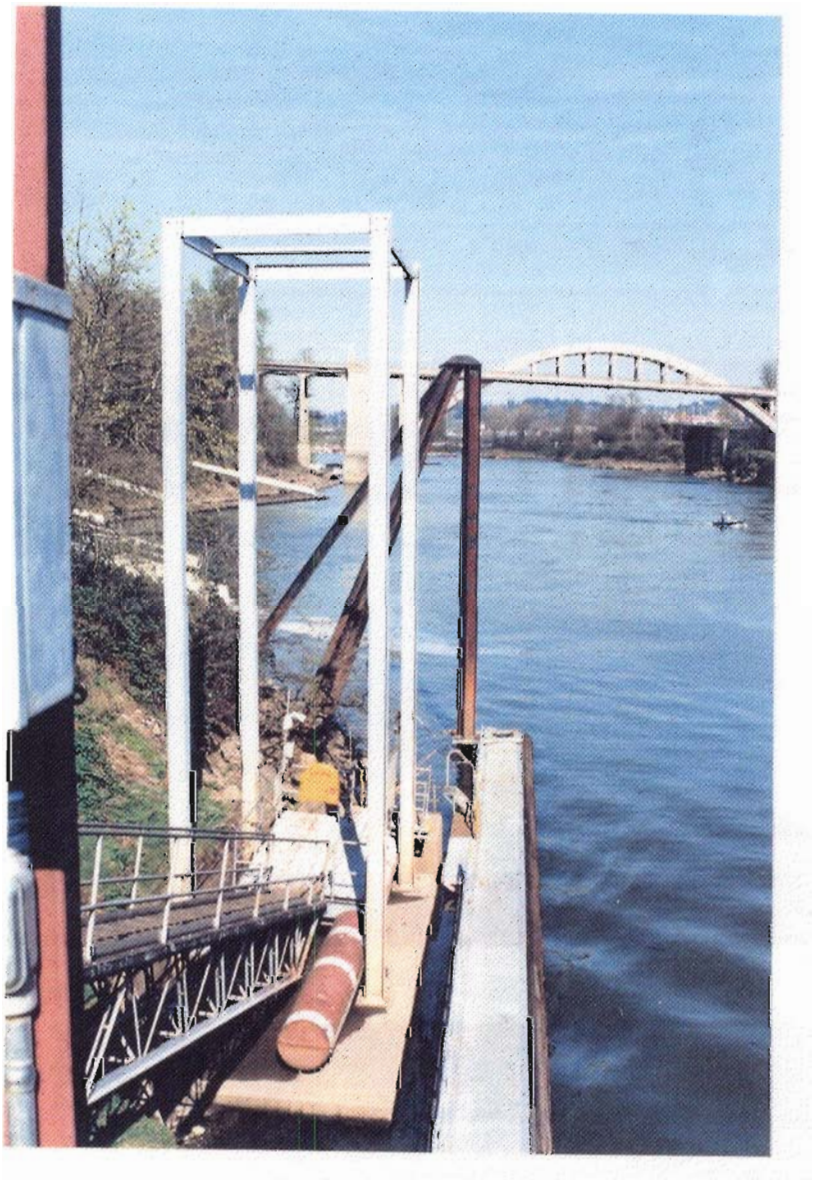
36. Left wall of guard lock, lower part of wall (ripples).



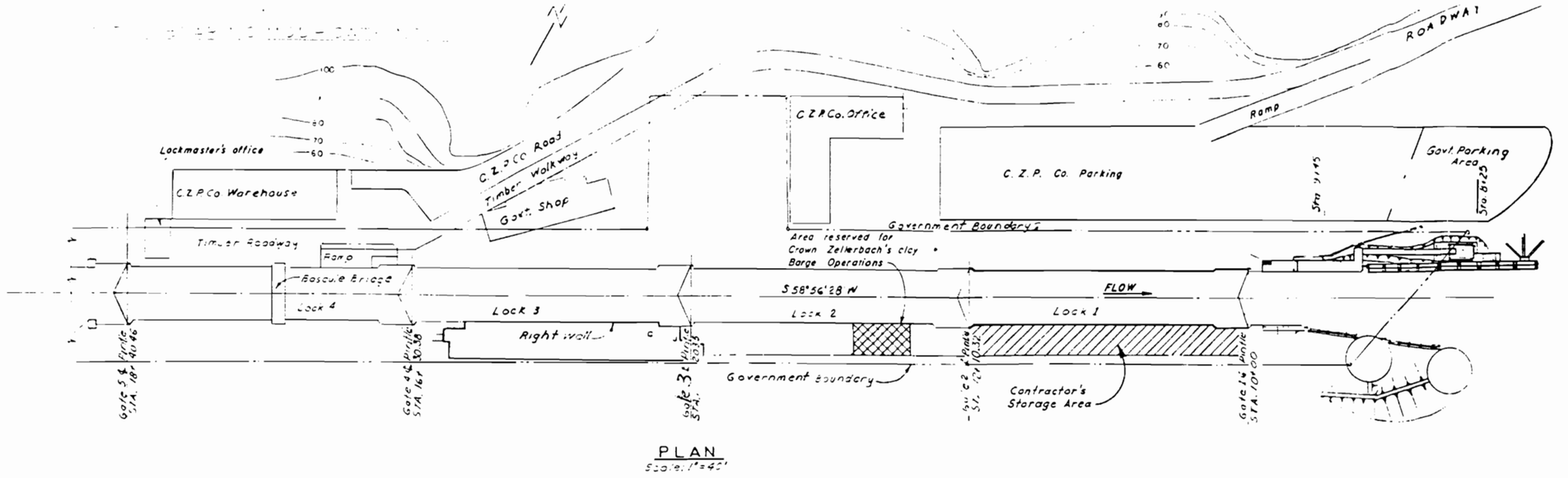
37. Downstream face of gate 7, at upstream end of lock.

38. Upstream guide wall, left side.

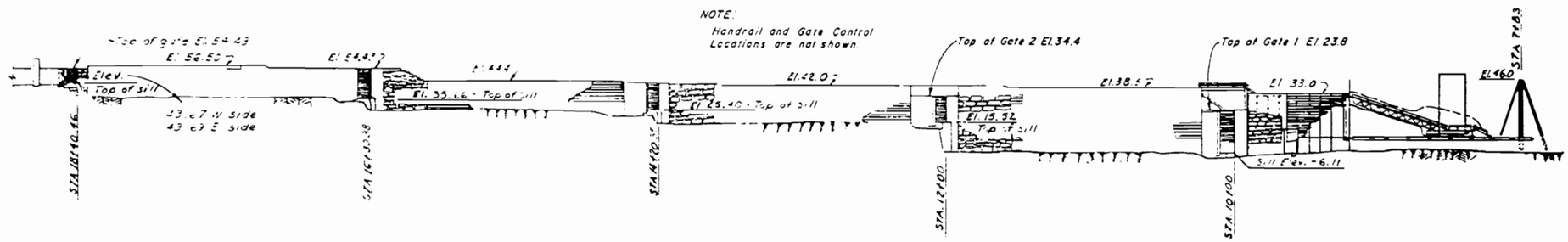
39. Downstream floating dock, upstream base on river side, loose nuts on anchor bolts.



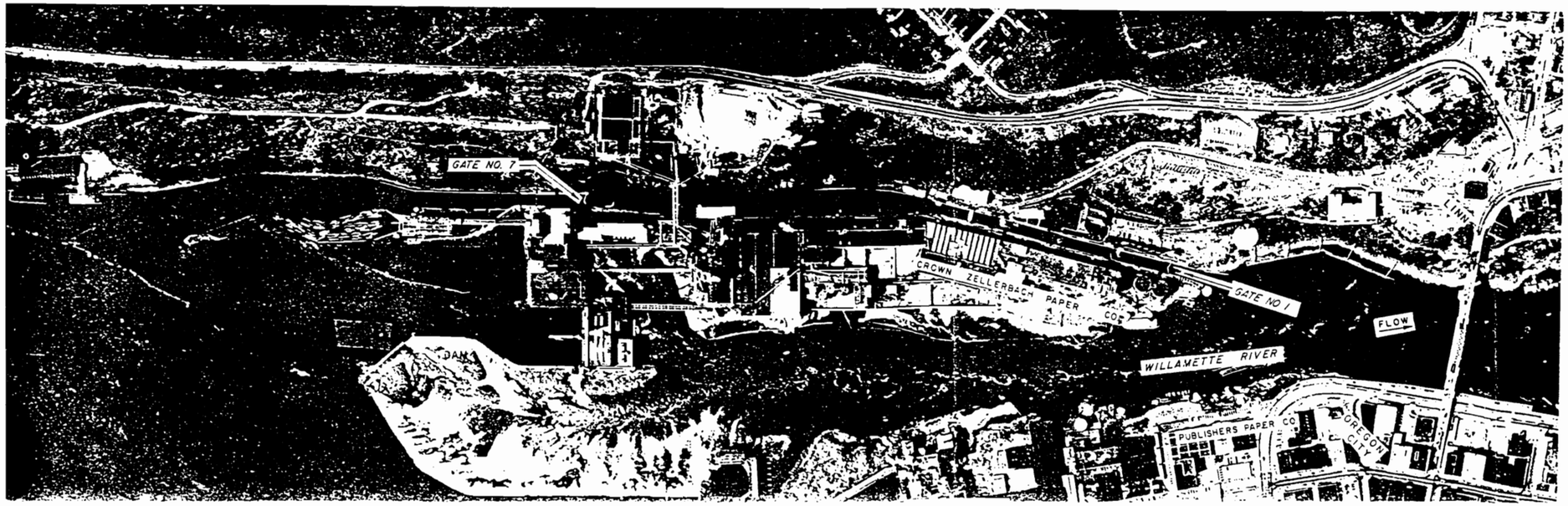
40. View of downstream floating dock.



PLAN
Scale: 1"=40'



ELEVATION
Scale: 1"=40'

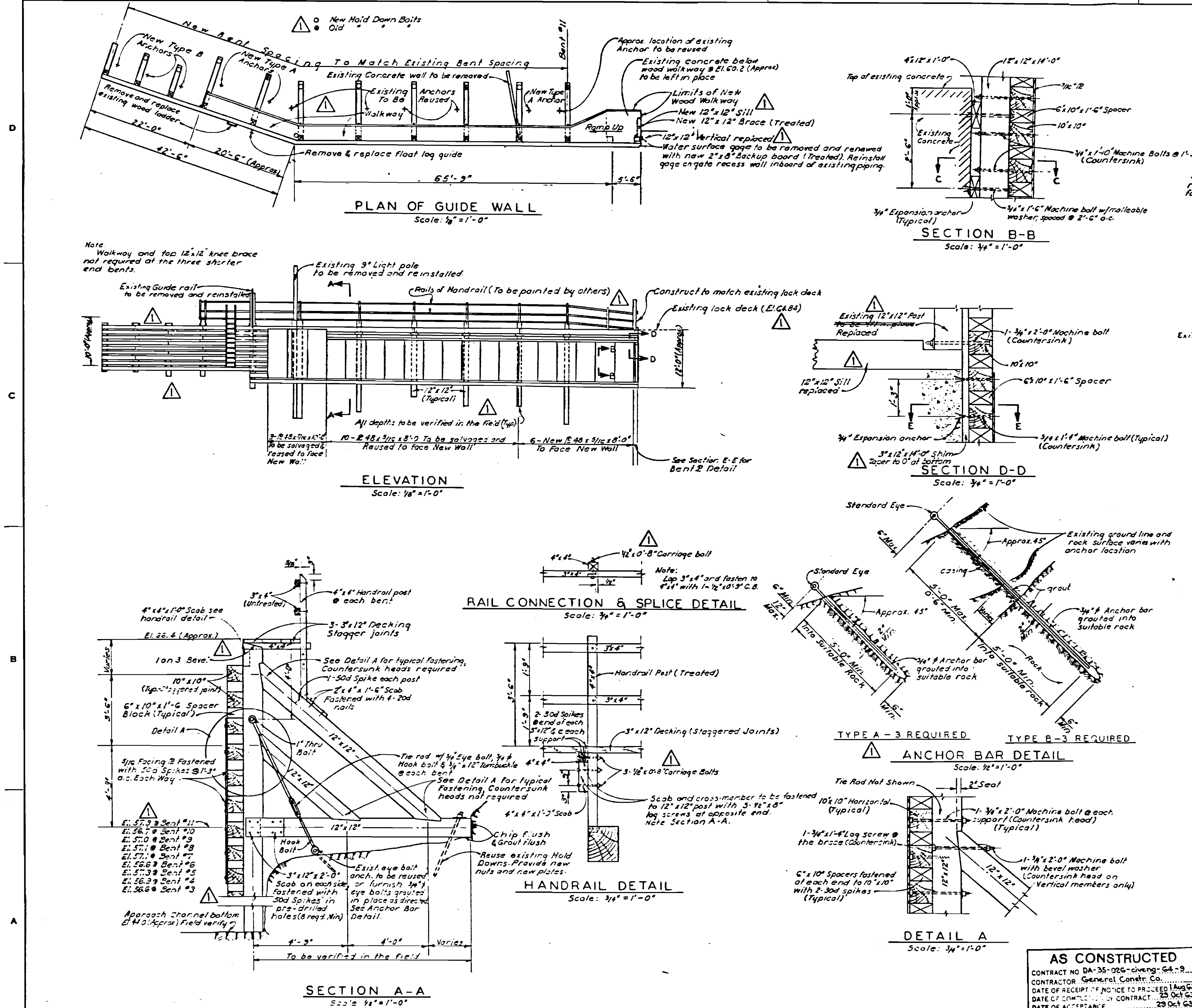


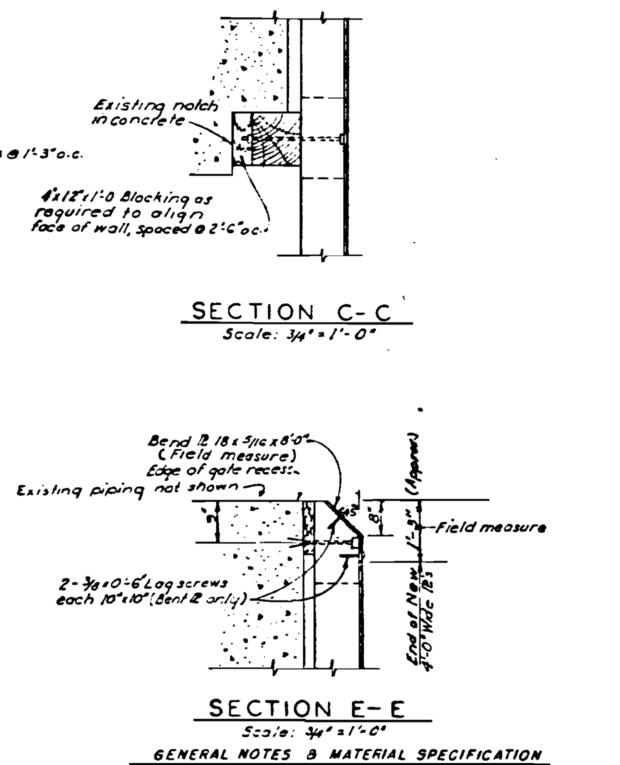
WILLAMETTE FALLS LOCKS

GENERAL PLAN AND ELEVATION
(Chambers 1 - 4)

(excerpted from plans for repair of gates 1 and 7)

PLATE 22





GENERAL NOTES & MATERIAL SPECIFICATION

Dimensions: New installation of timber guide wall shall conform to existing construction unless otherwise designated.

Lumber: All lumber shall conform to "Standard Grading and Dressing Rules No. 15, WCLA."
Par. 125aa Dense Select Structural 12"x 12" Posts and Bracing S4S
Par. 125a Select Structural 10"x10" Logging S4S
Par. 123b Construction, 3"x12" Walkway Planking S1S2E (Rough side up)
Par. 122b. Light Framing 4"x4" & 3"x4" Frame and Handrail S4S
All lumber shall be treated except the 3"x4" rails of handrail.

Lumber Treatment: Coal Tar Creosote - See Specifications.

Structural Steel and Reinforcing Steel: See Specifications.

Steel Bolts, Nuts, Washers & Expansion Anchors:
a. Bolts shall conform to Fed. Specs. FF-B-575b and shall be Type I or Type II, hot-dip zinc coated.
b. Nuts shall conform to Fed Specs. FF-N-836a, Group A-Type I, Group B-Type I-Style I, and hot-dip zinc coated.
c. Expansion anchors shall conform to Fed Specs, Group II, Type I.

Washers: Bolt head and nuts in contact with wood shall have Galv. malleable iron washers.

Nails and spikes: All nails and spikes shall conform to Fed. Specs. FF-S-606, hot-dip zinc coated.

Bolt & Lead Holes: Bolt hole diameter thru wood to be 1/16 inch larger than bolt diameter. Lead holes at end of all planks and blocks shall be approximately 3/4 diameter of nail and spikes.

Concrete & Grout: See Specs. for concrete. Grout shall consist of a mixture of 1 part Portland cement, 2 parts of concrete sand, unpolished aluminum powder in the amount of 3 grams per sack of cement, and sufficient water to produce a mix of flowable consistency. Grout mixed with the aluminum powder additive shall be used within 30 minutes after mixing.

AS CONSTRUCTED		
CONTRACT NO.	DA-35-026-civeng-64-9	
CONTRACTOR	General Constr. Co.	
DATE OF RECEIPT OF NOTICE TO PROCEED	1 Aug 63	
DATE OF COMPLETION OF CONTRACT	25 Oct 63	
DATE OF ACCEPTANCE	29 Oct 63	

Revised As Constructed

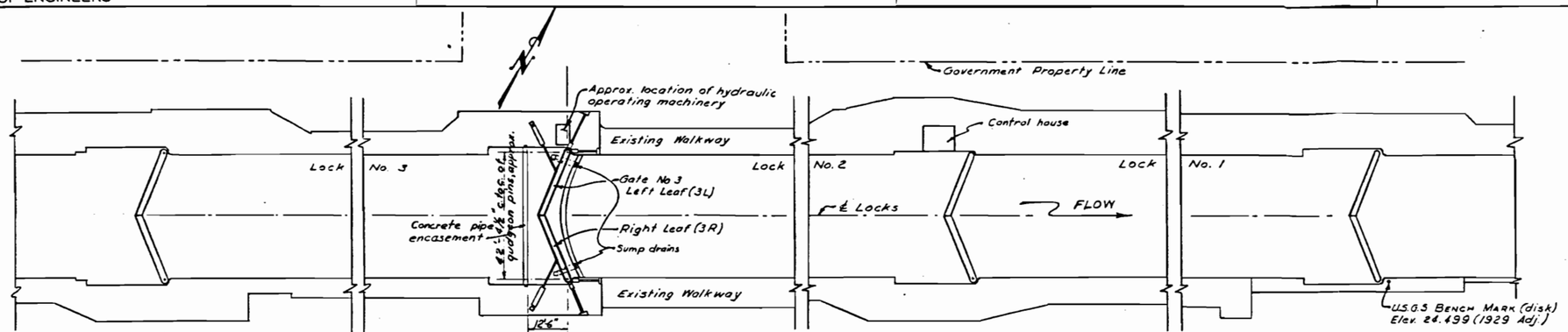
U. S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, PORTLAND, OREGON

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON

UPSTREAM TIMBER GUIDE WALL

Designed: D.A.K. Drawn: M.B. Checked: R.G.
Scale AS SHOWN
UWR-114/94

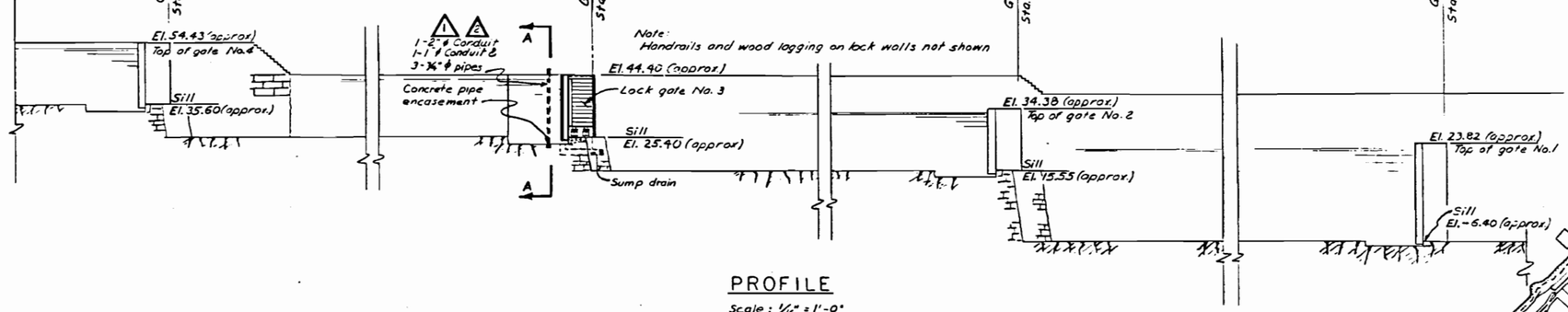
CORPS OF ENGINEERS — U. S. ARMY



GATE NO. 3 REPLACEMENT - LOCK CHAMBER NO. 1, 2 & 3 SHOWN

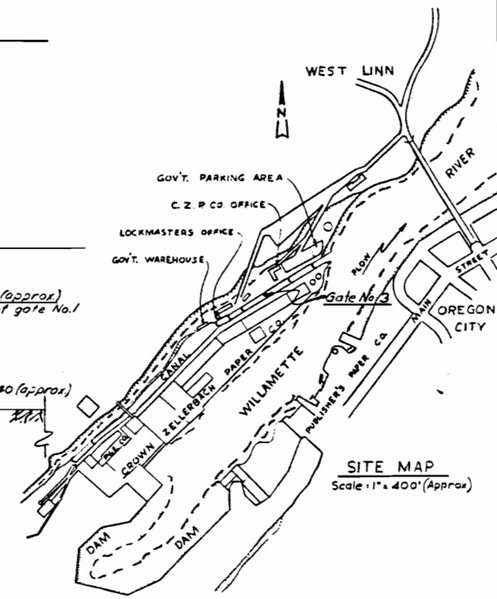
PLAN

Scale 1/16" = 1'-0"



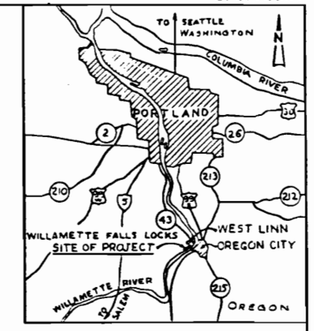
PROFILE

Scale : 1/16" = 1'-0"



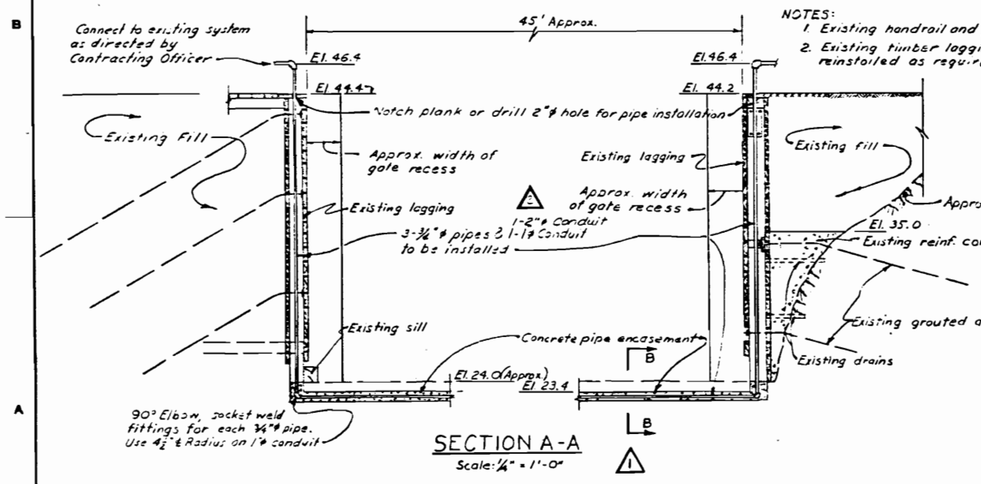
SITE MAP

Scale : 1" = 400' (Approx)



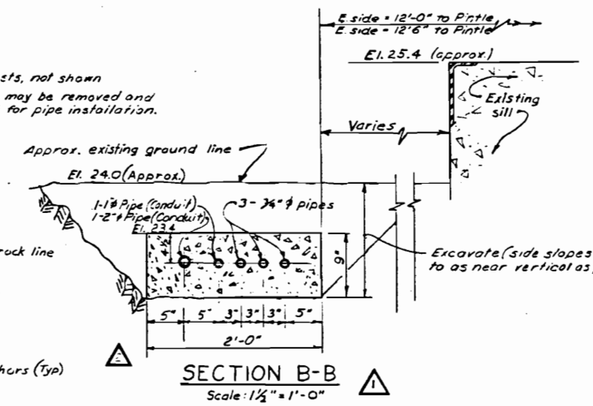
VICINITY MAP

NOTES:
1. Existing handrail and posts, not shown
2. Existing timber logging may be removed and reinstalled as required for pipe installation.



SECTION A-A

Scale: ¼" = 1'-0"



SECTION B-B

Scale: 1½" = 1'-0"

Notes:
1. The contractor shall field verify all existing conditions, dimensions, and elevations as shown See specifications
2. Elevations referred to on this set of drawings are based on M.S.L. Datum, 1929 Adjustment.

Note:
All pipes shall be Extra Strong black iron.
Use socket weld fittings on all pipes excepting at bends on conduits.

AS CONSTRUCTED
CONTRACT NO. DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 27 Sept 67
DATE OF BEGINNING OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
C	13 Aug 68	Revised As Constructed	
B	25 Aug 67	Added 1" ϕ Conduit & Note	

U. S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, PORTLAND, OREGON

DESIGNED: HC
DRAWN: HC
CHECKED: DPS
PREPARED: W. Douglas
SUPERVISED:
SUBMITTED:
RECOMMENDED:
APPROVED: DATE 2 Aug 67
SCALE AS SHOWN
SPEC. NO.

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
GENERAL PLAN AND MISCELLANEOUS PIPING DETAILS

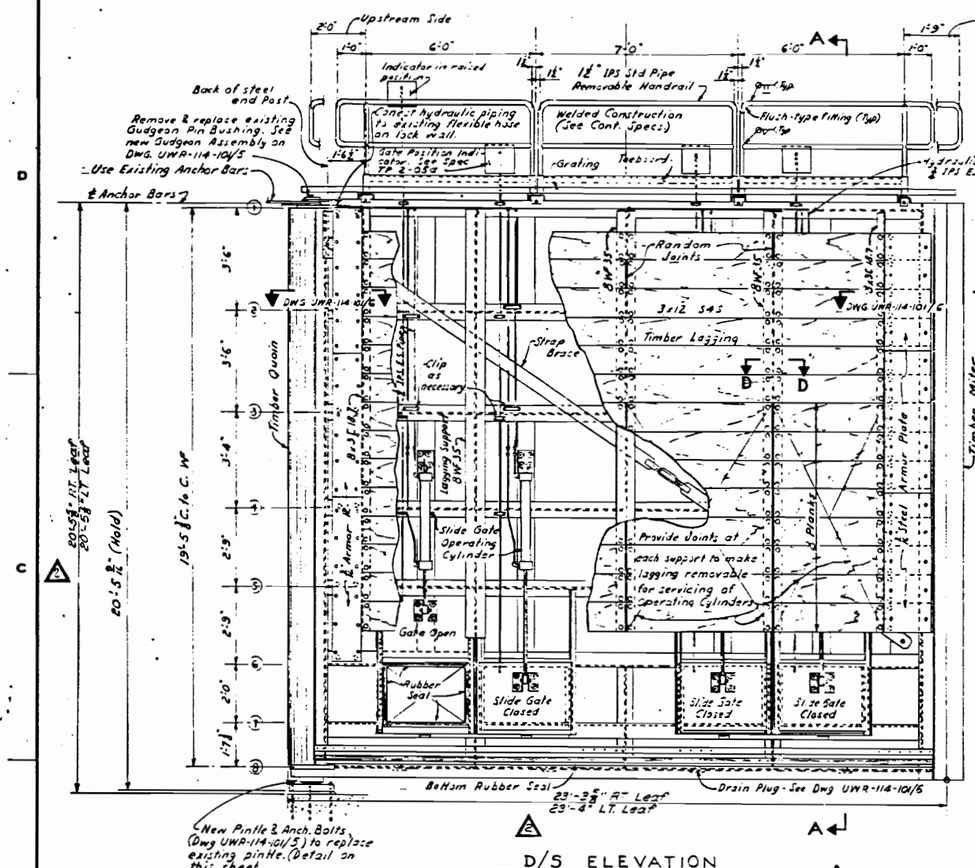
SHEET 1 OF 6
UWR-114-101/1

MISCELLANEOUS PIPING

PLATE 24

CORPS OF ENGINEERS

U. S. ARMY



D/S ELEVATION

Item (1) GATE #3 : Leaf 3R as shown & noted. Leaf 3L opposite hand.

Scale 1/2" = 1'-0"

SECTION A-A

Scale 1/2" = 1'-0"

SECTION B-B

Scale 1 1/2" = 1'-0"

DETAIL A

Scale 6" = 1'-0"

SECTION C-C

Scale 6" = 1'-0"

GENERAL NOTES

1. VERIFY DIMENSIONS TO EXISTING STRUCTURES WHERE NOTED, BY ACTUAL FIELD MEASUREMENT BEFORE FABRICATING TIMBER MITER POSTS.

2. SUITABLE EQUIVALENT DETAILS, MEMBERS, AND MATERIALS MAY BE SUBSTITUTED FOR THOSE SHOWN, IF APPROVED BY CONTRACTING OFFICER; PROVIDED, THERE SHALL BE NO INCREASE IN CONTRACT PRICE.

3. PARTS OF EXISTING CONSTRUCTION, WHERE NOTED, ARE INTENDED TO BE RE-USED IN THE NEW CONSTRUCTION. CONFIRM SERVICEABLE CONDITION OF THOSE PARTS.

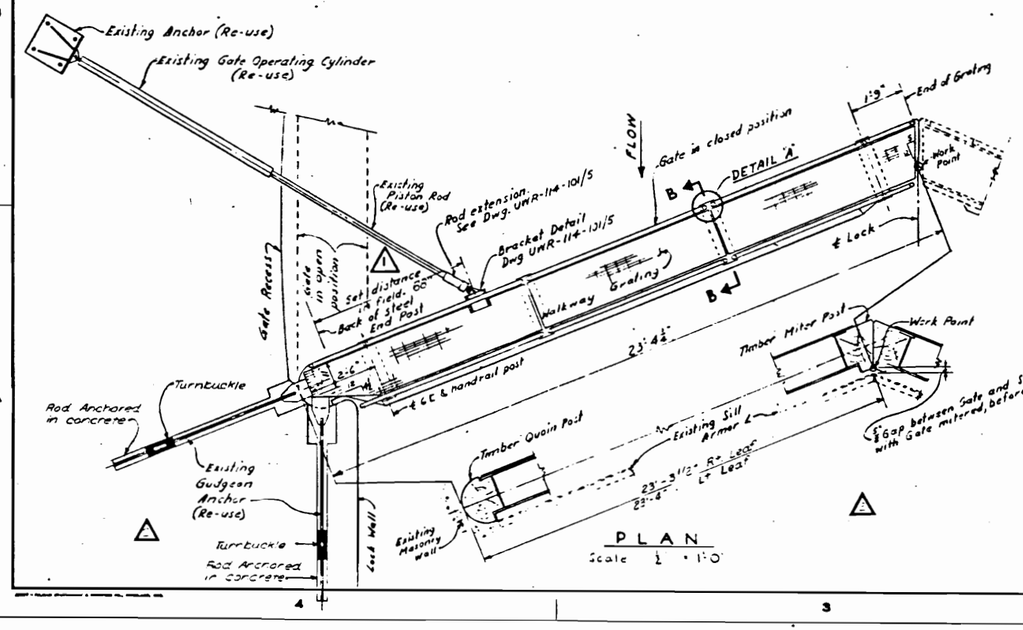
4. MATERIAL SPECIFICATIONS, UNLESS OTHER NOTED.
   (a) STRUCTURAL STEEL, ASTM A36-62T.
   (b) TIMBER POSTS, WEST COAST LUMBERMANS ASSOCIATION GRADING AND DRESSING RULES NO. 15, PARA. 125-aa, DENSE SELECT STRUCTURAL; TIMBER LAGGING, PARA. 125-a, SELECT STRUCTURAL.
   (c) BOLTS, ASTM A307-63T GRADE B, UNLESS OTHER NOTED.
   (d) HIGH STRENGTH (H.S.) BOLTS, ASTM A325-63T.
   (e) CORROSION RESISTING STEEL (CRES) BOLTS, AISI 410 OR 416.
   (f) FORGINGS, ASTM A235-63T CLASS C1.
   (g) HYDRAULIC PIPING, BLACK STEEL PIPE, PICKLED, WITH SOCKET-WELDED FITTINGS. (SEE CONTRACT SPECS.)
   (h) WELD STUDS, ASTM A108-61T GRADE 1017 - 1020 OR AISI C1020; GRANULAR FLUX FILLED, FULL PENETRATION AUTOMATIC BUTT WELDED.
   (i) OTHER MATERIALS AS NOTED ON DRAWINGS AND IN CONTRACT SPECS.

5. PAINT HANDRAIL, WALKWAY FRAMING, AND HYDRAULIC PIPING AND CYLINDERS, SYSTEM 1. NO PAINT ON CYLINDER PISTON RODS. PAINT OTHER METAL SURFACES, SYSTEM 2, EXCEPT, NO PAINT ON CORROSION RESISTING, FINISHED BEARING, AND GALVANIZED SURFACES. SEE CONTRACT SPECS. FOR SYSTEMS AND PAINTING DETAILS.

6. WELDING
   BASIC WELDING SPECIFICATIONS, AWS D2.0-66 AND ADDENDA, INCLUDING ACCEPTABLENESS, QUALITY, CORRECTION OF DEFECTS, AND RADIOGRAPHING OF WELDS. (SEE ALSO CONTRACT SPECS.) SUBMIT PROCEDURES FOR WELDS AND PROCESSES NOT PREQUALIFIED BY AWS SPEC. D2.0-66. ELECTRODES EXX12 & 13 NOT ACCEPTABLE FOR THIS CONTRACT. RADIOGRAPH WELDS FULL LENGTH, WHERE RADIOGRAPHING NOTED OR SPECIFIED.

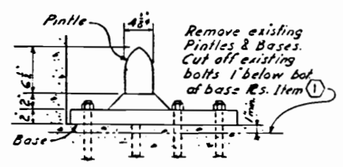
7. ADJUST STRAP BRACE AFTER GATE LEAF COMPLETE IN PLACE. CUT LAGGING IN WAY OF SLEEVE NUT UNTIL STRAP ADJUSTED.

8. INSTALL LIFTING EYES ON TOP OF LEAF FOR SAFE HOISTING WITHOUT DAMAGING PAINT OR STRUCTURE.

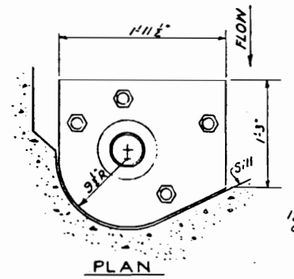


PLAN

Scale 1/2" = 1'-0"



ELEVATION

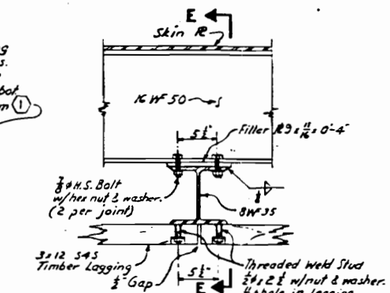


PLAN

EXISTING PINTLE

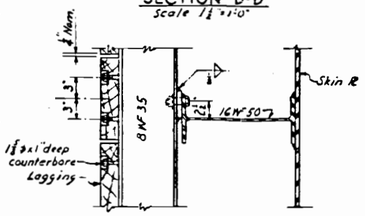
East one shown. West one opp. hand.

Scale 1 1/2" = 1'-0"



SECTION D-D

Scale 1 1/2" = 1'-0"



SECTION E-E

Scale 1 1/2" = 1'-0"

Reqd: One Gate complete in place, including pintles, Slide Gates complete with hydraulic cylinders and piping, lagging and supports, walkways and railings, and specified modifications of existing features; Gate No. 3, Item (1).

N.T.S. = Not to Scale.

AS CONSTRUCTED

CONTRACT NO DA-WC-57-68-C-0032

CONTRACTOR Halvorson-Mason

DATE OF RECEIPT OF NOTICE TO PROCEED 29 Sept 67

DATE OF COMPLETION OF CONTRACT 20 June 69

DATE OF ACCEPTANCE 20 June 69

REVISION	DATE	DESCRIPTION	BY
2	8 Aug 68	Revised As Constructed	TPd
1	25 Aug 67	Changed beam spacing (1)-2. Deleted dimension to bracket.	TPd

U. S. ARMY ENGINEER DISTRICT, PORTLAND

DESIGNED: D.P.S.

DRAWN:

CHECKED: N.E.D.

PREPARED:

SUPERVISED:

SUBMITTED:

RECOMMENDED:

APPROVED: DATE: 5 Aug 67

COL., C.E., DISTRICT ENGINEER

WILLAMETTE FALLS LOCKS

WILLAMETTE RIVER NEAR WEST LINN, OREGON

LOCK GATE 3 REPLACEMENT

GATE LEAF ARRANGEMENT

SCALE AS SHOWN SPEC. NO.

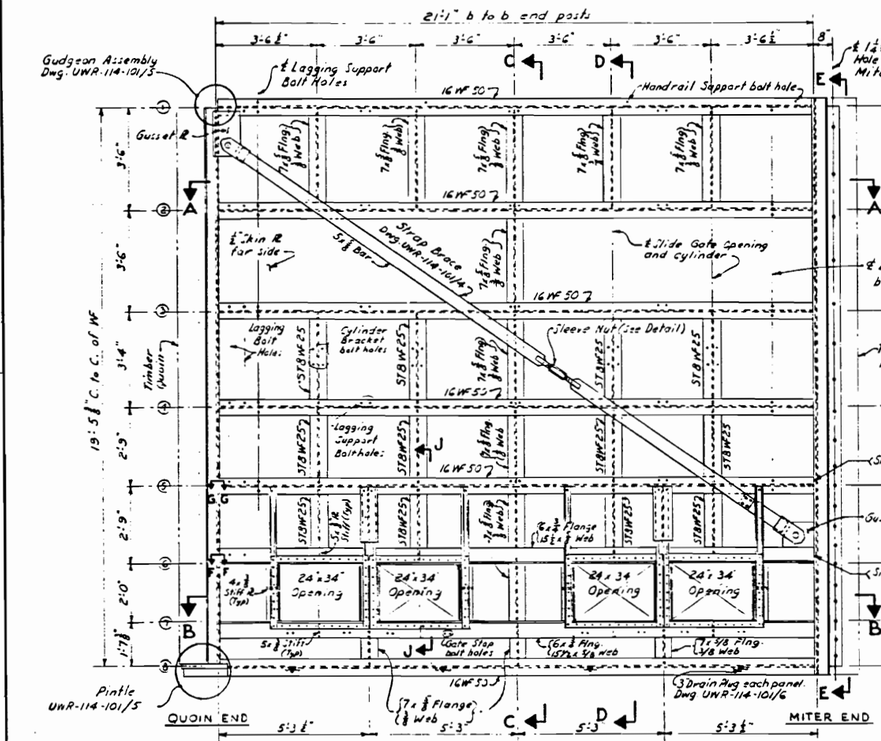
UWR-114-101/2

SHEET 2 OF 6

MICROFILMED 10 Sep 19__

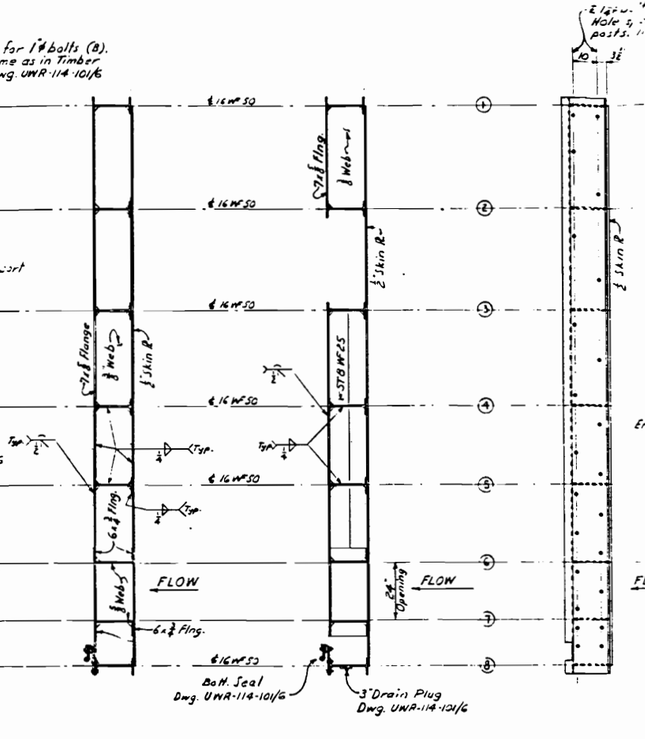
PLATE 25

CORPS OF ENGINEERS — U. S. ARMY



D/S ELEVATION ⚠

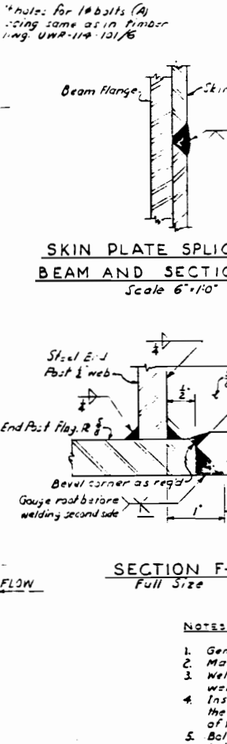
Logging Supports not shown; bottom seal not shown.



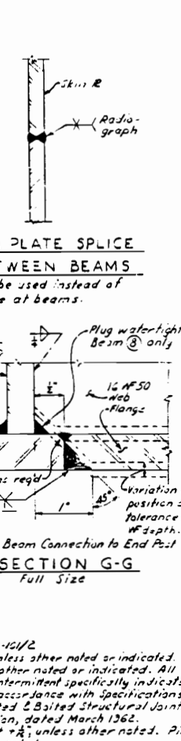
SECTION C-C

SECTION D-D
Scale ½" = 1'-0"

VIEW E-E
Miter End Shown.
Quoin End similar to, but opp. hand



SKIN PLATE SPLICE AT BEAM AND SECTION H-H
Scale 6"=1'-0"



SKIN PLATE SPLICE BETWEEN BEAMS
May be used instead of splice at beams.

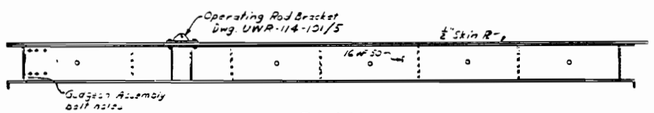
SECTION F-F
Full Size

*Typ. Beam Connection to End Post

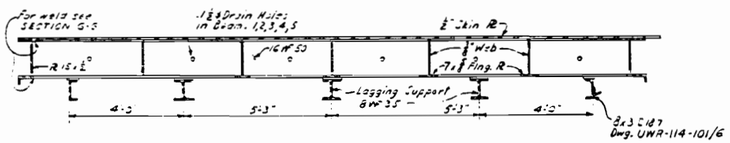
SECTION G-G
Full Size

NOTES:

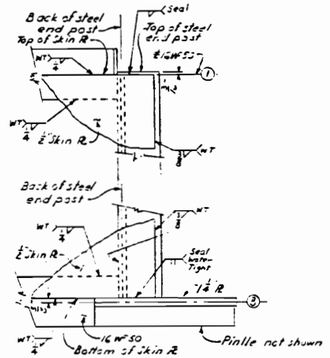
1. General Notes, Dwg. UWR-114-101/2.
2. Material, Structural Steel, unless other noted or indicated.
3. Welded Construction unless otherwise noted or indicated. All welding continuous unless intermittent specifically indicated.
4. Install ASTM A325 Bolts in accordance with Specifications of the Research Council on Riveted & Bolted Structural Joints of the Engineering Foundation, dated March 1962.
5. Bolt Holes, nom. dia. of bolt + ⅛", unless other noted. Pin holes ¼" oversize, except as noted.
6. Drain Holes drilled or neat-burned circular ⅜ to size.
7. Skin R and seal mountings watertight.
8. Maintain Leaf Structure to dimensions, square and in plane. Steel End Posts (Quoin & Miter) must be parallel and straight. Hold Slide Gate openings square, to dimension and correctly spaced. Install Slides & Seal Mountings parallel to sides of opening and in plane.
9. Fabricate assembly comprising beams ⑥ & ⑦ as a unit; downstream flanges of assembly must lie in a common plane.



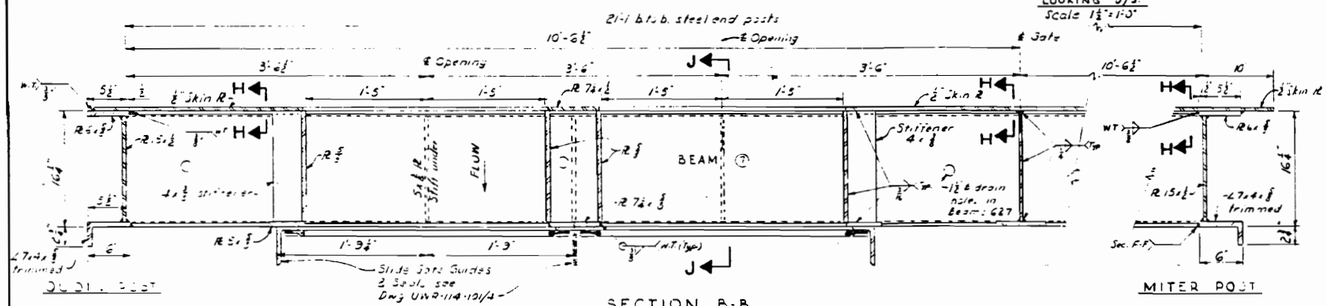
PLAN



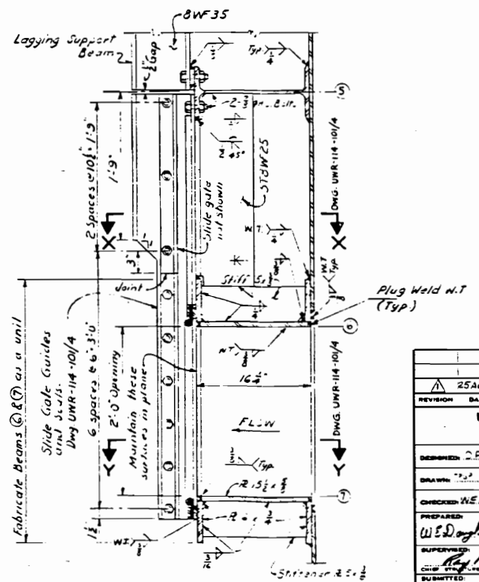
SECTION A-A
Scale ½" = 1'-0"



SKIN R DETAILS AT QUOIN POST
LOOKING D/S
Scale 1½" = 1'-0"



SECTION B-B
Scale 1½" = 1'-0"



SECTION J-J
Scale 1½" = 1'-0"

AS CONSTRUCTED
CONTRACT NO. DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 25 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
⚠	25 Aug 67	Revised dimension to bracket, changed spacing of BM ① - ②	

U. S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, PORTLAND, OREGON

DESIGNED: D.P.S.
DRAWN: "D.P."
CHECKED: W.E.D.
PREPARED: W.E.D.

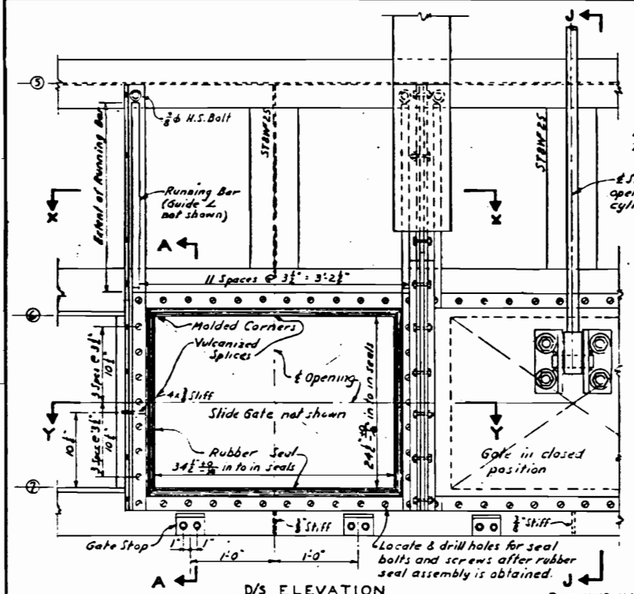
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
GATE LEAF FRAMING

SUPERVISED: Roy P. Williams, CHIEF, STRUCTURAL SECTION
SUBMITTED: CHIEF, DESIGN BRANCH
RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: [illegible], COL., C. E., DISTRICT ENGINEER
DATE: Aug 67
SCALE AS SHOWN
SPEC. NO.
SHEET 3 OF 6
UWR-114-101/3

MICROFILMED

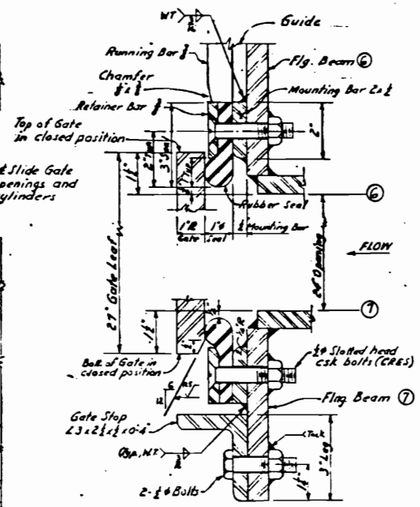
PLATE 26

CORPS OF ENGINEERS — U. S. ARMY

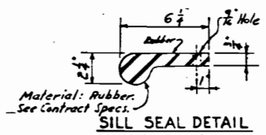


D/S ELEVATION
SLIDE GATES
Scale 1½"=1'-0"

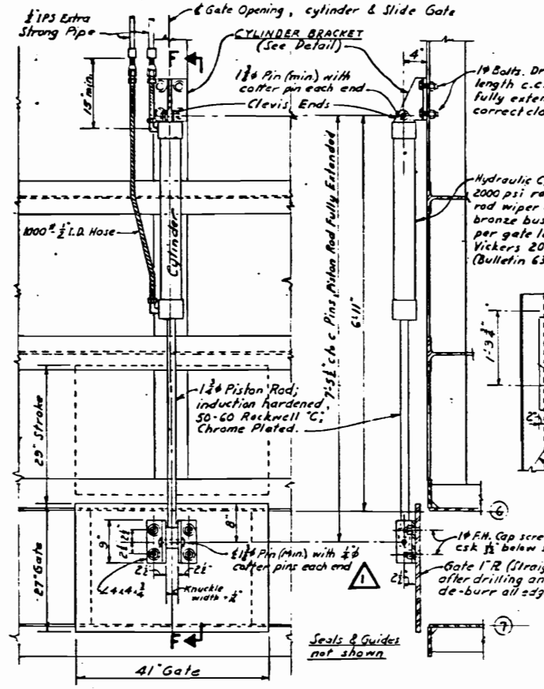
Dwg. UWR-114-101/3



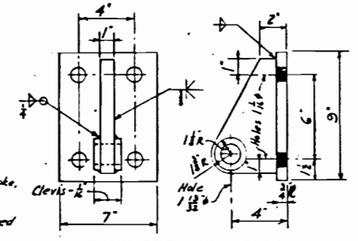
SECTION A-A
Scale 6"=1'-0"



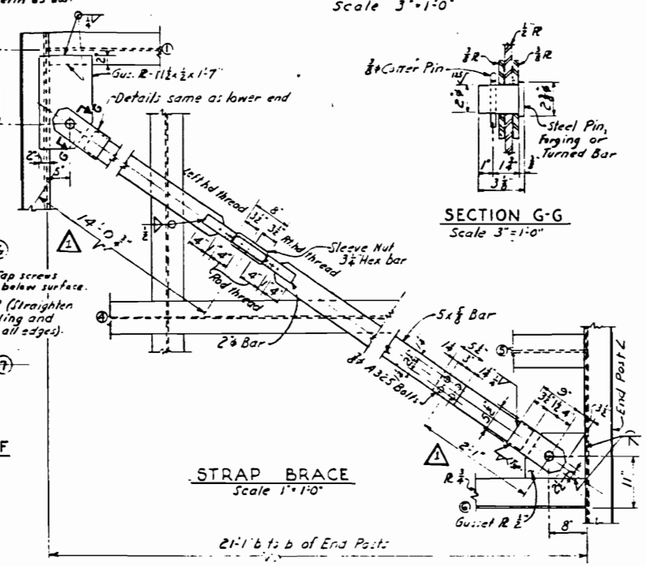
SILL SEAL DETAIL
Scale 3"=1'-0"



ELEVATION — SECTION F-F
OPERATING CYLINDER
Scale 1½"=1'-0"

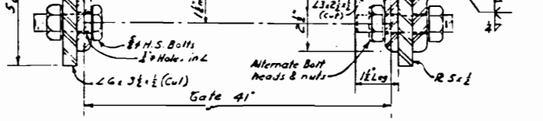


CYLINDER BRACKET
Scale 3"=1'-0"

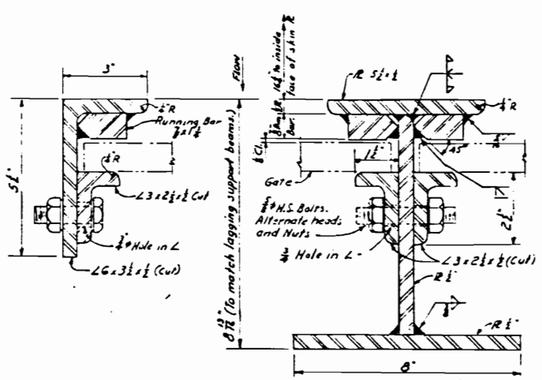


STRAP BRACE
Scale 1"=1'-0"

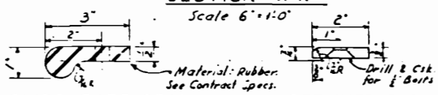
SECTION G-G
Scale 3"=1'-0"



SECTION Y-Y
Scale 6"=1'-0"

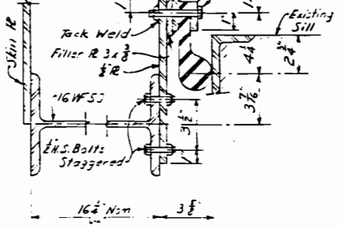


SECTION X-X
Scale 6"=1'-0"

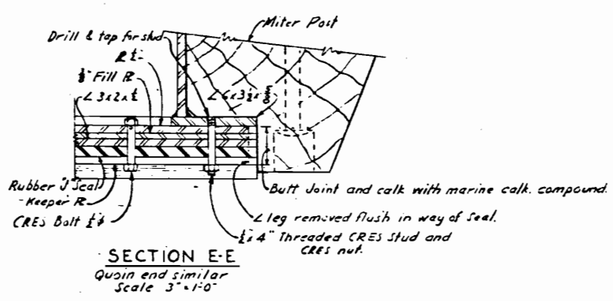


SLIDE GATE SEAL
Scale 6"=1'-0"

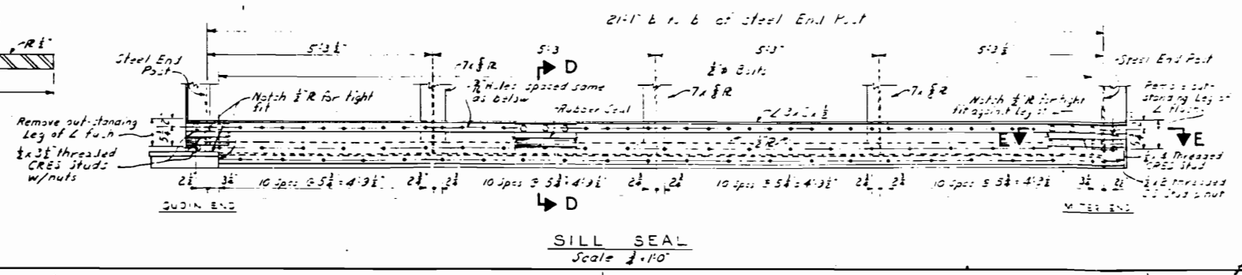
RETAINER BAR
Scale 6"=1'-0"



SILL SEAL
SECTION D-D
Scale 3"=1'-0"



SECTION E-E
Quoin end similar
Scale 3"=1'-0"



SILL SEAL
Scale ½"=1'-0"

NOTES:

1. Provide Indicating Device for Slide Gates. See Specs..
2. ⚠ The Slide Gates shall be checked, in closed position, to assure that the Seal is in full contact with Gate Leaf. If any section of Seal is not in contact, adjustments shall be made until seal is in full contact around perifery of Gate Leaf. Care should be taken so that the Seal is not compressed more than necessary.

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 25 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
⚠	25 Aug 67	Added Note. Added Cotter Pin size.	

U. S. ARMY ENGINEER DISTRICT, PORTLAND

DESIGNED - D.P.S.
DRAWN - [illegible]
CHECKED W.E.G.
PREPARED W.E.Douglas
SUPERVISED Roy R. Mathews
SUBMITTED
RECOMMENDED
APPROVED
DATE 1 Aug 67

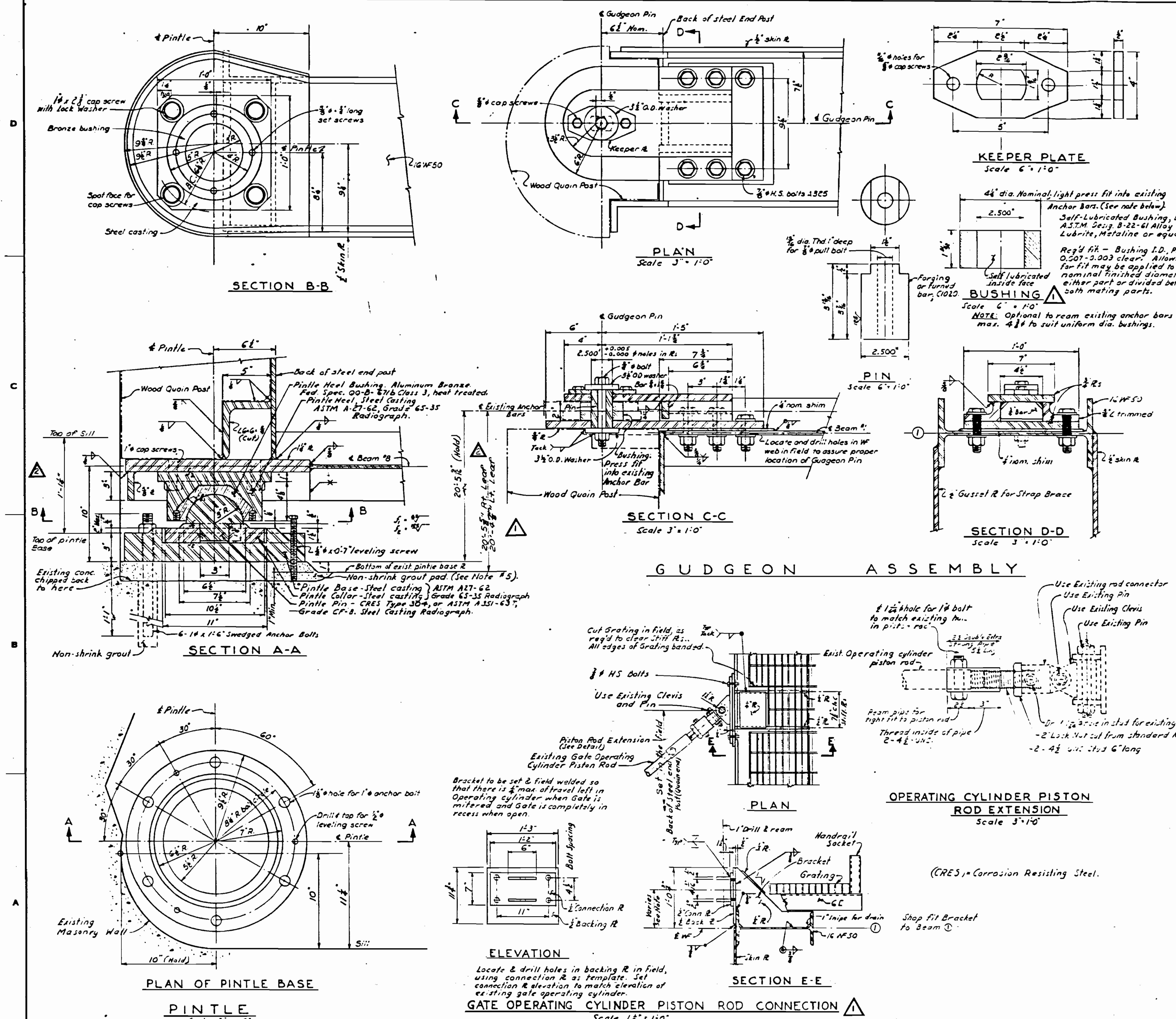
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
SLIDE GATES, SILL SEAL, AND MISCELLANEOUS DETAILS

SCALE AS SHOWN — SPEC. NO.
UWR-114-101/4
SHEET 4 OF 6

MICROFILMED 10

PLATE 27

CORPS OF ENGINEERS | U. S. ARMY



NOTES

1. GENERAL NOTES, DWG. UWR-114-101/2.
2. MATERIAL, STRUCTURAL STEEL, UNLESS OTHER NOTED OR INDICATED.
3. STEEL CASTINGS, ASTM A27-63T GRADE AS NOTED.
4. RADIOGRAPH STEEL CASTINGS ACCORDING TO ASTM E71-52 CLASS 4 SERVICE.
5. ACCURATELY SET PINTLE BASE AND ANCHOR BOLTS IN 1:1 CEMENT-SAND HIGH-EARLY-STRENGTH GROUT. (SEE CONTRACT SPECS.) LEVEL AND SECURE BASE AFTER ANCHOR BOLT GROUT ATTAINS SPECIFIED SET. RELEASE LEVELING SCREWS 2 TURNS AFTER BASE GROUT HAS SET.
6. LOCATE AND DRILL FOR GUDGEON CONNECTION ON GATE LEAF WITH LEAF IN CLOSED POSITION AND MITER POST VERTICAL. MAKE NOMINAL FINAL ADJUSTMENTS AFTER GATE IS INSTALLED, BY ADJUSTING ANCHOR BARS. MITER POST WILL NOT BE VERTICAL WITH GATE IN OPEN POSITION.

AS CONSTRUCTED
CONTRACT NO. DA-WC-57-68-C-0032
CONTRACTOR Halverson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 25 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION
2	6 Aug. 68	Revised As Constructed
1	25 Aug. 67	Revised Rod Extension detail. Revised Connection and dimensions. Revised Bushing & added to Note 6.

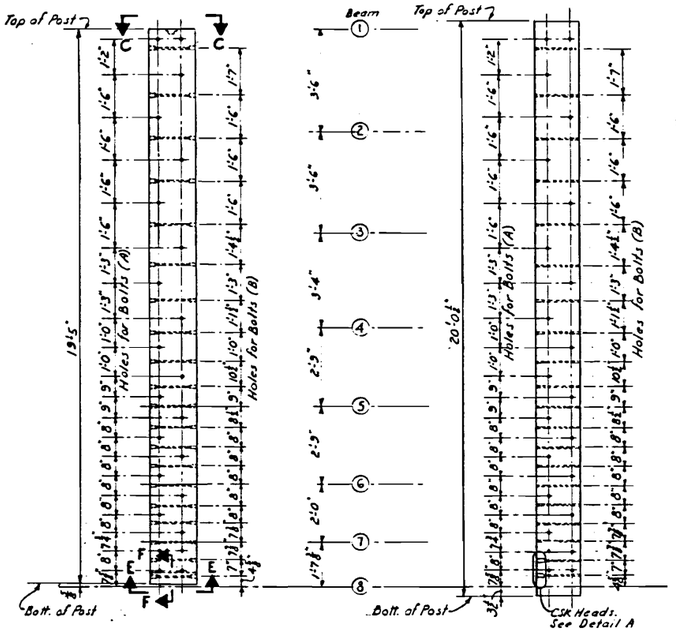
U. S. ARMY ENGINEER DISTRICT, PORTLAND

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
PINTLES, GUDGEON, OPERATING ROD EXTENSION & MISCELLANEOUS DETAILS

DESIGNED: C.P.S.
DRAWN: I.P.G.P.
CHECKED: W.E.D.
PREPARED: W.E. Dough
SCALE AS SHOWN
UWR-114-101/5
SHEET 5 OF 6

MICR

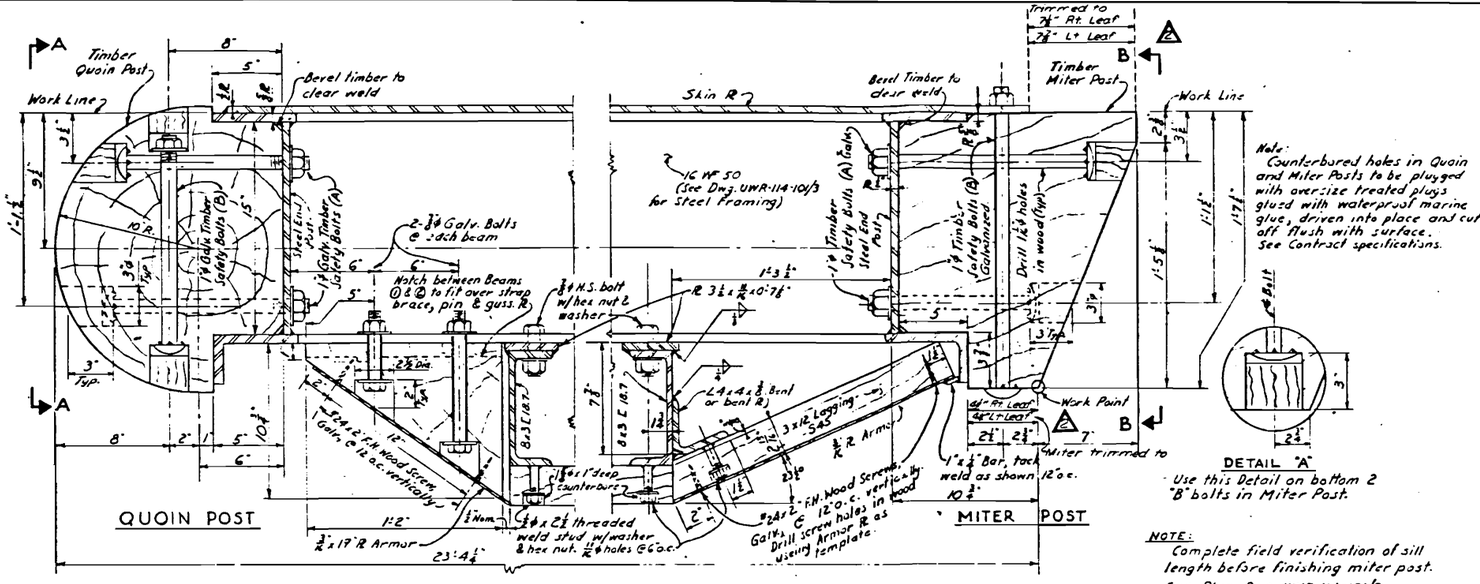
PLATE 28



ELEVATION A-A TIMBER QUOIN ⚠1

ELEVATION B-B TIMBER MITER ⚠1

Scale 1/2" = 1'-0"



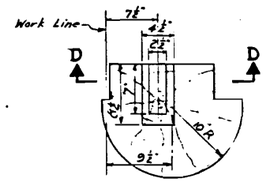
QUOIN & MITER DETAILS
Scale 3" = 1'-0"

NOTE:
Complete field verification of sill length before finishing miter post. See Plan Dwg UWR-114-101/2.

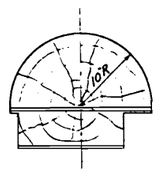
NOTES

1. GENERAL NOTES - DWG UWR-114-101/2.

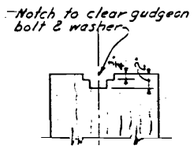
⚠1 2. Plug Bolt holes (A) in Miter Post, in field after gate has been adjusted and Miter Post trimmed. Brush plugs with hot Coal Tar Creosote. (See Specs.)



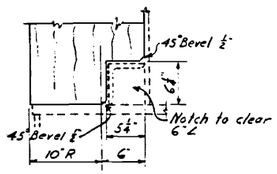
PLAN C-C
Scale 1 1/2" = 1'-0"



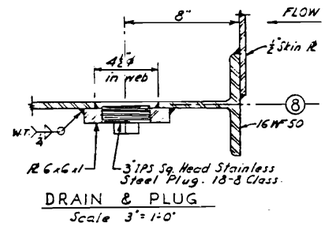
VIEW E-E
Scale 1 1/2" = 1'-0"



SECTON D-D
Scale 1 1/2" = 1'-0"



SECTION F-F
Scale 1 1/2" = 1'-0"



DRAIN & PLUG
Scale 3" = 1'-0"

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 29 Sept 67
DATE OF COMPLETION OF CONTRACT 20 JUNE 68
DATE OF ACCEPTANCE 20 JUNE 68

REVISION	DATE	DESCRIPTION	BY
⚠2	6 Aug 68	Revised As Constructed	
⚠1	15 Aug 67	Added Note 2. Revised Dim. on Miter & Quoin Posts.	

U. S. ARMY ENGINEER DISTRICT, PORTLAND

DESIGNED D.P.S.
DRAWN
CHECKED W.E.Q.
PREPARED

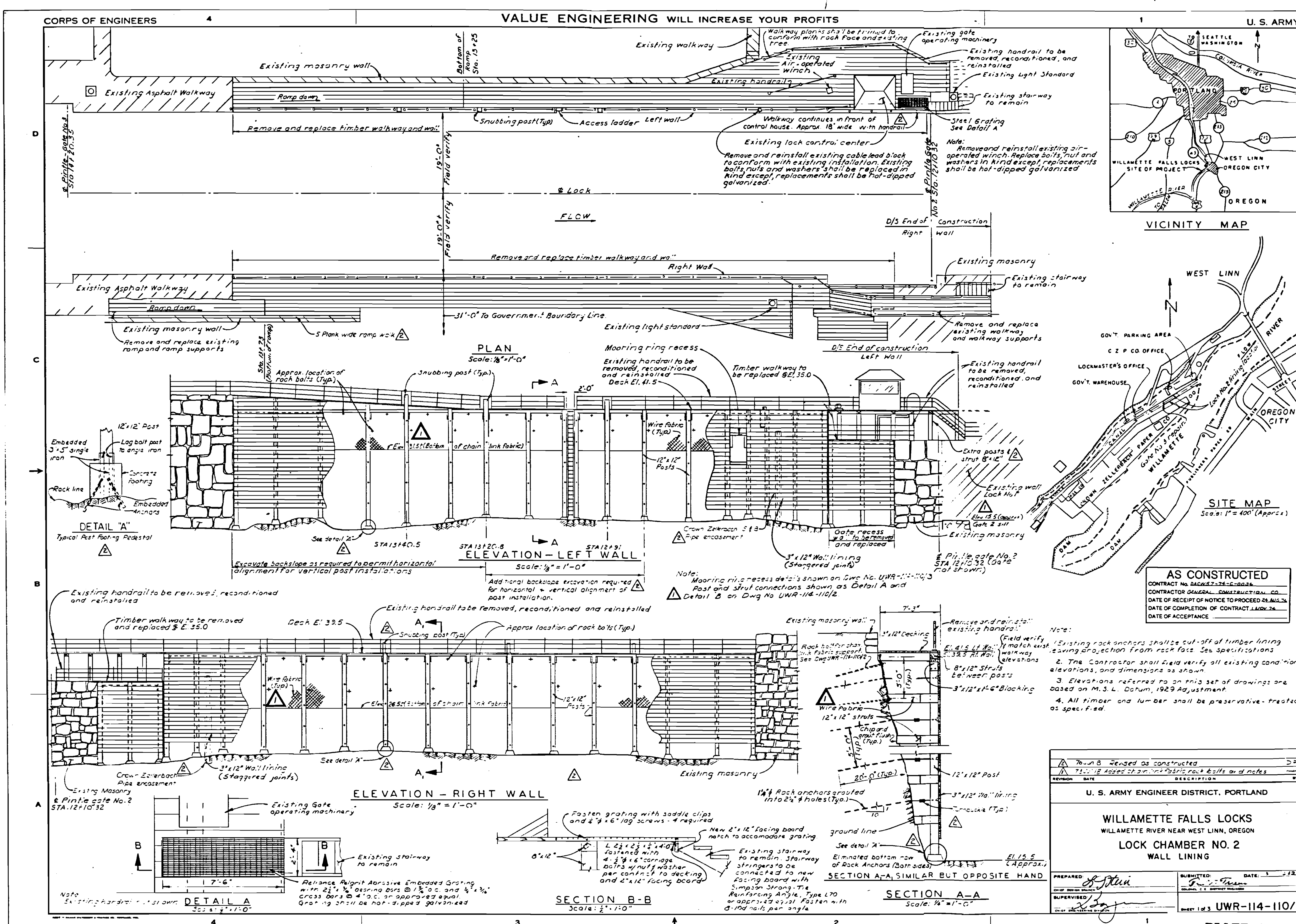
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
QUOIN, AND MITER POST, AND MISCELLANEOUS DETAILS

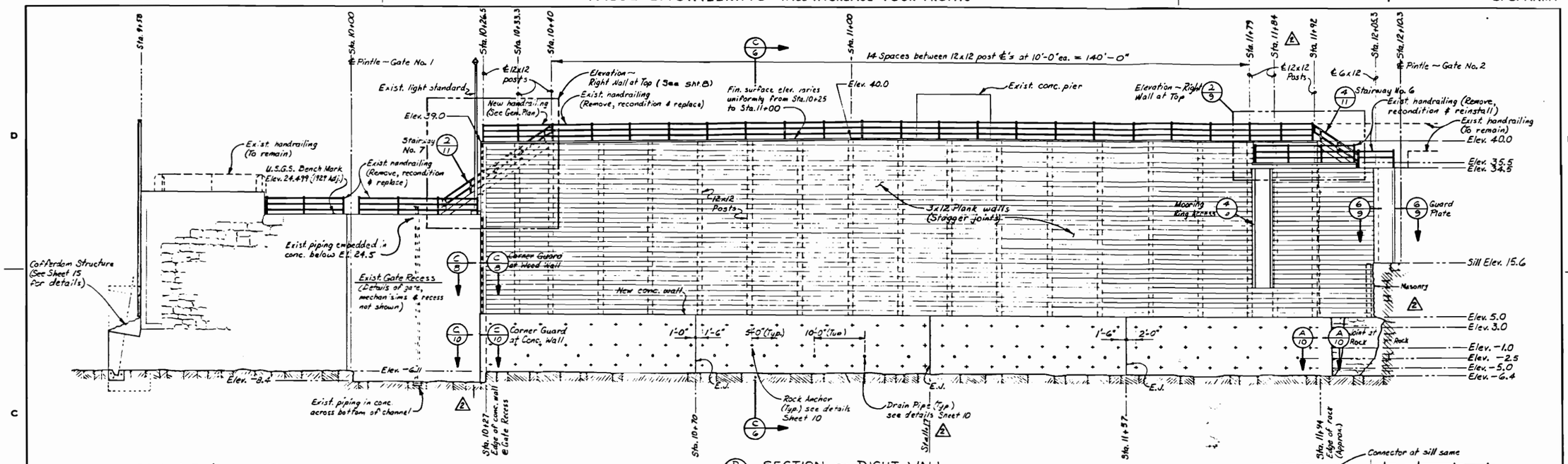
SUPERVISED Roy R. Mullen, CHIEF, STRUCTURES SECTION
SUBMITTED, CHIEF, DESIGN BRANCH
RECOMMENDED, CHIEF, ENGINEERING DIVISION
APPROVED, COLONEL, C. E., DISTRICT ENGINEER, DATE 2 Aug 68

SCALE AS SHOWN SPEC. NO.
UWR-114-101/6
SHEET 6 OF 6

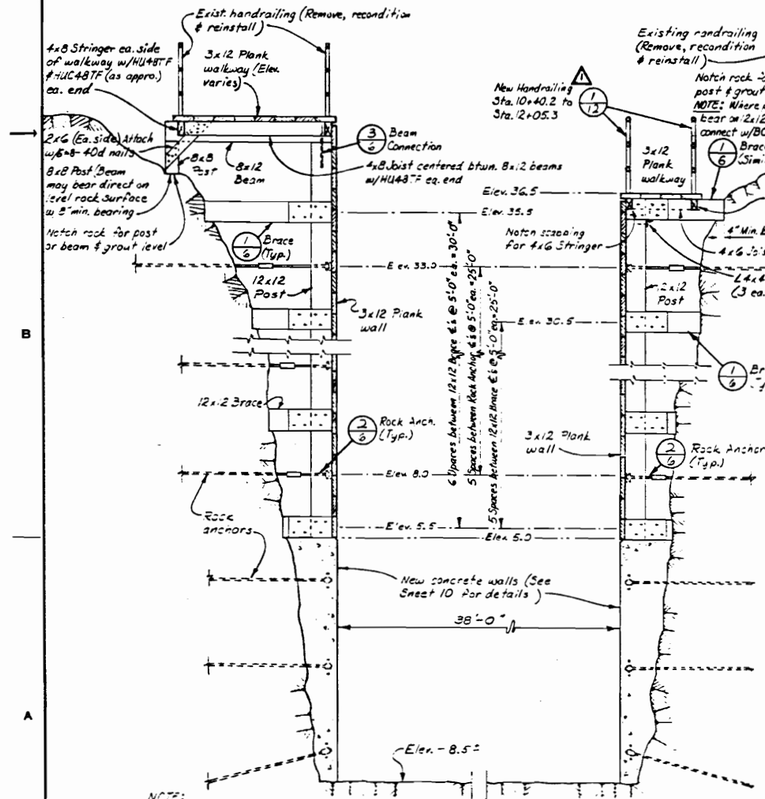
MICROFILMED 10 Sep

PLATE 29


CORPS OF ENGINEERS
VALUE ENGINEERING WILL INCREASE YOUR PROFITS
U. S. ARMY
PLAN
Scale: 1/8" = 1'-0"
ELEVATION – LEFT WALL
Scale: 1/8" = 1'-0"
ELEVATION – RIGHT WALL
Scale: 1/8" = 1'-0"
DETAIL "A"
Typical Post Footing Pedestal
DETAIL A
SECTION B-B
SECTION A-A
Scale: 1/4" = 1'-0"
SECTION A1-A1 SIMILAR BUT OPPOSITE HAND
VICINITY MAP
SITE MAP
Scale: 1" = 400' (Approx.)
Existing masonry wall
Existing Asphalt Walkway
Ramp down
Remove and replace timber walkway and wall
Existing lock control center
FLOW
Right Wall
Left wall
Existing light standard
Existing stairway to remain
Steel Grating See Detail A
Note: Remove and reinstall existing air-operated winch. Replace bolts, nut and washers in kind except, replacements shall be hot-dipped galvanized
Existing handrail to be removed, reconditioned and reinstalled
Timber walkway to be replaced @ El. 35.0
Deck El. 41.5
Deck El. 39.5
12"x12" Posts
3"x12" Wall lining (Staggered joints)
Wire fabric (Typ.)
Note: Mooring ring recess details shown on Dwg No. UWR-114-110/3. Post and strut connections shown as Detail A and Detail B on Dwg No UWR-114-110/2.
Note:
1. Existing rock anchors shall be cut-off at timber lining leaving projection from rock face. See specifications
2. The Contractor shall field verify all existing conditions, elevations, and dimensions as shown.
3. Elevations referred to on this set of drawings are based on M. S. L. Datum, 1929 Adjustment.
4. All timber and lumber shall be preservative-treated as specified.
AS CONSTRUCTED
U. S. ARMY ENGINEER DISTRICT, PORTLAND
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK CHAMBER NO. 2
WALL LINING
Sheet 1 of 3 UWR-114-110/1

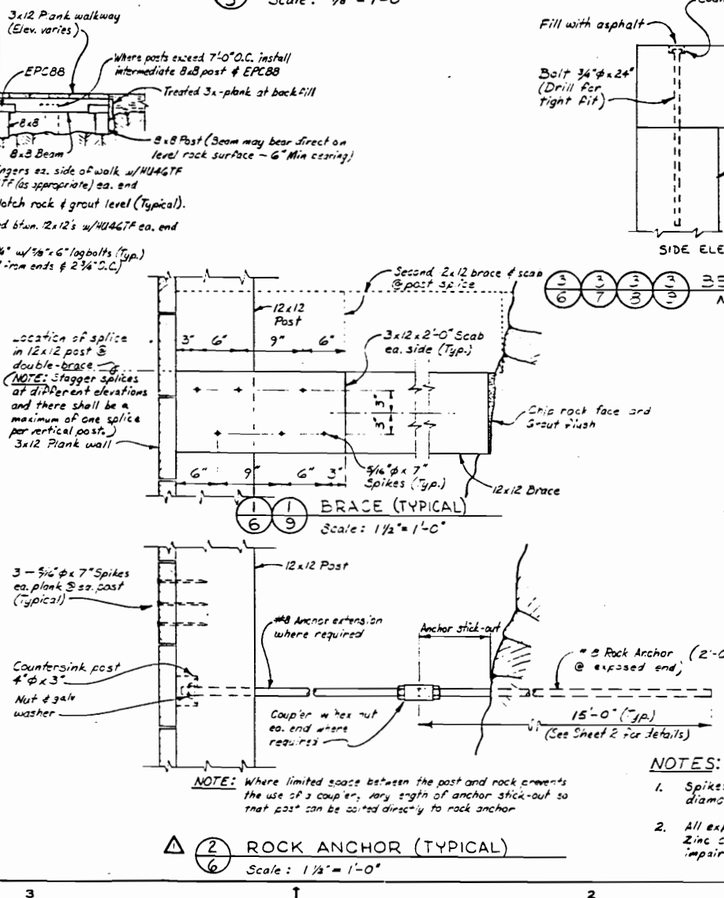


B/5 SECTION – RIGHT WALL
Scale: 1/8" = 1'-0"



NOTE: Timber connectors as shown HUC48TF, HU48TF, HUC46TF, HU46TF, BC20 and EPC88 shall be as manufactured by Simpson Co. or approved equal.

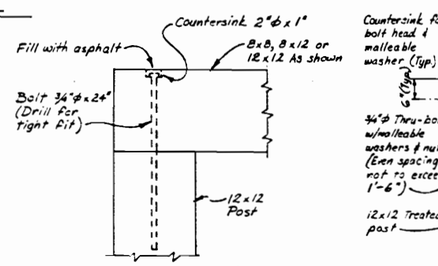
C/5 C/6 C/7 SECTION
Scale: 3/8" = 1'-0"



1/9 1/6 BRACE (TYPICAL)
Scale: 1½" = 1'-0"

NOTE: Where limited space between the post and rock prevents the use of a coupler, vary length of anchor stick-out so that post can be seated directly to rock anchor.

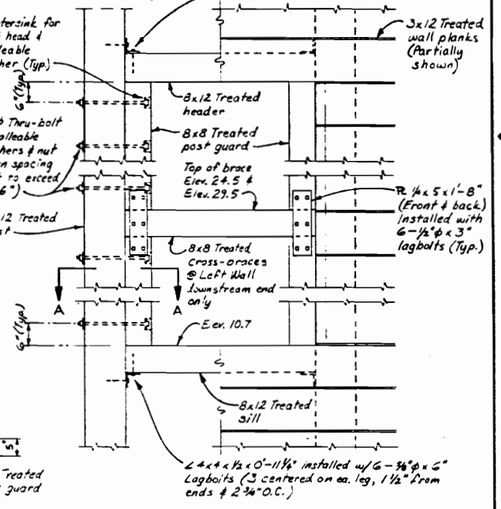
△ 2/6 ROCK ANCHOR (TYPICAL)
Scale: 1½" = 1'-0"



SIDE ELEVATION

4/6 3/7 3/8 3/9 BEAM CONNECTION
Not to scale

SECTION A-A
Scale: 3/4" = 1'-0"



4/5 4/6 4/9 ELEVATION – MOORING RING ACCESS
Scale: 3/4" = 1'-0"

NOTES:
1. Spikes shall be galvanized, flathead, diamond point & roved.
2. All exposed steel shall be zinc coated. Zinc coating of connections not to impair their fit.

AS CONSTRUCTED
CONTRACT No. DACW57-80-C-0060

REVISION	DATE	DESCRIPTION	BY
1	87 July 9	Revised As Constructed	DJB
0	80 May 20	Revised new handrail & rock anchor	DJB

U. S. ARMY ENGINEER DISTRICT, PORTLAND

DESIGNED: M. Flynn
DRAWN: R. Kirkham
CHECKED: G. Taser
PREPARED:
SUPERVISED:

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK NO.1 REHABILITATION
RIGHT WALL
ELEVATION & SECTIONS

SUBMITTED: DATE: 30 APR 82
SHEET 6
UWR-114-111/6

PLATE 31

WILLAMETTE FALLS LOCKS

PERIODIC INSPECTION REPORT NO. 1

APPENDIX A

REPORT OF 1978 INSPECTION OF LOCK STRUCTURES

(not encluding enclosures)

REPORT OF
INSPECTION OF LOCK STRUCTURES
WILLAMETTE FALLS LOCK
WILLAMETTE RIVER, OREGON

1. A complete inspection of the Willamette Falls Lock was made on 25-27 July 1978. Corps of Engineers personnel that participated in the inspection were:

Portland District - Engineering Division

Raymond Dewey, Structures Section, Design Branch
Michael Flynn, Structures Section, Design Branch
Philip Grubaugh, Geology Section, F&M Branch
Darrell Hibbits, Concrete Control Section, F&M Branch
Owen Tessman, Mechanical Section, Design Branch
Edwin Watkins, Structures Section, Design Branch

Portland District - Project Operations Division

Jack Braithwaite, Technical Branch

Portland District, Willamette Falls Locks

Bill Cuddy
Bruce Tangen, Lockmaster
Emerson Tiedeman

2. Inspection Summary. The walls of Lock 1 and walkways along No. 1 were found to be in need of repair. The rock walls behind both sides of Lock 1 are unstable and contain loose basalt blocks. Locks 2 and 3 were found to be in good condition. Lock 4 was found to be in sound condition except that the ramp and wood deck along the west wall of the Lock Chamber No. 4 has deteriorated and presents a safety hazard to lock personnel and the public. The deck planking around the Lockmaster's office was found to be rotten. The Government warehouse adjacent to the Lock Basin is settling into the basin. The east guide wall upstream of gate No. 7 was found to be rotten.

3. Recommendations. The following major recommendations are made.

a. New walls for Lock Chamber No. 1 should be designed and constructed.

b. The walkway along Lock Chamber No. 1 should be replaced.

c. The rock walls on both sides of Lock No. 1 should be stabilized by the removal of all loose rock blocks, bolting of rock faces and shotcreting of the interbeds.

d. The ramp and wood deck adjacent to Lock 4 should be repaired and the deck planking around the Lockmaster's office should be repaired.

e. Methods of stabilizing the warehouse which is settling should be investigated, and repair of deck planking and ramps around the warehouse should be performed.

f. The east guide wall upstream from Gate No. 7 should be replaced.

g. Miscellaneous repairs as discussed in paragraph 12 of the report should be made.

4. Reference Data.

Type of Lock	Multiple Lift
Normal Total Lift	Feet 41
Maximum Width of Tow	Feet 37
Maximum Length of Tow	Feet 175
Maximum Draft of Tow	Feet 6.5
Maximum and Normal Water Surface Fluctuations	
Downstream	Feet 30-20
Upstream	Feet 12-10

5. General. Inspection details and comments follow. Information is current to the date of this report.

6. Inspection Monitoring and Reading Schedule. No current instrumentation is being performed at the Locks, but previous data on rock movements at the east side of Lock 1 and photographs of this inspection are on file in the Foundation and Materials Branch.

7. Lock Number 1.

a. Core samples of the timber posts and wall lining of Lock No. 1 were taken. Core samples of posts and planks below wall elevation 16 were solid. Most of the core samples above wall elevation 24 were found to be rotten. Some columns were observed to shake and move when a small force was applied. Horizontal boards above elevation 24 are loose and new spikes used for repairs do not hold sufficiently. Spikes were observed to go into the posts with little resistance. New walls for Lock Chamber No. 1 should be designed and constructed (Incl. 1 and Incl. 4 items 1A).

b. Walkways along Lock No. 1 were inspected. Many of the walkway beams were found to be easily penetrated with a pocket knife. Part of these beams were found to be easily removed and crumbled by hand. Carpenter ants have hollowed out several walkway beams, reducing the allowable stresses in these areas. The walkway along Lock Chamber No. 1 should be replaced (Incl. 4 item 1B).

c. Inspection of the west side of Lock No. 1 revealed several loose basalt blocks or rock masses in the near vertical rock cut adjacent to the lower wood deck on top of the wall planking. These rock blocks are separated by open joints and in some areas are temporarily restrained or supported by passive "girdle" systems of steel cables that are stretched horizontally across several blocks and anchored at minimal depths to adjacent more stable appearing blocks. The loose rock masses extend downward from the top of the cut to approximate elevation 25, where interbed erosion has partially undercut the basalt flow. Interbed locations are mostly hidden behind the Lock No. 1 planking, but projections from previous nearby explorations indicate there is an upper interbed that extends from approximate elevation 27 at Gate 2 to approximate elevation 24 at Gate 1, and a lower interbed that extends from approximate elevation 1 at Gate 2 to approximate elevation -1 at Gate 1. Conditions of these interbeds and of the number and extent of the loose or potentially loose rock masses that might eventually fail cannot be determined without either at least partial removal of the wall planking or possibly in part by lowering personnel on safety lines between the lock wall and the rock cut. Conditions along the Lock 1 east wall are similar to those along the west wall except that the extent and number of unstable rock blocks is much less since the dip of the rock layers is to the southeast away from the lock instead of into the lock.

d. The rock walls on both sides of Lock No. 1 should be stabilized by the removal of all loose rock blocks, bolting of rock faces and shotcreting of the interbeds. This work should be scheduled to coincide with repair or replacement of the lock walls. An accurate geologic map will have to be prepared for both walls to determine the location and amounts of loose rock to be removed, rock bolt design and the tentative rock bolt pattern. The final rock bolt pattern will have to be determined in the field upon completion of removal of all loose rock materials. It will most likely be necessary to remove portions of the lock wall planking to prepare the geologic map. If the planking can be removed temporarily for this mapping in advance of final lock repair, it would be advantageous both for the final design of the rock wall stability plans, and for the contract quantity estimates. Loose rock materials will have to be removed by wedging and splitting and with a barge mounted crane, since no blasting will be permitted and access is limited. Preliminary estimates include removal of at least 200 tons of rock materials with single rock blocks up to 30+ tons. Tentatively, the rock bolts are to be a groutable type of one-inch or greater diameter and 15- to 20-foot lengths, placed on an approximate eight-foot rectangular pattern. Shotcrete together with suitable reinforcing and drainage will be required for the full length and thickness of the interbeds (See Incl. 5).

8. Lock Numbers 2 and 3. Locks 2 and 3 were drained and inspected. The walls appeared to be in sound condition from inside the Lock Chamber. In the middle two-thirds of Lock 3 rock debris was noted

to have been deposited. This material should be removed when normal maintenance is performed. No repair of these locks is required.

9. Lock Number 4.

a. Lock 4 was inspected and found in sound condition. A core sample from a post in this area was taken and found to be solid. The masonry steps to the control house at Gate No. 4 are out of alignment. The steps appear to have been hit by a barge in the past.

b. The ramp and wood deck along the west wall of Lock Chamber No. 4 has deteriorated and present a safety hazard to Lock Personnel and the public. Core borings were taken of the timbers supporting the ramp and wood deck. The core samples showed the timbers to be rotted in most cases. Also, visible deterioration of the wood timbers was observed under the wood deck and ramp. The rock wall on the west side of the lock was observed to leak landward through the joints in the wall. The leakage has caused the vertical timbers, behind the wall, which support the deck to rot. The ramp and wood deck adjacent to Lock No. 4 should be repaired as soon as a design can be prepared (Incl. 4, item 2).

c. The deck planking between the Lockmaster's Office and Lock Chamber No.4 was inspected. One deck plank was removed and core sample from a support beam was taken and found to be rotten. Deck planks on the south and west side of this building were easily penetrated with a crowbar. This should be repaired at the same time as the ramp and wood deck adjacent to Lock 4 is repaired (Incl. 4, item 3).

10. Lock Basin.

a. The Government warehouse adjacent to the Lock is settling. Timber bracing in the foundation has come apart from other structural members. The ends of some beams under the warehouse and ramp have deteriorated. A foundation post core showed rot in the middle of the sample. Methods of stabilizing the warehouse should be investigated. Many deck planks around the warehouse were easily penetrated with a crowbar. The deck and ramp should be repaired. Seven sections of the log boom on the west bank adjacent to and upstream from the warehouse are becoming waterlogged and should be replaced (Incl. 4A, item 4).

11. Guard Lock. The east guide wall upstream from Gate #7 was found to be rotten and should be replaced (See Incl. 3 for location). Sinker logs go under the adjacent log boom and into the locks. Methods of preventing this should be studied.

12. Miscellaneous Observations and Recommendations.

a. Downstream Access Walkway and Float.

(1) Nuts on base plates of Float Guide Frame were observed not to be snug against the base plate and covered with mud. The mud should be removed and all loose nuts should be tightened down when normal maintenance is performed.

(2) The connecting pin at each end of the walkway should be replaced. To keep the walkway centered on the pins, washers should be installed on each side of the pins. The pins were found to be bent and rusted at the time of the inspection (cost not provided).

(3) Inside angles of lower chords on the walkway were observed to be rusting under the paint. Additional spot rusting at other places was observed on the walkway.

b. Handrails.

(1) All loose handrail base plates should be tightened.

(2) Clean and paint all handrail base plates with extensive rusting.

(3) The handrail base plate that is located next to Gate #1 recess on the left side of the lock should be replaced.

(4) Unstable Ground in Government Parking Area. Cracking was noted in the asphalt at the southeast corner of the Government Parking area. The cracks form a rectangular rather than a curved pattern, more indicative of an asphalt patching problem than of slope instability. However, additional investigations indicate previous slope failures beyond the outer edge of the present area, together with fresh local slope raveling and some apparent minor settlement. The affected area is roughly 20- by 40-feet in size and apparently underlain by fill materials. It may possibly be on non-Government land. No specific corrective action is believed to be economically justified or recommended, but unless it can be ascertained that the area is definitely stable, it would perhaps be advisable to keep traffic off this corner of the parking lot.

13. Cost Estimate. The estimated cost for design and construction of the above discussed items are inclosed (Incl. 4 and 5). The costs are current to the date of this report, and does not reflect any future costs. No costs are provided for the miscellaneous items in paragraph 12 of the text.

14. Conclusion. The Willamette Falls Locks are in need of repair as discussed in the report. The estimates of cost for design and construction for repair of the lock structures, and stabilization of rock cut slopes is approximately $ 546,140.

WILLAMETTE FALLS LOCKS

PERIODIC INSPECTION REPORT NO. 1

APPENDIX B

DOCUMENTATION OF 1987 CANAL WALL REPAIRS

MEMORANDUM FOR RECORD 31 July 1987

Subject: Willamette Falls Lock Repair, Contract No. DACW57-C-0090

Background.

Please refer to contract specifications, plans and the attached drawing. Specifications required the repair of three leaking cavities in the lock wall opposite the PGE hydropower plant. This work could be scheduled only during 4 July 1987, the one time each year which the Crown Zellerbach paper plant is normally shut down. The paper plant uses river water from intakes located near the repair area on both sides of the lock. Unwatering both sides of the lock requires a paper plant shut-down. All work except underwater excavation was required to be done in a 26 hour time period when both sides of the wall could be unwatered. Seven NW vertical exploratory holes were drilled in the repair areas through the lock wall to bedrock. The cavities were to be repaired by excavating material from the lock floor to fully expose the cavities to allow dewatering and removal of debris and contaminants. The cavities were required to be completely cleaned and filled with concrete. The concrete required was a nine inch slump, 3/8 inch aggregate mix, containing a fluidifier and a non-shrink additive.

The leaks in the wall have apparently been a repair problem for many years. When the wall was exposed for repair work under this contract, it was evident that previous repairs using wood formwork and replacement concrete had been attempted at least once before. No documentation of the previous repairs nor any original construction plans of the lock have been available. The remaining concrete in the cavity areas is poor in quality and has the appearance of a mix with very low cement content.

Repair Construction Work.

During the repair work under this contract, water leaking through upstream gates into the lock chamber was a problem. The gates leak at each of the valve seals and at points where debris becomes caught as the gates close. The contractor did not completely remove water and debris from the cavities in areas 2 and 3 which are below the elevation of the lock floor. Initial excavation was required to be done underwater on the lock side of area 3 prior to draining the lock using a barge mounted clamshell. Approximately 100 cy was removed. The sideslopes of the excavation gradually sloughed back in and filled the hole. Repair work began at 2000 hours, 3 July 1987 with both sides of the lock wall drained. Sandbag dikes were placed in the lock around areas 2 and 3 with limited results. The material in the lock floor is composed of rocks, mud and decomposing organics. Water flowed through this material under the sandbag dikes and carried mud into the excavation as fast as it could be pumped and removed. As a result, cavities in areas 2 and 3 were not completely dewatered and concrete was placed into cavities which contained mud and gravel deposits. Due to limited access to the site concrete was pumped through 1500 feet of 4 inch diameter pipe to

the site. Most of the forms failed when the concrete was pumped into cavities. The cavity at area 1 was just above the lock floor and was filled through both side forms and down the drill hole with about 1/3 cy of concrete. The lockside form deflected several inches outward under pressure from the concrete pump but no concrete was lost. The lockside form at area 2 broke during concrete pumping and most of the concrete flowed out the bottom of the formwork. At area 3, the cavity was partially filled with about 15 cy of concrete when the formwork on the forebay side began to fail. Work stopped at 0200, 5 July 1987 and it was agreed that the remaining concrete work would be completed at a later date since the forms were failing and becomming a safety hazard.

Assessment of Conditions.

On 7 July 1987 an assessment was made with the lock full and the powerplant side dewatered to evaluate the lock repairs to date. No leakage was observed at area 1. This was a small cavity and the only one completely filled with concrete. Leakage flow was the same as prior to repair work at area 2. Most of the concrete had flowed out the bottom of the ruptured form. At area 3 leakage flow was observed to be approximately 10 percent of the flow prior to repair work. The contractor agreed to complete all work on 14 July 1987 under the existing contract.

Completion of Remaining Contract Work.

On 14 July 1987, work remaining under the subject repair contract was completed. Both sides of the lock wall were at full pool. A standard concrete pump was used to pump grout through the drill holes in areas 2 and 3. Approximately 1/3 cy of grout was pumped into the cavity in area 2 through DH #58 and topped out. Approximately 6 cy of grout was pumped into DH #60 in area 3 and some of this was forced out to the forms on the powerhouse side and up into the bottom of DH #55, the next adjacent downstream hole. A 3/8 inch aggregate mix was pumped into the top of the forms on the powerhouse side of area 3. The remaining drill holes in area 3, #54, #56, and #59, were filled to the top of the wall using less than 0.1 cy of grout.

Assessment of Repair

The PGE hydropower plant was shut down for major repairs beginning 24 July 1987. The outside of the lock in front of the PGE forebay which is directly opposite all three repair areas was dewatered and this allowed an assessment of the repair work and any remaining leakage.

No leakage was observed at area 1. Area 2 leakage is approximately 1 cfs which is about one tenth the original leakage flow. Area 3 leakage is approximately 2 cfs. This is roughly five percent of the leakage flow prior to repairs. In addition to these flows it was observed that the PGE inflow gate leaks at 5 to 10 cfs into the same area of the PGE forebay. The formwork on the forebay side of area 3 will be removed so the location of the leak can be determined.

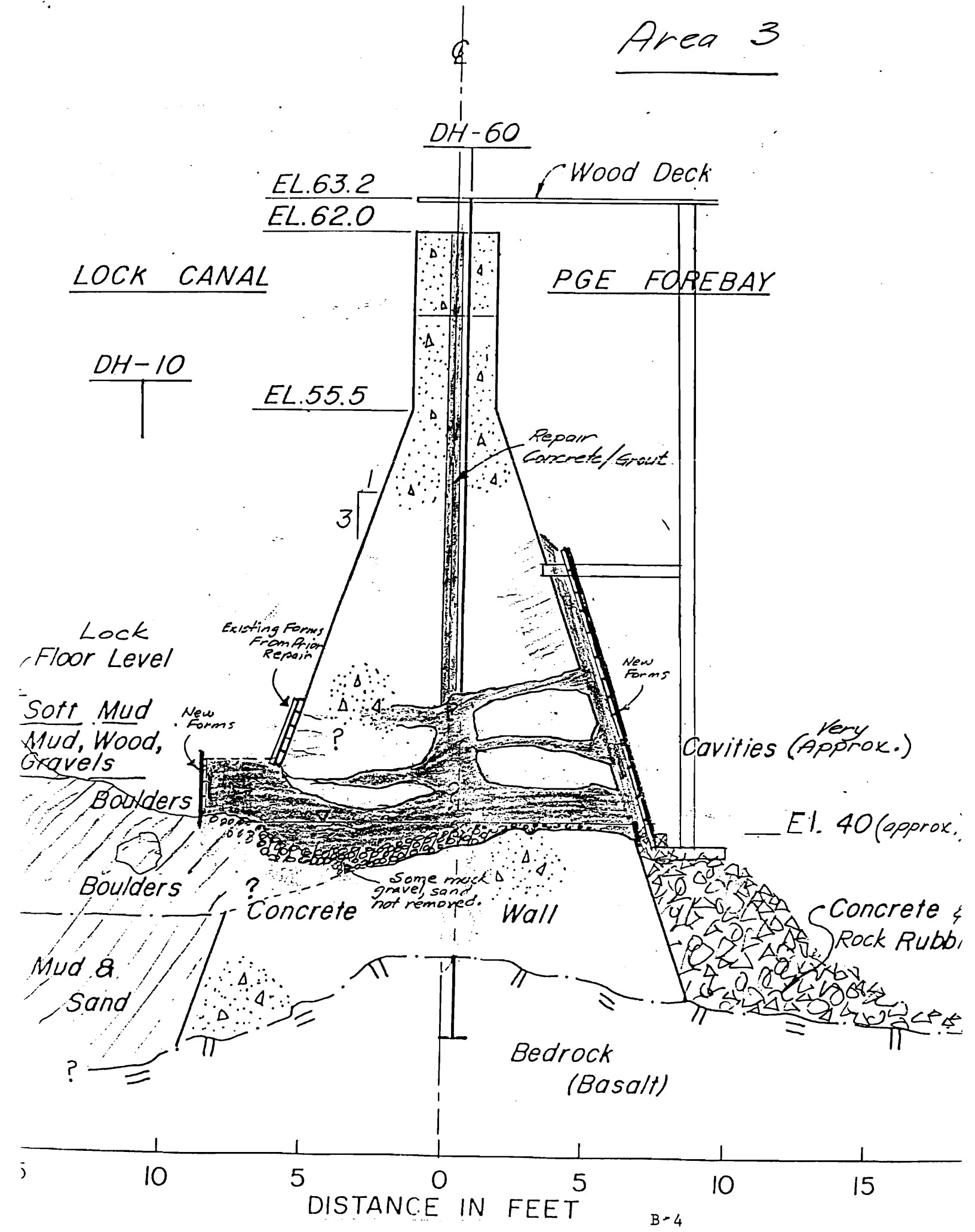
Total leakage at areas 2 and 3 is now less than five percent of the flow prior to repair. This is not considered to be problem and no additional repairs are planned at the present time. Under normal operating conditions both sides of the lock wall in the repair area have a full pool and there is very little flow through the wall. The leaks will be monitored periodically during powerplant shutdowns and if flows increase significantly, repairs will be made.

Considerations for Possible Future Repairs.

If repairs are to be made in the future with minimum cost and without powerplant and paperplant shutdowns the following should be considered. Several grout holes can be drilled from the top of the lock wall to bedrock through the remaining cavities. The cavities should be cleaned with high-volume water fushing at a maximum pressure of 25 psi to remove mud and gravel deposits just prior to grouting with a rapid setting sand-cement mixture. The grouting should be done with equal pool elevations on both sides of the wall.

If it becomes necessary to dewater both both sides of the lockwall to make repairs it should be noted that stopping the leakage of water through the upstream lock gate will be critical to the success of the repair effort. During the 4 July 87 repair, plastic sheeting was used effectively as a temporary water barrier. If water leaking through the lock gate can be controlled by placing plastic sheeting on the upstream side of the lock gate or by some other method the lock chamber can be effectively dewatered. Then excavation in the lock floor adjacent to the wall can be done to completely expose the areas to be repaired and the cavities can be cleaned of mud, sand and other debris prior to filling with repair concrete. The lock floor is above, and the forebay floor is below the cavities. Unwatering the lock side of the wall before draining the forebay can help flush the cavities with clean water. If the forebay is unwatered first, debris and mud from the lock floor will be carried into the wall cavities. Underwater excavation should not be attempted. A track mounted backhoe should be required for excavation since this type of equipment has been used previously in the dewatered lock floor with good results.

Dale Haslem
Concrete Section


Area 3
DH-60
EL.63.2
EL.62.0
Wood Deck
LOCK CANAL
PGE FOREBAY
DH-10
EL.55.5
Repair Concrete/Grout
3
1
Lock Floor Level
Existing Forms From Prior Repair
New Forms
New Forms
Soft Mud
Mud, Wood, Gravels
Boulders
Cavities (Very Approx.)
El. 40 (approx.)
Boulders
?
Some mud gravel, sand not removed.
Concrete Wall
Concrete & Rock Rubb
Mud & Sand
?
Bedrock (Basalt)
10
5
0
5
10
15
DISTANCE IN FEET

WILLAMETTE FALLS LOCKS

PERIODIC INSPECTION REPORT NO. 1

APPENDIX C

INSPECTION OF MITER GATES, MARCH 1994

CENPP-PE-DS 14 APRIL 1994

MEMORANDUM FOR CHIEF, CENPP-OP

Subject: Inspection of Willamette Falls Miter Gates.

1. General. Miter gates 2 through 6 at Willamette Falls Locks were dewatered and inspected on 29 March 1994 as part of the overall inspection of the locks. Gates 1 and 7 were recently repaired (in the fall of 1993) and were not inspected. The inspectors from CENPP-PE-DS were Matt Hanson and Don Erickson. A concurrent periodic inspection of the lock chambers and appurtenant structures was performed by an interdisciplinary dam safety team. Photos and inspection records will be retained in PE-DS and are available upon request.

The gates appear to be in generally good condition. Timber lagging on the downstream gate faces prevented a thorough inspection of the main structural members of the miter gates and heavy seepage in the lock chamber prevented a careful inspection of the pintle bases. The lagging, skin plates, and sill angles on all the gates were in good condition except as noted. Problems that were noted with many of the gates include loose gudgeon anchors, loose gate operating cylinder anchors and pins, worn guide plates for the slide gates, and wear of the miter posts due to tugs bumping and rubbing on the miter posts.

2. Inspection Observations

a. Miter Gate Number 2. The upstream edge of the miter posts showed 1 to 2 inches of wear along the entire length of the posts. At the waterline, the posts showed 3 to 4 inches of wear, 5 to 6 feet in length, due to tug contact. A large gap of approximately 2-3 inches was present at the bottom of the miter posts when the miter gates were closed and unloaded. This is most likely due to the gate leaves not hanging vertically. This condition exists on several of the gate sets and hydrostatic load may be insufficient to fully close the gates. The water leaking between the miter posts further contributes to seal and sill angle wear.

The installation of baffles above the slide gates prevented a complete inspection of the slide gates. West Linn slide gate #1 showed damage to the seal face, most probably from worn gate guides. West Linn slide gate #4 was missing 4 inches of seal in the corner. Oregon City slide gates #1 through #4 leak at the sides of the gate seals as evidenced by white metal near the side seals. The baffles as well as the bottom J-seal plate had missing or loose bolts on both leaves. The bottom rubber J-seal was in good condition. Minor concrete loss from barge impact on the downstream side of the sill was observed. The upstream sill angle had a 7/8" steel plate welded to the face that extended 5" on either side of the miter post location.

The quoin posts are in good condition with the exception of minor scoring at the midpoints on both quoin blocks (1/2" deep by 1 foot in length). This scoring is likely due to debris at the waterline that rubs the posts when the gates open and close. A 1/2" deep by 2" wide gouge at the sill was observed in the West Linn quoin post.

On the West Linn side, the pin for the gate operating cylinder where it contacts the anchor is worn. On the Oregon City side, the gate operating arm bolts are loose and the anchor plate bolt holes are slotted due to movement of the anchor plate during gate operation.

b. Miter Gate Number 3. The upstream edge of the miter posts showed 1 to 2 inches of wear along the entire length of the posts. At the waterline, the posts showed 3 to 4 inches of wear, 4 to 5 feet in length, due to tug contact. In addition, the miter post on the West Linn side showed minor wear (1 to 2 inches deep by 1 foot in length) along the face of the miter post. When the miter gates were closed, the miter posts were offset approximately 2 inches in the upstream/downstream direction.

All of the slide gates on gate number 3 operated properly. West Linn slide gate #1 however operated very slowly in closing and was noisy, probably due to worn gate guides. West Linn slide gates #1-#3 had torn seals at the mold joint in the corner. Oregon City slide gate #2 had a torn seal.

The quoin posts are in good condition with the exception of minor scoring at the midpoint on the West Linn quoin block (1/2" deep by 1 foot in length).

Several bolts were missing or loose on the J-seal, particularly near the lock centerline.

The gate operating cylinder on the West Linn side was missing anchor bolts and some of the anchor concrete was cracked. In addition, the gudgeon anchor recesses require cleaning.

The Oregon City sump had loose stones around its outlet and less flow the West Linn sump.

c. Miter Gate Number 4. The upstream edge of the miter posts showed 1 to 2 inches of wear along the entire length of the posts. When the miter gates were mitered, a gap of 1 to 2 inches was present at the bottom of the miter posts.

All of the slide gates on gate number 4 operated properly. Only slight wear was observed in the guides. The slide gate seals were in good condition. One metal stop (3" X 1 1/2" X 1" steel blocks welded to the gate frame) on each of the two inside gates on the Oregon City side were missing.

Approximately 10 feet of embedded sill angle on either side of the miter posts is loose. In addition, the J-seal retainer bars were missing several bolts on both gate leaves and several bolts were loose.

The quoin posts are in good condition with the exception of minor scoring at the midpoint on the West Linn quoin block (1/2" deep by 1 foot in length).

The bottom half of the skin plate on both leaves of miter gate 4 is corroding and requires painting.

d. Miter Gate Number 5. The miter posts were in good condition with only a small gap of approximately 1-2 inches present at the bottom of the gates when the gates were mitered and unloaded. The Oregon City gate operating cylinder connection pin to the anchor plate was worn and should be replaced because the arm shifts approximately 3/8" during gate operations and transfers an impact load to the anchor which will eventually loosen the anchor plate.

Except for Oregon City slide gate #2, all of the slide gates on gate number 5 operated properly. Oregon City slide gate #2 did not appear to open fully (was about 4" lower than the other gates). Only slight wear was observed in the guides. The slide gate seals were in good condition. A gap was observed at the top of Oregon City slide gate #1 when closed. The slide gate stops should be adjusted to prevent this.

The quoin posts are in good condition with the exception of minor scoring at the top of the quoin post on the Oregon City side due to a concrete obstruction. The concrete should be ground smooth to prevent this when the gates are next worked on. A small gouge was present near the top of the West Linn quoin post, cause unknown.

Project personnel have noted the concrete guide block upstream of gate #5 on the West Linn side moves when impacted by barges and tugs during normal operation. The movement is up to 1" in a direction perpendicular to the centerline of the lock. This block should be anchored securely to it's foundation.

e. Miter Gate Number 6. The upstream edge of the miter posts showed 1 to 2 inches of wear along the entire length of the posts. At the waterline, the posts showed 3 to 4 inches of wear, 2 to 3 feet in length, due to tug contact.

All of the slide gates on gate number 6 operated properly. Due to high water, it was not possible to closely inspect the slide gates.

The quoin posts are in good condition with the exception of minor scoring at the midpoint on both gates (1/2" deep by 1 foot in length).

The gate operating cylinder concrete anchor block on the West Linn side moves approximately 1/2" during operation of the gate arm.

f. Sumps. Heavy seepage prevented a thorough inspection of the dewatering sumps. Project personnel felt the dewatering sump covers require rubber seals to seal properly.

3. Repair Recommendations. General maintenance items to be performed include cleaning the tops of the gates to prevent water ponding and eventual rusting, and gudgeon anchor recesses cleaning.

All locations where the gate operating cylinder anchor plates have loose

bolts or the anchor plate moves should be repaired. The constant movement of the anchor or plates will eventually require that the plates be replaced or new bolt holes drilled and new anchors placed. At locations where the connecting pin between the operating arm and the anchor plate is loose, the pin should be replaced. If it is not replaced, the impact load from the operating arm will eventually loosen the anchor plate or the anchor bolts.

Each gate should be checked for excessive leakage at the miter posts under hydrostatic loading. The gates should be remitered and additional checks for leakage at the sills and seals and the quoin posts should be checked. In addition, armor should be placed at the water line to protect the miter posts from barges rubbing up and down on the miter posts.

The concrete anchor block for the #6 West Linn gate operating cylinder should be repaired in the next available maintenance contract. Repair should consist of drilling and post tensioning the block into the rock hillside and grouting the interface between the rock and concrete. If the repair is not completed, the block may allow more movement which will affect the operation of the gate operating cylinder.

The guide block on the upstream West Linn side of Gate Number 5 should be securely anchored to it's foundation. The block is a hazard because continued impact may cause it to become unstable and fall into the lock chamber.

Normal wear of the slide gates and slide gate guides is apparent on many of the slide gates throughout the locks. Slide gates and guides should be repaired and seals replaced should the miter gates be removed and serviced.

The miter posts and quoin posts, although in good condition at this time, should be replaced when the gates are next maintained. In addition, the gates should be repainted and the sill seals should be replaced as part of a scheduled overhaul of the gates.

Sump covers were almost all missing seals and were of varying sizes. Repairs should include field verification of sump cover size and installation of new seals.

Donald L. Erickson, P.E.
Structural Engineer

Matthew D. Hanson, P.E.
Structural Engineer

cf
PE-DS (file)
Campbell PE-GC
Schmidtke OP-T
Wasson OP-PW

CENWP-EC-DS
MEMORANDUM FOR RECORD July 31, 2006

SUBJECT: Field Inspection Trip Report at the Willamette Falls Locks on June 29th, 2006

Inspection Attendees: Matt Hanson, P.E (EC-DS)
Jim Hinds, P.E. (EC-HC)
Kevin Perletti, P.E. (OD-B)
Bryan Mason, EIT (EC-DS)

1. A site visit to the Willamette Falls Locks was conducted to assess the overall condition of the project. A full periodic inspection will be conducted during fiscal year 07. Operation of Gates 1 and 2 were observed. The locks were not dewatered, so the gates, lock floor, and lock walls could not be fully inspected. Below is a summary of the findings.

2. The site visit consisted of a complete walkthrough of the entire lock system on each side.

A. Handrails – Handrails throughout the entire project are in poor condition. Handrails in many places do not meet EM 385 requirements. In many locations handrails are not mounted securely, missing anchor bolts, or are severely corroded. Below are several specific locations.

Mill side of lock:

- Handrail base plate between Miter gates 1 and 2 is severely corroded and is missing all anchor bolts.
- Areas adjacent to gate no. 2
- Areas between gate no. 2 and gate no. 3
- Area near gate no. 3, handrail is missing
- Broken handrail near gate no. 6

Corps' side of lock:

- Upstream of gate no. 4
- Handrail and stairs at entrance to museum
- Loose handrail upstream of gate 5.

B. Walkways and walkway support – The wooden walkway deck planks throughout the project need replacement in many areas. Many of the planks are rotten, have checks, and are missing fasteners. Specific locations are noted below.

Mill side of lock:

- Several boards between gate 1 & 2 are rotten and are not fastened down.

- Walkway ramp between gates 2 &3 several boards are rotten.
- Bad planks between gates 3 & 4.

Corps' side of lock:

- The lower walkway planks below gate 1 are rotted and checked.
- The gangway to the floating dock has at least 5 rotten boards. The skid boards are rotten, loose, or missing in several locations on gangway.
- There are bad planks between gates 3 & 4.
- Planking at gate 6 is missing support in areas. Planking is in acceptable condition but some of the spans are long. The spans should be limited to about 8 feet.

C. Floating docks – The lower dock on the Corps' side has a broken float support. The metal float casing has large corrosion holes, and is broken in several locations and requires monitoring. It does not appear necessary to repair the casing, as the flow is supported along the bottom by a structural member. The casing protects the Styrofoam core and once the Styrofoam begins to get damaged, the casing will have to be repaired. The pins that attach the gangway to the dock are bent and should be repaired. A new connection should be fabricated so that the pins are in double shear instead of single shear as they are now. The floating docks on the mill side all appear to be in good condition with no problems noted.

D. Wooden lock wall supporting structure – In several places problems were noted. Specific areas are noted below.

Mill side of lock:

- Between gate 1 & 2 several buttresses are held up by anchor bolts. One has fallen off its support and is resting on a small rock ledge.

Corps' side of lock:

- Walkway support post near gate 2 operating arm, the 8"x 12" post is rotting and only a 4"x 8" section remains.

E. Lock walls – The locks walls consist of wood and rock walls. Both the wood and rock walls having missing pieces and should be repaired. Throughout the locks wooden wall planks are missing, broken, or rotten and need to be replaced. The several wooden support blocks are missing, exposing tie back rods. Several areas of minor leakage were noted on the lock walls.

F. Ladders – The mill side of the lock below gate 1 has a vertical ladder that needs to be either repaired, tagged out, or removed completely.

G. Gate control house – The control house located on the Mill side near gate 6 has questionable lateral bracing in the direction perpendicular to the center of the lock. The direction parallel to the lock is braced adequately by the stairway.

Investigations and calculations should be preformed, and adequate bracing should be added to fix the problem.

H. Lock miter gates – The lock system consists of seven miter gates. These miter gates utilize built in slide gates to fill and empty the chambers. Listed below are the condition and problems found on each set of miter gates.

Miter gate set 1:

- Corps' side
  - The hydraulic operating arm base plate anchors allow the plate to move. It also was noticed that the concrete block that the hydraulic arm is connected to moves when gate is operated.
  - The handrail that is on the gate is loose.
- Mill side
  - No deficiencies noted.

Miter gate set 2:

- Corps' side
  - Leakage noted between miter block and gate. This was not noted in last inspection.
- Mill side
  - Hand railing should be added where floating mooring bit is operated by tied-on rope.
  - Walkway grating is missing tie down anchor posing a tripping hazard.
  - Handrail on gate in loose.
  - Hydraulic line appears to be leaking. Monitor and fix if needed.

Miter gate set 3:

- Corps' side
  - No deficiencies noted.
- Mill side
  - No deficiencies noted.

Miter gate set 4:

- Corps' side
  - No deficiencies noted.
- Mill side
  - No deficiencies noted.

Miter gate set 5:

- Corps' side
  - Weeds are growing over and through gate. Weeds and debris need to be removed.

- Gate should be operated monthly.
- No deficiencies noted.

- Mill side
  - Weeds are growing over and through gate. Weeds and debris need to be removed.
  - Gate should be operated monthly.
  - No deficiencies noted.

Miter gate set 6:

- Corps' side
  - The nuts connecting the hydraulic operating arm to gate are loose.
  - These same nuts were noted on last inspection as being loose.
  - Blackberry bushes are covering access to miter gate operating equipment and control panel.
- Mill side
  - No deficiencies noted.

Miter gate set 7:

- Corps' side
  - Hydraulic lines need to be re-piped around top of gate pivot point.
  - The current hose layout causes it to get hung up in the gate during operation, potentially causing the hose to rupture due to the gate wearing on the hose.
- Mill side
  - No deficiencies noted.

I. Operation of gates:

Gates 1 and 2 were operated through a complete filling and emptying cycle. The gates were then operated through a complete opening and closing cycle.

It was noticed during the opening and closing of the gates that anchor plates shift and the concrete blocks in several locations also move.

3. Conclusions/recommendations

A. Clean all debris and vegetation growth off of operating equipment, including the top of the miter gates where the filling and emptying operating rods pass through the structure.
B. Check all hydraulic lines for leaks. Clean joints that show oil to verify that there are no active leaks.

C. Monitor condition of gudgeon anchors for all miter gates. This is a long term issue as the original design/installation is suspect at most locations. This is probably the biggest safety issue and the weak link of the lock operation.
D. Make all walkways around the lock safe. Many planks are rotting or not supported correctly. These require resolution to insure safe pedestrian access for both visitors and operations personnel. Handrail, especially on the mill side is weak or even unsupported. This needs resolution.
E. Consider adding a vertical ladder with landing to access the D/S floating dock and eliminate the existing ramp.
F. Lock Operators should develop a running list of repairs or operations issues that require repair or attention. This list should include a place to note when the issue was resolved.
G. HSS and Periodic Inspections: A program of regular periodic inspections should be performed. A formal periodic inspection of the de-watered lock should be conducted in FY 07. HSS inspections of the lock gates should be scheduled and performed prior to the periodic inspection. Subsequent periodic inspection should be schedule at a 5-year frequency.
H. Life Safety: Project should initiate life safety repairs and upgrades to handrails, wood decking on walkways, stairs, ladders and ramps. Project should also initiate preventative maintenance program that includes hydraulic systems, spill containment, vegetation control and inspection of anchors and connectors.
I. Operation: Continued operation of the Willamette Falls Locks is recommended through the 2006 season.

4. If you have any questions regarding the findings of this trip report, please contact Matt Hanson (4934) or Bryan Mason (4946).

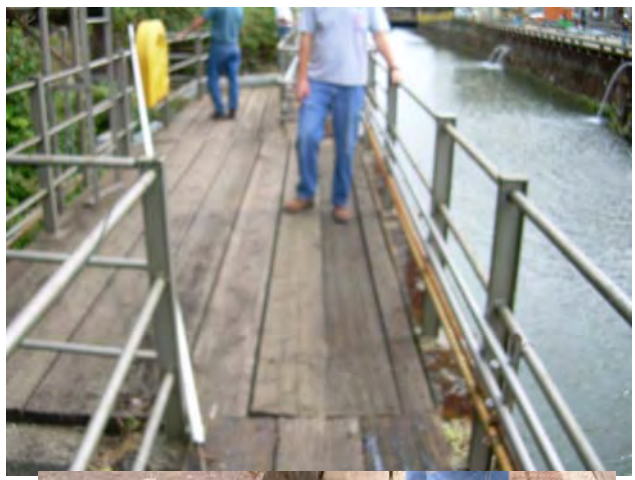
Bryan Mason, EIT
Matthew Hanson, P.E.
CENWP-EC-DS

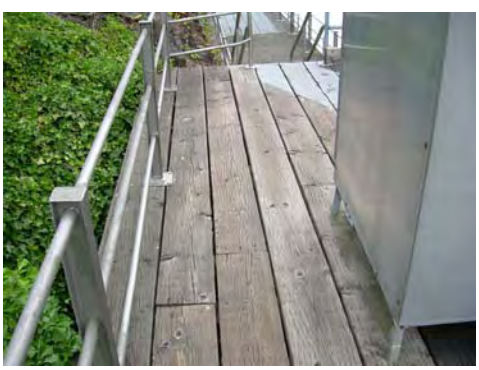
Attached photos in a PowerPoint Presentation

Various Handrail deficiencies at the Willamette Falls Locks

- West side gangway, pin and deck planks. Float casing cracking and corrosion



- Walkway and deck planking issues: checking, rotting, offset, deflection, etc.

- Typical Lock Wall conditions.
- Misplaced wall support

- Various Miter gate photos - chambers and operations

Miscellaneous issues:

- Moving gudgeon anchor block
- Rotted walkway support
- Insufficient lateral bracing
- Missing grating support

WILLAMETTE FALLS LOCKS

Annual Maintenance Report

Fiscal Year 2006

The Annual Maintenance Report is compiled to document execution of appropriated funding, operating costs, accomplishments and identification of backlog deficiencies.

Willamette Falls Locks operated under caretaker funding for fiscal year 2006. Supplemental funding is also provided through a partnership with Oregon Solutions Coalition.

Operating Budget:

Appropriated funding identified as caretaker status.

- Received- $53,000
- Expended Labor- $37,763
- Expended Materials/Supplies- $14,900
- Execution- 97.34%

Coalition funding received through Oregon Solutions Coalition.

- Received- $156,800
- Expended Labor- $84,469
- Expended Materials/Supplies- $6,200
- Remaining- $66,090

Annual Lockage by Vessel Type:

- Dry Cargo 8
- Commercial 51
- State/Local 1
- Passenger/Ferry 36
- Federal 2
- Recreational 393
- Tow/Barges 46

Willamette Falls Locks operated under caretaker funding from 1 October 2005 through 31 May 2006. Willamette Falls Locks opened under coalition funding on 1 June, 2006 through 30 September, 2006. Operation was on a Thursday through Monday schedule to meet the needs of both commercial and recreational river traffic. Work under caretaker funding was for winterization, minimal maintenance, emergency lockages and addressing high river flows and flooding issues. Coalition funding provided passage through the lock from 9:00 AM to 5:00 PM for the five day per week schedule. Additional maintenance and safety items were worked during the June through September season.

Lock Fest is a seasonal event sponsored by the Willamette Falls Heritage Foundation. Lock Fest was conceived to help spread the word in the local community and abroad on the concerns over funding and reduced operations and impacts to local communities. The first Lock Fest was in 2003 and has become an annual event with many volunteers, sponsors and growing participation. Lock Fest was held on 20 May, 2006 with a signing ceremony of

stakeholders for the Oregon Solutions Coalition Partnership Agreement. Attendance included Colonel Thomas O'Donovan, Portland District Commander, James Mahar, Bonneville Lock and Dam and Willamette Falls Locks Project Operations Manager and many from the Oregon Solutions group and stakeholders from the local community.

Brief of Maintenance and Repairs Conducted:

Repairs to miter gate 2 west gudgeon anchor system was conducted. This is an interim repair to keep the gate in operation and is not considered a permanent repair. Auto control system was partially updated. Repairs were made to the museum stairway for emergency exit. Some walkway and handrail was removed and barricaded off or repairs made as needed for public safety. Removal of the buried diesel tank was accomplished to meet regulatory requirements. Repairs to hydraulic hoses, fittings and lines were made. Incorporation of hydraulic level controls for overflow of tanks was installed. Repairs to lighting, communication and lock controls were made. Some identified safety discrepancies were corrected. Routine maintenance was conducted as needed.

Three separate safety inspections were conducted during FY06. District Dam safety staff conducted an inspection in July, District safety office conducted an inspection in August and project engineering staff conducted an inspection in June. All provided documentation of safety discrepancies and recommendations. The most critical items were corrected with an emphasis on public safety, employee safety and the safety of employees from the adjacent West Linn Paper Mill and Portland General Electric Sullivan Plant. Items that have the potential for impacting the environment also received high priority and were addressed. All remaining discrepancies are documented and broke out by category. Repairs to walkways and walkway support structure, ladders and guardrails will be extensive.

Backlog of Discrepancies:

Process and Standard Operating Procedures:

- Emergency Action Plan needs updating
- Supply fall protection equipment
- Conduct fall protection training
- Update Activity Hazard analysis for fall protection

Main Office Building and General Facility:

- Illuminated exit sign required in garage area
- Exit sign in visitor area needs lamp replaced or sign is faulty
- Exit sign in main visitor area needs lamp replaced or sign is faulty
- Repair stairs and access for visitor entrance
- Replace damaged and missing fire fighting equipment
- Conduct inspections and label fire fighting equipment
- Replace or repair non compliant and damaged guardrails, ladders and walkways
- Upgrade chain restraints to meet regulatory requirements
- Remove home made and non-compliant rigging
- Conduct maintenance, inspection and load testing for rigging equipment
- Replace gutters as needed
- Repair irrigation line underneath roadway

Gates Common:

- Install fall protection in areas employees' access and no fall protection exists
- Repair slide gates as required for normal operation
- Repair miter gate gudgeons and stay rod anchorages
- Repair or replace grating as needed
- Complete repairs to auto control system to control flooding mill facility and maintain proper chamber levels
- Conduct annual inspection of gudgeon anchor system for each gate
- Repair or replace guardrails for all gates

Gate #1:

- Repair hydraulic operating arm base plate anchor
- Replace or stabilize concrete block for gate anchoring system

Gate #2:

- Repair miter gate gudgeons and stay rod anchorages, this one is most critical

Gate #3:

Gate #4:

Gate #5:

Gate #6:

- Repair or replace operating arm bolts and nuts

Gate #7:

Control Houses:

- Repair control house communication system
- Repair lateral bracing for control house six

Chambers:

- Conduct Hydraulic Steel Structure (HSS) inspection
- Repair chamber walls including planking and loose granite
- Replace hydraulic piping crossing chambers
- Repair down stream booms
- Repair down stream access ramp and dock
- Conduct chamber inspection after HSS inspection and repairs are conducted

Hydraulic Systems:

- Replace hydraulic hoses as needed

Work Barge:

- Repair or replace sump pumps
- Conduct annual inspection
- Complete activity Hazard analysis and rescue plan for barge work
- Have personal floatation devices available
- Have a throwable floatation device available
- Install guardrails
- Provide safe access to work barge
- Install fire extinguisher

Museum:

- Repair steps to museum
- Paint structure
- Repair window seals
- Repair heaters

Public Access:

- Throwable flotation devices need replaced and installed where missing

Electrical Systems:

- Repair indicating lighting

Hazardous Waste/Storage:

- Housekeeping
- Remove compressed gas cylinders from flammable lockers (Verify completion)
- Repair exhaust fan for flammable storage building
- Cut back brush from around flammable building
- Clean out flammable lockers and remove expired materials

Storage Buildings:

- Housekeeping
- Replace oil absorbents and oil boom

Appendix C

USACE Supplied Technical Data and Bid Tabs

Willamette Falls Locks

West Linn, Clackamas County, Oregon

Pertinent Data

The locks system consists of 4 locks, canal basin and a guard lock at the upstream end. The gates are numbered 1 through 7 starting at the downstream end.

Total length: 3,565 ft.

Total lift: 50.4'
Depth over sills: 6.5 ft.

Usable width: 37 ft.

Max. vessel length: 175 ft.

Gate No.	Station	Top of Gate Elev.	Top of Sill Elev.
1	10 + 00	23.82	- 6.11
2	12 + 10	34.38	15.52
3	14 + 20	44.40	25.40
4	16 + 30	54.43	35.66
5	18 + 40	54.14	43.33
6	31 + 12	64.5	43.60
7	33 + 23	64.84	43.41

Lock No.	Lock wall Elev	Lift of Lock
1	38.5	20.5'
2	42.0	10.6'
3	44.4	10.0'
4	56.5	9.3'

Guard lock at upstream end is used only seasonally, to maintain constant level of canal basin.

Canal basin - between lock 4 and guard lock:

Length: 1250 ft.

Width: 40-100 ft. variable

Water level: maintained constant

Crown Zellerbach timber wharf - 850' along right side canal basin.

River stage fluctuations

Above locks: 10 ft. (12' - extreme conditions)

Below locks: 20 ft. (30' - extreme conditions)

Original locks were built in 1870-1872. They are located 12 miles upstream from Portland along the left bank of the Willamette River at Willamette River Falls, 26.1 miles from the mouth of the Willamette where it flows into the Columbia. They were built by the Willamette Falls Canal and Lock Company, and ownership has changed several times. The United States purchased the locks 26 April 1915.

1917 - A division wall was built to separate the canal from the powerhouse intake. It is constructed of concrete, 1,227 ft. long.

A complete rehabilitation was finished in 1921. The locks were deepened to a controlling depth of 6 ft. at low water; they renewed all seven pairs of wooden gates, and renewed timberwork and fenders along the lock walls.

The left side of the locks system is for the most part cut in rock, and the walls of the right side are mostly concrete, masonry, embankment and wooden cribbing. The bed of the locks system is generally on solid rock.

STRUCTURES

Walls - Most of the walls consist of a wooden lining constructed of 3"x12" waling fastened to 12"x12" posts. The posts extend to the bed of the locks and rest on prepared bases. The posts are fastened to 12"x12" horizontal braces by tie rods. The tie rods are either anchored in sound rock or extend to dead-men buried well back of the wall.

Improvements:

1960 - Lock 3 left wall (landward side) - Replaced by a modified timber structure with a partial concrete backfill. Consists of 12"x12" vertical treated timber posts spaced 5'0" o.c. and braced and anchored to rock. The inner face of the wall is lined with treated rough plank to retain the backfill, consisting of concrete for the lower 10 ft. and broken rock and sandy gravel for the remainder of the backfill.

1962 - Lock 4 - Walls were replaced with new timber wall lining of similar structure to original except that the lumber is now treated.

1971 - Lock 3 right wall replaced with the same type of structure as the left wall: modified timber structure with partial concrete backfill.

1973 - Lock 2 - Wall linings were replaced with similar structure to original using treated timber supports. Also, chain link fabric was added above elev. 26.5 on the right wall and above elev. 31.5 on the left wall.

Gates - The seven lock gates are constructed of structural steel with wooden miter and quoin posts. Except for Gate No. 1, which is 30 ft. 5½ inches high, they are approximately 20 ft. high by 20 ft. wide. Each gate

consists of two leaves, and in each leaf there are four sliding gates for releasing water from the chamber. Each gate , leaves and sliding gates, can be controlled locally from adjacent platform to each gate, as follows:

10 HP Gate No. 1 Platform, west side

7.5 HP Gate No. 2 Platform, west side

7.5 HP Gate No. 3 Platform, west side

7.5 HP Gate No. 4 Platform, west side

7.5 HP Gate No. 5 Platform, west side

7.5 HP Gate No. 6 Platform, east side

10 HP Gate No. 7 Platform, east side

These are all 220/440 three phase motors and operated at 1,750 RPM, on 480 volts. Replacement of gates has been completed:

Gate No. 1 - Jan 1970 (Lock 1)

Gates Nos. 2 and 4 - 1970 (Between Locks 1&2,Between 3&

Gate No. 3 - 1968 (Between Locks 2 and 3)

Gate No. 5 - 1971 (Between Lock 4 and Canal)

Gates No. 6 and 7 - 1966 (Guard Lock)

The sliding gates of structural steel are located in the lower portion of the gate leaves. There are four in each leaf, and each sliding gate measures 27" x 41". The sliding gates are connected to slide gates connecting rods which are raised and lowered by hydraulic cylinders on Gates No. 1, 5, 6, and 7 and by six 3/4 HP electric motors on Gates 2, 3, and 4. One motor is located on each gate leaf of the above mentioned gates.

Platform - Gate platforms, to which gates are anchored and from which the gates are operated, are of stone masonry. The miter gate sills are also of stone masonry except for portions replaced by concrete.

Sills - All sills are concrete on rock masonry, except for Gate No. 1, which is timber on concrete.

Sumps - At Gates 2, 3, and 4 are sumps in the bottom of the lock chambers, approximately 2 feet square, used for unwatering when necessary.

Shear Cribs and Guide Walls - A guide wall system was built to aid in guiding barges and other river traffic into the lock approach channels. At the downstream entrance a log guide boom and short section of timbered wall form a guide on the west side, and two rock-filled steel sheet pile cells, two log booms set between them, and a section of concrete wall form a guide wall on the east side. Three rock filled cribs with sections of guide boom set between them form a guide on the east side of the upstream entrance to the locks.

Booms -

Upstream Entrance	West side - 350 ft.	
	East side - 315 ft.	(used mainly to separate channel from paper mill log pond)
Downstream Entrance	West side - 150 ft.	

Lock Basin - West Bank - 300 ft. (used to guide rafts into Lock No. 4)

All of the guide booms are self-adjusting to the river stages.

The Crown-Zellerbach paper mill maintains a load dock along the east side of the canal basin.

GEOLOGY

General - The locks are excavated in the Columbia River Basalt Formation, consisting of a series of 25 to 30 ft. thick basalt rock layers, alternating with a 0.1 to 1 ft. thick interbed material of mixed sedimentary and pyroclastic

origin. The layers strike N30°E, dip about 5°SE and cross the locks and river obliquely, dipping downstream. The basalt rock layers vary in vertical section and have been classified into two zones based on a combination of interrelated factors such as percentage of vesicles, weathering, hardness, joint and fracture spacing, and rock density. Zone I is a soft, porous, highly vesicular, fragmented rock. This phase usually occurs at the top of each layer and has random joints commonly paralleling the overlying contact with the interbed. The vesicles are often filled with dark green, soft, chloritic minerals. Zone II is a very hard, dense, medium-grained crystalline rock and has systematic and continuous, prismatic jointing perpendicular to the underlying contact with the interbed. The dense phase usually occurs at the base of each layer. The interbed material is a light weight, very soft, fine-medium grained, granular rock. The interbeds contain a continuous shear plane with plastic fines, and has an irregular undulating attitude, with a relief of 1-2 ft. from a plane surface. The shear planes were developed by tectonic forces and further weakened by the effects of weathering and unloading by erosion and excavation.

Lock Conditions -

The rock sides of the lock are vertical cuts that have been in excavation for over 100 years. The dense phase (Zone II) forms the upper part of the lock sides, the interbed occurs about in the middle of each side, and the vesicular phase (Zone I) comprises the bottom and lower parts of the sides. The vesicular phase is massive and only contains randomly spaced joints. The interbed contains a continuous shear plane which dips about 5° out of the west wall and into the east wall. The dense phase has nearly vertical joints

which divide the rock mass into joint blocks 2-3 ft. wide, 10-15 ft. tall, and an estimated weight of 8-10 tons. The fracture system within the blocks is random. Joint blocks are interlocked, preventing mass movement of the blocks toward the excavation. Movement and inflation of the outermost joint blocks on the underlying, sheared interbed base has taken place on a random and selective basis. The amount of movement has been slight but results in opening of the joints and fractures, and sagging of some blocks. Weathering and the effects of alternate wetting and drying has removed part of the interbed in the cut face resulting in an overhang or slight recess. The bottom of the lock entrance is in sound rock, and the riverward guide wall system was constructed on rock.

Rock Anchorage Conditions

Core drilling indicated that the rock along the lock wall face is intensively fractured, jointed, and weathered for several feet back from the face. For the replacement of the east wall at lock No. 3, it was decided that 20-ft.-long rebar or rock bolt drill holes collared at about elev. 34 and at a minimum 20° angle to the horizontal would penetrate Zone II material in most instances or into Zone I material having optimum anchor conditions. Grouted rock bolts penetrating a minimum of 5 ft. into Zone II would provide the most effective anchorage at the site and would help prevent further deterioration of rock conditions along the lock wall. The design for the replacement of walls at lock No. 2 indicated that rock anchorage in the vesicular phase would present no difficulties except for random occurring vesicule concentrations resulting in reduced shear strength, and anchorage with rock bolts in the interbed should not be attempted. Rock anchorage in the upper dense phase would be based on the weight of the rock mass and the

degree of interlock of the joint blocks. It was decided that 20 ft.-long rock anchors with a slight down angle to allow gravity filling with grout would penetrate enough suitable rock material of adequate weight in most instances. The foundation for the wall is in the vesicular phase which has an allowable bearing capacity many times that required.

Rock Failures -

In March 1970 it was noted that the large basalt blocks behind the north walls of Locks 1 and 2 were unstable and should be monitored, as they were restrained by old cables. On 11 March 1970 a 12 ft. high block did fail, causing slight damage to the wall of Lock No. 1. In May 1970 the removal of two large rocks, located along the left wall of the downstream entrance to the locks, was accomplished. Rock A was located just downstream of the end of the guide wall, and Rock B was behind the wood guide wall. Rock A, weighing over 40 tons, had become tilted, opening up natural fractures and new breaks. The fractured, unstable condition of the rock made it an immediate hazard. Rock B weighed about 26 tons and was restrained only by a rusty cable from falling into the canal. At this time the bottom of Lock No. 1 was cleaned out, removing loose rock.

REPORT OF
INSPECTION OF LOCK STRUCTURES
WILLAMETTE FALLS LOCK
WILLAMETTE RIVER, OREGON

1. A complete inspection of the Willamette Falls Lock was made on 25-27 July 1978. Corps of Engineers personnel that participated in the inspection were:

Portland District - Engineering Division

Raymond Dewey, Structures Section, Design Branch
Michael Flynn, Structures Section, Design Branch
Philip Grubaugh, Geology Section, F&M Branch
Darrell Hibbits, Concrete Control Section, F&M Branch
Owen Tessman, Mechanical Section, Design Branch
Edwin Watkins, Structures Section, Design Branch

Portland District - Project Operations Division

Jack Braithwaite, Technical Branch

Portland District, Willamette Falls Locks

Bill Cuddy
Bruce Tangen, Lockmaster
Emerson Tiedeman

2. Inspection Summary. The walls of Lock 1 and walkways along No. 1 were found to be in need of repair. The rock walls behind both sides of Lock 1 are unstable and contain loose basalt blocks. Locks 2 and 3 were found to be in good condition. Lock 4 was found to be in sound condition except that the ramp and wood deck along the west wall of the Lock Chamber No. 4 has deteriorated and presents a safety hazard to lock personnel and the public. The deck planking around the Lockmaster's office was found to be rotten. The Government warehouse adjacent to the Lock Basin is settling into the basin. The east guide wall upstream of gate No. 7 was found to be rotten.

3. Recommendations. The following major recommendations are made.

a. New walls for Lock Chamber No. 1 should be designed and constructed.

b. The walkway along Lock Chamber No. 1 should be replaced.

c. The rock walls on both sides of Lock No. 1 should be stabilized by the removal of all loose rock blocks, bolting of rock faces and shotcreting of the interbeds.

d. The ramp and wood deck adjacent to Lock 4 should be repaired and the deck planking around the Lockmaster's office should be repaired.

e. Methods of stabilizing the warehouse which is settling should be investigated, and repair of deck planking and ramps around the warehouse should be performed.

f. The east guide wall upstream from Gate No. 7 should be replaced.

g. Miscellaneous repairs as discussed in paragraph 12 of the report should be made.

4. Reference Data.

Type of Lock	Multiple Lift
Normal Total Lift	Feet 41
Maximum Width of Tow	Feet 37
Maximum Length of Tow	Feet 175
Maximum Draft of Tow	Feet 6.5
Maximum and Normal Water Surface Fluctuations	
Downstream	Feet 30-20
Upstream	Feet 12-10

5. General. Inspection details and comments follow. Information is current to the date of this report.

6. Inspection Monitoring and Reading Schedule. No current instrumentation is being performed at the Locks, but previous data on rock movements at the east side of Lock 1 and photographs of this inspection are on file in the Foundation and Materials Branch.

7. Lock Number 1.

a. Core samples of the timber posts and wall lining of Lock No. 1 were taken. Core samples of posts and planks below wall elevation 16 were solid. Most of the core samples above wall elevation 24 were found to be rotten. Some columns were observed to shake and move when a small force was applied. Horizontal boards above elevation 24 are loose and new spikes used for repairs do not hold sufficiently. Spikes were observed to go into the posts with little resistance. New walls for Lock Chamber No. 1 should be designed and constructed (Incl. 1 and Incl. 4 items 1A).

b. Walkways along Lock No. 1 were inspected. Many of the walkway beams were found to be easily penetrated with a pocket knife. Part of these beams were found to be easily removed and crumbled by hand. Carpenter ants have hollowed out several walkway beams, reducing the allowable stresses in these areas. The walkway along Lock Chamber No. 1 should be replaced (Incl. 4 item 1B).

c. Inspection of the west side of Lock No. 1 revealed several loose basalt blocks or rock masses in the near vertical rock cut adjacent to the lower wood deck on top of the wall planking. These rock blocks are separated by open joints and in some areas are temporarily restrained or supported by passive "girdle" systems of steel cables that are stretched horizontally across several blocks and anchored at minimal depths to adjacent more stable appearing blocks. The loose rock masses extend downward from the top of the cut to approximate elevation 25, where interbed erosion has partially undercut the basalt flow. Interbed locations are mostly hidden behind the Lock No. 1 planking, but projections from previous nearby explorations indicate there is an upper interbed that extends from approximate elevation 27 at Gate 2 to approximate elevation 24 at Gate 1, and a lower interbed that extends from approximate elevation 1 at Gate 2 to approximate elevation -1 at Gate 1. Conditions of these interbeds and of the number and extent of the loose or potentially loose rock masses that might eventually fail cannot be determined without either at least partial removal of the wall planking or possibly in part by lowering personnel on safety lines between the lock wall and the rock cut. Conditions along the Lock 1 east wall are similar to those along the west wall except that the extent and number of unstable rock blocks is much less since the dip of the rock layers is to the southeast away from the lock instead of into the lock.

d. The rock walls on both sides of Lock No. 1 should be stabilized by the removal of all loose rock blocks, bolting of rock faces and shotcreting of the interbeds. This work should be scheduled to coincide with repair or replacement of the lock walls. An accurate geologic map will have to be prepared for both walls to determine the location and amounts of loose rock to be removed, rock bolt design and the tentative rock bolt pattern. The final rock bolt pattern will have to be determined in the field upon completion of removal of all loose rock materials. It will most likely be necessary to remove portions of the lock wall planking to prepare the geologic map. If the planking can be removed temporarily for this mapping in advance of final lock repair, it would be advantageous both for the final design of the rock wall stability plans, and for the contract quantity estimates. Loose rock materials will have to be removed by wedging and splitting and with a barge mounted crane, since no blasting will be permitted and access is limited. Preliminary estimates include removal of at least 200 tons of rock materials with single rock blocks up to 30+ tons. Tentatively, the rock bolts are to be a groutable type of one-inch or greater diameter and 15- to 20-foot lengths, placed on an approximate eight-foot rectangular pattern. Shotcrete together with suitable reinforcing and drainage will be required for the full length and thickness of the interbeds (See Incl. 5).

8. Lock Numbers 2 and 3. Locks 2 and 3 were drained and inspected. The walls appeared to be in sound condition from inside the Lock Chamber. In the middle two-thirds of Lock 3 rock debris was noted

to have been deposited. This material should be removed when normal maintenance is performed. No repair of these locks is required.

9. Lock Number 4.

a. Lock 4 was inspected and found in sound condition. A core sample from a post in this area was taken and found to be solid. The masonry steps to the control house at Gate No. 4 are out of alignment. The steps appear to have been hit by a barge in the past.

b. The ramp and wood deck along the west wall of Lock Chamber No. 4 has deteriorated and present a safety hazard to Lock Personnel and the public. Core borings were taken of the timbers supporting the ramp and wood deck. The core samples showed the timbers to be rotted in most cases. Also, visible deterioration of the wood timbers was observed under the wood deck and ramp. The rock wall on the west side of the lock was observed to leak landward through the joints in the wall. The leakage has caused the vertical timbers, behind the wall, which support the deck to rot. The ramp and wood deck adjacent to Lock No. 4 should be repaired as soon as a design can be prepared (Incl. 4, item 2).

c. The deck planking between the Lockmaster's Office and Lock Chamber No.4 was inspected. One deck plank was removed and core sample from a support beam was taken and found to be rotten. Deck planks on the south and west side of this building were easily penetrated with a crowbar. This should be repaired at the same time as the ramp and wood deck adjacent to Lock 4 is repaired (Incl. 4, item 3).

10. Lock Basin.

a. The Government warehouse adjacent to the Lock is settling. Timber bracing in the foundation has come apart from other structural members. The ends of some beams under the warehouse and ramp have deteriorated. A foundation post core showed rot in the middle of the sample. Methods of stabilizing the warehouse should be investigated. Many deck planks around the warehouse were easily penetrated with a crowbar. The deck and ramp should be repaired. Seven sections of the log boom on the west bank adjacent to and upstream from the warehouse are becoming waterlogged and should be replaced (Incl. 4A, item 4).

11. Guard Lock. The east guide wall upstream from Gate #7 was found to be rotten and should be replaced (See Incl. 3 for location). Sinker logs go under the adjacent log boom and into the locks. Methods of preventing this should be studied.

12. Miscellaneous Observations and Recommendations.

a. Downstream Access Walkway and Float.

(1) Nuts on base plates of Float Guide Frame were observed not to be snug against the base plate and covered with mud. The mud should be removed and all loose nuts should be tightened down when normal maintenance is performed.

(2) The connecting pin at each end of the walkway should be replaced. To keep the walkway centered on the pins, washers should be installed on each side of the pins. The pins were found to be bent and rusted at the time of the inspection (cost not provided).

(3) Inside angles of lower chords on the walkway were observed to be rusting under the paint. Additional spot rusting at other places was observed on the walkway.

b. Handrails.

(1) All loose handrail base plates should be tightened.

(2) Clean and paint all handrail base plates with extensive rusting.

(3) The handrail base plate that is located next to Gate #1 recess on the left side of the lock should be replaced.

(4) Unstable Ground in Government Parking Area. Cracking was noted in the asphalt at the southeast corner of the Government Parking area. The cracks form a rectangular rather than a curved pattern, more indicative of an asphalt patching problem than of slope instability. However, additional investigations indicate previous slope failures beyond the outer edge of the present area, together with fresh local slope raveling and some apparent minor settlement. The affected area is roughly 20- by 40-feet in size and apparently underlain by fill materials. It may possibly be on non-Government land. No specific corrective action is believed to be economically justified or recommended, but unless it can be ascertained that the area is definitely stable, it would perhaps be advisable to keep traffic off this corner of the parking lot.

13. Cost Estimate. The estimated cost for design and construction of the above discussed items are inclosed (Incl. 4 and 5). The costs are current to the date of this report, and does not reflect any future costs. No costs are provided for the miscellaneous items in paragraph 12 of the text.

14. Conclusion. The Willamette Falls Locks are in need of repair as discussed in the report. The estimates of cost for design and construction for repair of the lock structures, and stabilization of rock cut slopes is approximately $ 546,140.

REFERENCE DRAWINGS

	Plate
General Plan and Elevation (Chambers 1 - 4)	1
Upstream Timber Guide Wall	2
Lock 3 Gate Replacement:	
- General Plan and Misc. Piping Details	3
- Gate Leaf Arrangement	4
- Gate Leaf Framing	5
- Slide Gates, Sill Seal, and Misc. Details	6
- Pintles, Gudgeon, Operating Rod Extension, Misc. Det.	7
- Quoin, Miter Post, and Misc. Details	8
Lock Chamber No. 2: Wall Lining	9
Lock No. 1: Right Wall Elevation and Sections	10

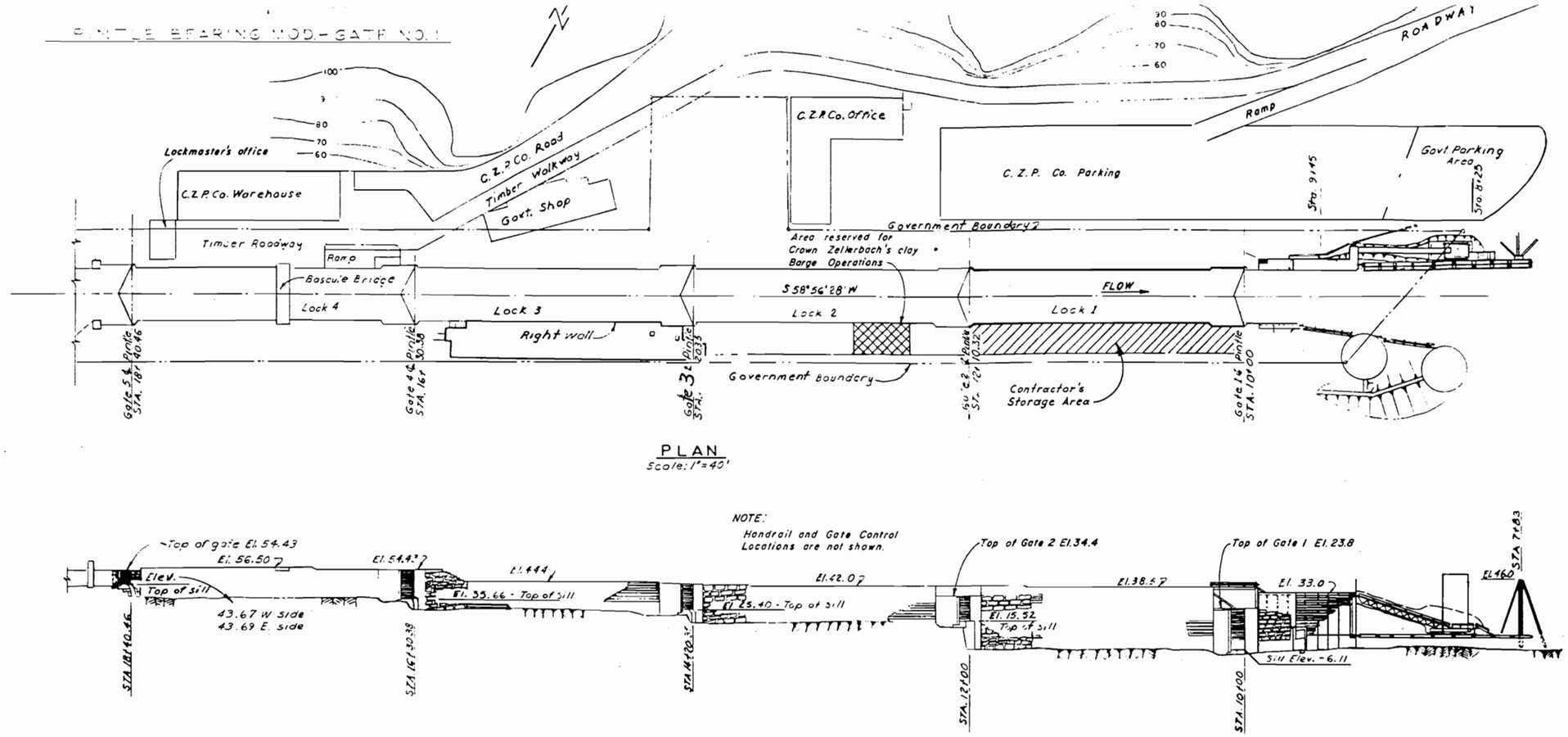
Note: These drawings should be fairly typical for other gates and chambers not included here.

D

C

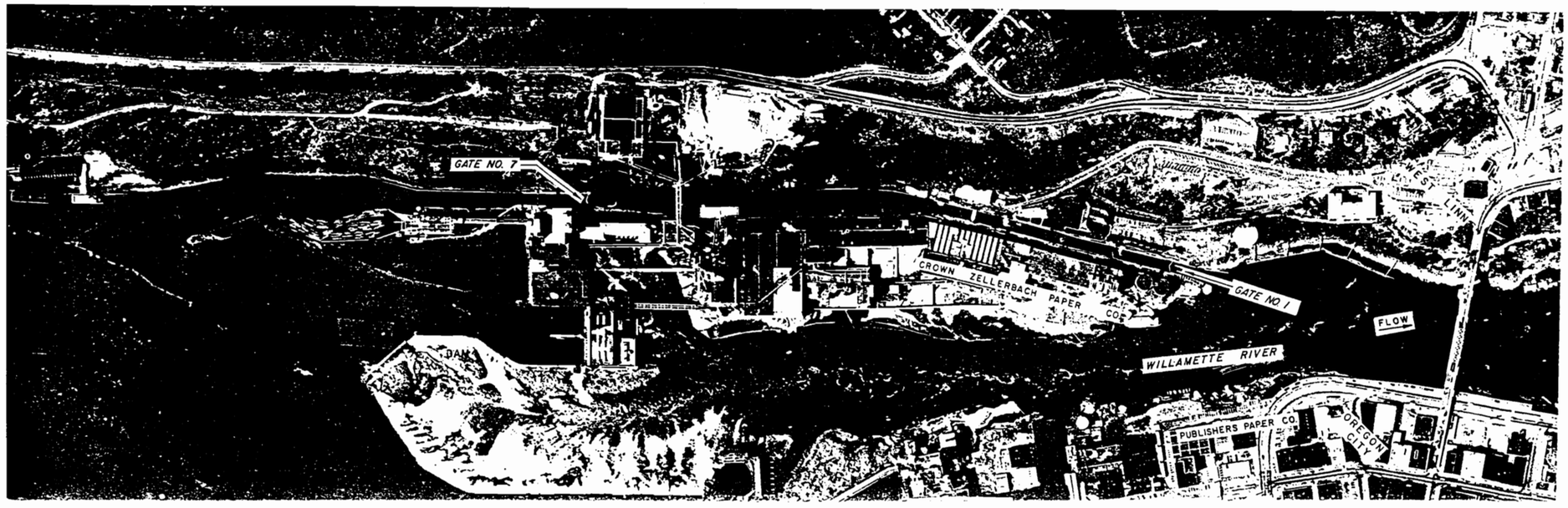
B

A



PLAN
Scale: 1"=40'

ELEVATION
Scale: 1"=40'

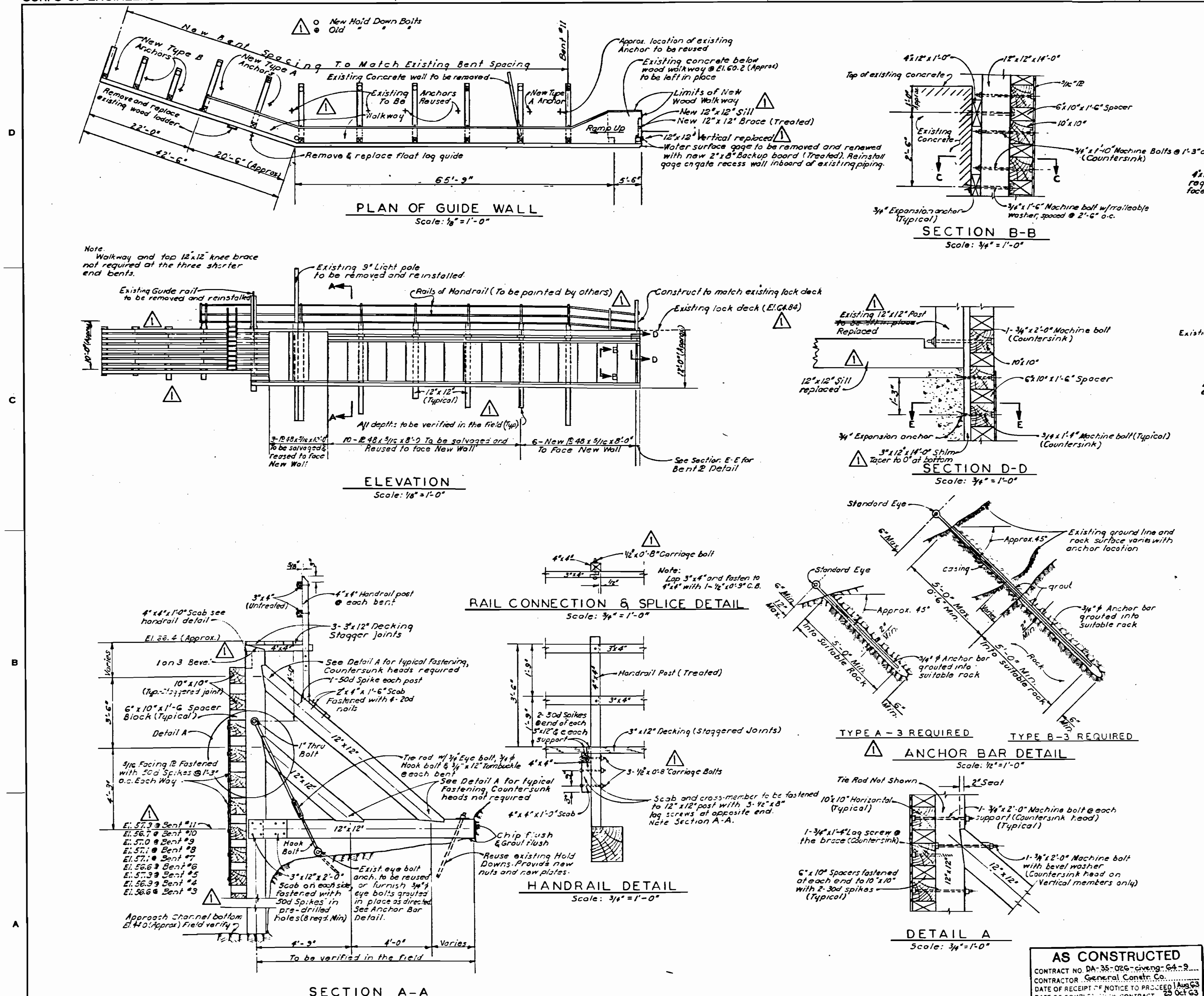


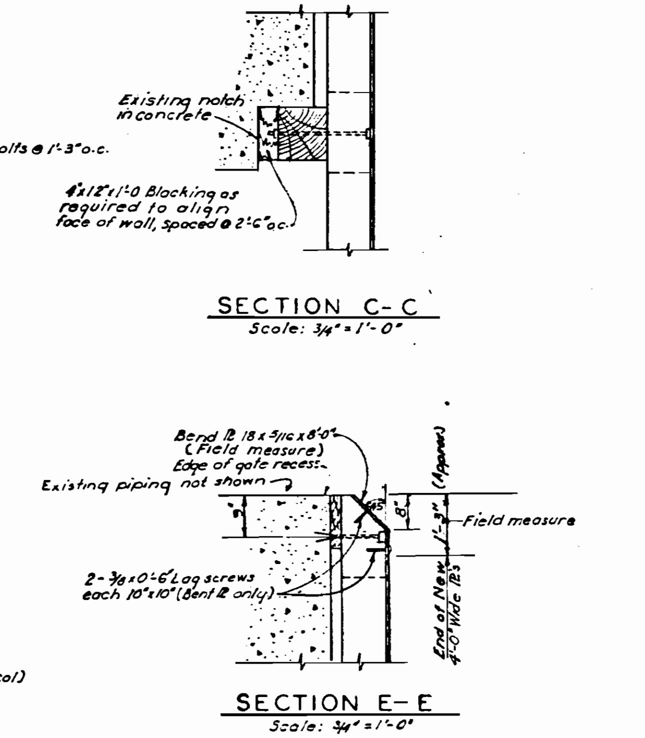
Willamette Falls Locks

Chambers 1-4 Plan and Elevation

Excerpted from plans for Gates 1 & 7 Repair

PLATE 1





GENERAL NOTES & MATERIAL SPECIFICATION

Dimensions: New installation of timber guide wall shall conform to existing construction unless otherwise designated.

Lumber: All lumber shall conform to "Standard Grading and Dressing Rules No. 15, WCLA."

Par. 125aa Dense Select Structural
12"x12" Posts and Bracing S4S
Par. 125a Select Structural
10"x10" Lagging S4S
Par. 123b Construction
3"x12" Walkway Planking S1S2E (Rough side up)
Par. 122b. Light framing
4"x4" & 3"x4" Frame and Handrail S4S

All lumber shall be treated except the 3"x4" rails of handrail.

Lumber Treatment: Coal Tar Cresote - See Specifications.

Structural Steel and Reinforcing Steel: See Specifications.

Steel Bolts, Nuts, Washers & Expansion Anchors:
a. Bolts shall conform to Fed. Specs. FF-B-575b and shall be Type I or Type II, hot-dip zinc coated.
b. Nuts shall conform to Fed. Specs. FF-N-836a, Group A - Type I, Group B - Type I - Style I, and hot-dip zinc coated.
c. Expansion anchors shall conform to Fed Specs, Group I, Type I.

Washers: Bolt head and nuts in contact with wood shall have Galv. malleable iron washers.

Nails and spikes: All nails and spikes shall conform to Fed. Specs. FF-S-606, hot-dip zinc coated.

Bolt & Lead Holes: Bolt hole diameter thru wood to be 1/16 inch larger than bolt diameter. Lead holes at end of all planks and blocks shall be approximately 3/4 diameter of nail and spikes.

Concrete & Grout: See Specs. for concrete. Grout shall consist of a mixture of 1 part Portland cement, 2 parts of concrete sand, unpolished aluminum powder in the amount of 3 grams per sack of cement, and sufficient water to produce a mix of flowable consistency. Grout mixed with the aluminum powder additive shall be used within 30 minutes after mixing.

AS CONSTRUCTED
CONTRACT NO. DA-35-026-civeng-64-9
CONTRACTOR General Constr. Co.
DATE OF RECEIPT OF NOTICE TO PROCEED 1 Aug 63
DATE OF COMPLETION OF CONTRACT 29 Oct 63
DATE OF ACCEPTANCE 29 Oct 63

REVISION	DATE	DESCRIPTION	BY
1	28 July 64	Revised As Constructed	

U. S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, PORTLAND, OREGON

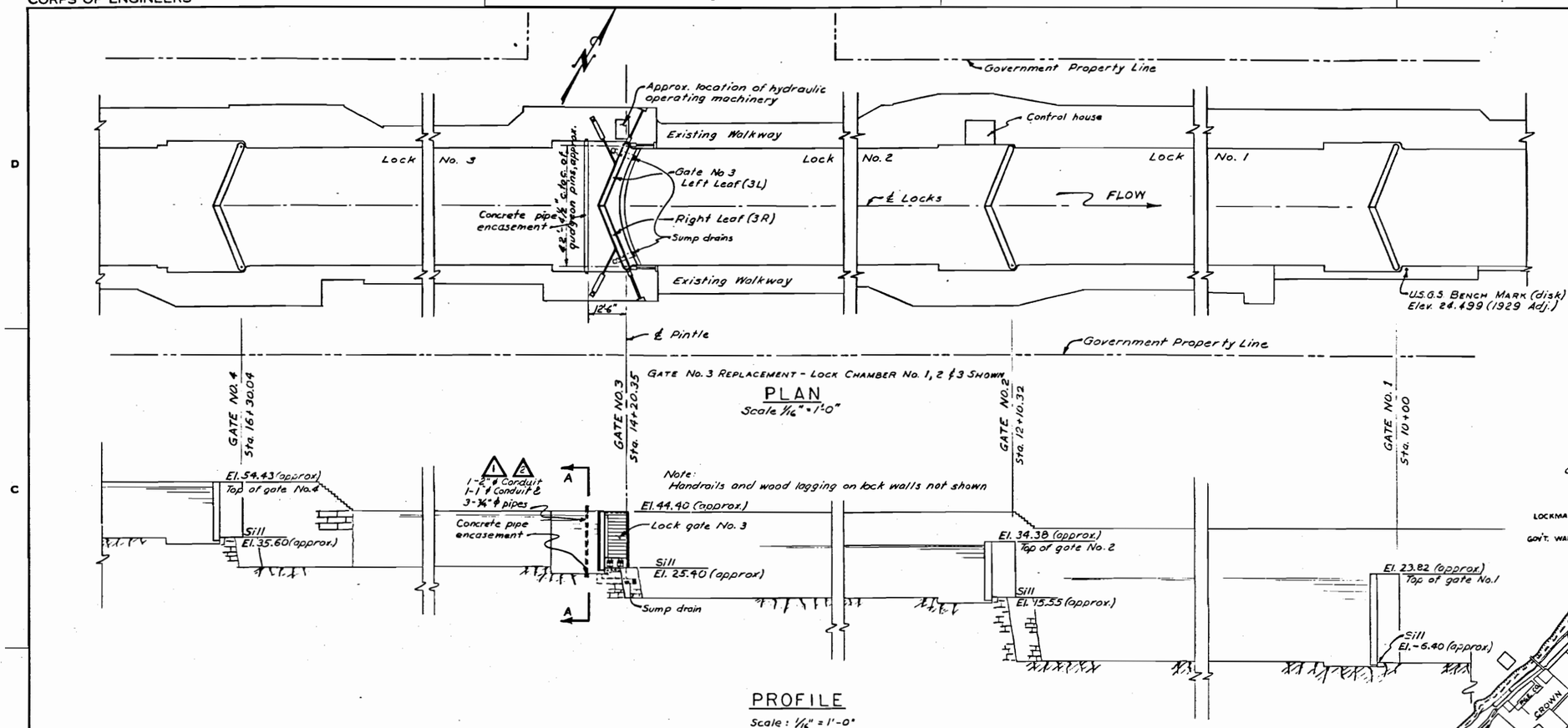
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON

UPSTREAM TIMBER GUIDE WALL

DESIGNED: D.A.F.
DRAWN: M.B.
CHECKED: W.R.G.
PREPARED: George B. Ludowick
REVIEWED: W.K. Zenik for, CHIEF, SAFETY BRANCH
SUPERVISED: Heber C. Heine, CHIEF, STRUCTURES SECTION
SUBMITTED: CHIEF, DESIGN BRANCH
RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: COLONEL, C. E., DISTRICT ENGINEER — DATE 17 MAY 63
SCALE AS SHOWN — SPEC. NO.
SHEET OF — UWR-114/94

PLATE 2

CORPS OF ENGINEERS — U. S. ARMY



Notes:
1. The contractor shall field verify all existing conditions, dimensions, and elevations as shown. See specifications.
2. Elevations referred to on this set of drawings are based on M.S.L. Datum, 1929 Adjustment.

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 17 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

Note:
All pipes shall be Extra Strong black iron.
Use socket weld fittings on all pipes excepting at bends on conduits.

REVISION	DATE	DESCRIPTION	BY
℄	13 Aug 68	Revised As Constructed	
1	25 Aug 67	Added 1" ϕ Conduit & Note	

U. S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, PORTLAND, OREGON

DESIGNED: H.C.
DRAWN: H.C.
CHECKED: D.P.S.
PREPARED: W.C. Douglas
SUPERVISED: Roy Reed, CHIEF STRUCTURES SECTION
SUBMITTED: CHIEF DESIGN BRANCH
RECOMMENDED: CHIEF ENGINEERING DIVISION
APPROVED: 23 Aug 67, COLONEL, C. E., DISTRICT ENGINEER

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
GENERAL PLAN AND MISCELLANEOUS PIPING DETAILS

SCALE AS SHOWN | SPEC. NO.
SHEET 1 OF 6 | UWR-114-101/1

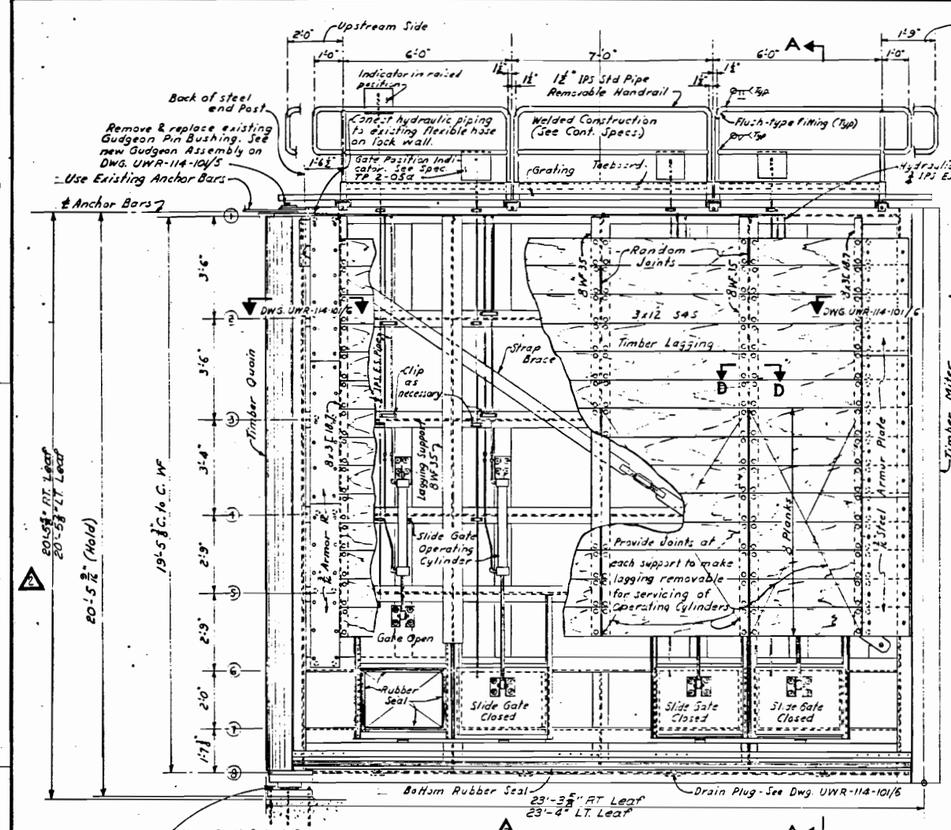
MISCELLANEOUS PIPING

PLATE 3

MICROFILMED 10 Sep 1968 AB

CORPS OF ENGINEERS

U. S. ARMY



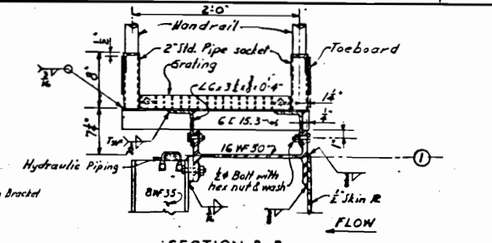
D/S ELEVATION

Item (1) GATE #3 : Leaf 3R as shown & noted. Leaf 3L opposite hand.

Scale 1/2" = 1'-0"

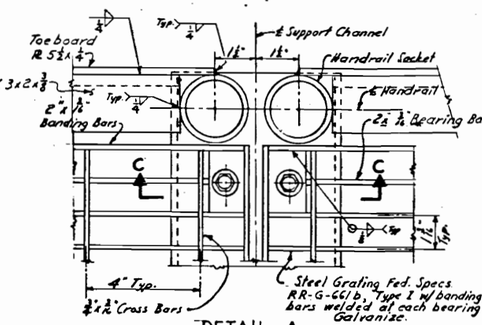
SECTION A-A

Scale 1/2" = 1'-0"



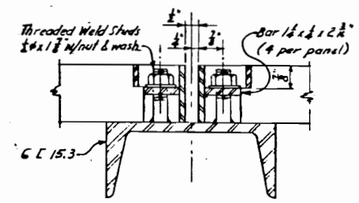
SECTION B-B

Scale 1 1/2" = 1'-0"



DETAIL A

Scale 6" = 1'-0"



SECTION C-C

Scale 6" = 1'-0"

GENERAL NOTES

1. VERIFY DIMENSIONS TO EXISTING STRUCTURES WHERE NOTED, BY ACTUAL FIELD MEASUREMENT BEFORE FABRICATING TIMBER MITER POSTS.

2. SUITABLE EQUIVALENT DETAILS, MEMBERS, AND MATERIALS MAY BE SUBSTITUTED FOR THOSE SHOWN, IF APPROVED BY CONTRACTING OFFICER; PROVIDED, THERE SHALL BE NO INCREASE IN CONTRACT PRICE.

3. PARTS OF EXISTING CONSTRUCTION, WHERE NOTED, ARE INTENDED TO BE RE-USED IN THE NEW CONSTRUCTION. CONFIRM SERVICEABLE CONDITION OF THOSE PARTS.

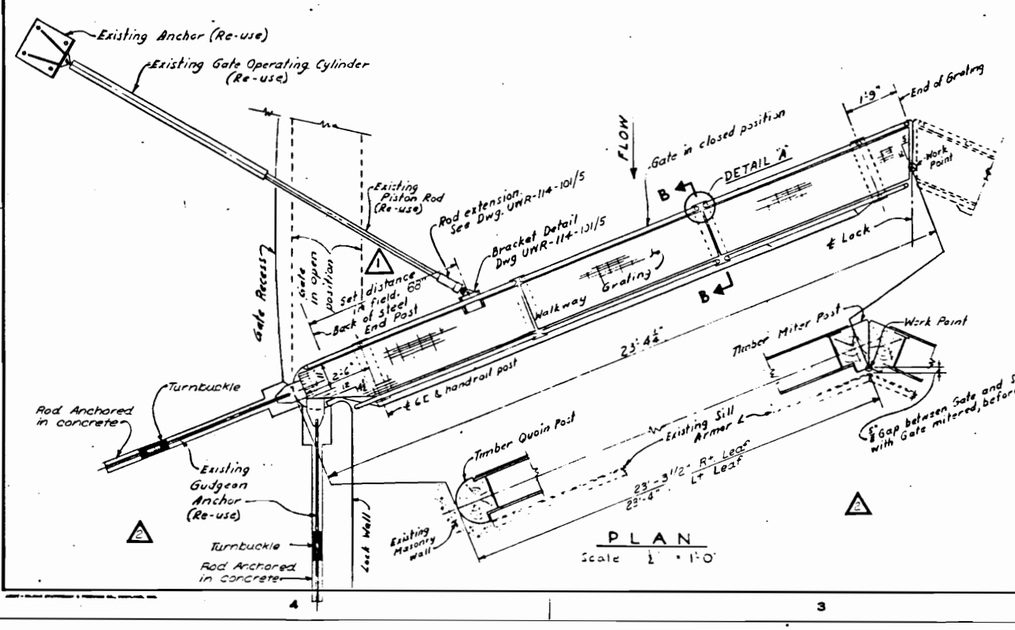
4. MATERIAL SPECIFICATIONS, UNLESS OTHER NOTED.
   (a) STRUCTURAL STEEL, ASTM A36-62T.
   (b) TIMBER POSTS, WEST COAST LUMBERMANS ASSOCIATION GRADING AND DRESSING RULES NO. 15, PARA. 125-aa, DENSE SELECT STRUCTURAL; TIMBER LAGGING, PARA. 125-a, SELECT STRUCTURAL.
   (c) BOLTS, ASTM A307-63T GRADE B, UNLESS OTHER NOTED.
   (d) HIGH STRENGTH (H.S.) BOLTS, ASTM A325-63T.
   (e) CORROSION RESISTING STEEL (CRES) BOLTS, AISI 410 OR 416.
   (f) FORGINGS, ASTM A235-63T CLASS C1.
   (g) HYDRAULIC PIPING, BLACK STEEL PIPE, PICKLED, WITH SOCKET-WELDED FITTINGS. (SEE CONTRACT SPECS.)
   (h) WELD STUDS, ASTM A108-61T GRADE 1017 - 1020 OR AISI C1020; GRANULAR FLUX FILLED, FULL PENETRATION AUTOMATIC BUTT WELDED.
   (i) OTHER MATERIALS AS NOTED ON DRAWINGS AND IN CONTRACT SPECS.

5. PAINT HANDRAIL, WALKWAY FRAMING, AND HYDRAULIC PIPING AND CYLINDERS, SYSTEM 1. NO PAINT ON CYLINDER PISTON RODS. PAINT OTHER METAL SURFACES, SYSTEM 2, EXCEPT, NO PAINT ON CORROSION RESISTING, FINISHED BEARING, AND GALVANIZED SURFACES. SEE CONTRACT SPECS. FOR SYSTEMS AND PAINTING DETAILS.

6. WELDING
   BASIC WELDING SPECIFICATIONS, AWS D2.0-66 AND ADDENDA, INCLUDING ACCEPTABLENESS, QUALITY, CORRECTION OF DEFECTS, AND RADIOGRAPHING OF WELDS. (SEE ALSO CONTRACT SPECS.) SUBMIT PROCEDURES FOR WELDS AND PROCESSES NOT PREQUALIFIED BY AWS SPEC. D2.0-66. ELECTRODES EXX12 & 13 NOT ACCEPTABLE FOR THIS CONTRACT. RADIOGRAPH WELDS FULL LENGTH, WHERE RADIOGRAPHING NOTED OR SPECIFIED.

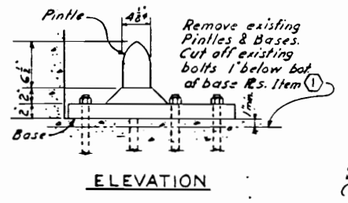
7. ADJUST STRAP BRACE AFTER GATE LEAF COMPLETE IN PLACE. OMIT LAGGING IN WAY OF SLEEVE NUT UNTIL STRAP ADJUSTED.

8. INSTALL LIFTING EYES ON TOP OF LEAF FOR SAFE HOISTING WITHOUT DAMAGING PAINT OR STRUCTURE.

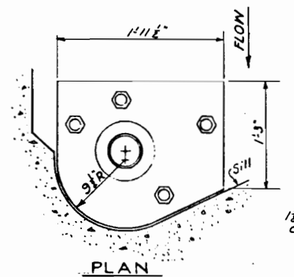


PLAN

Scale 1/2" = 1'-0"



ELEVATION

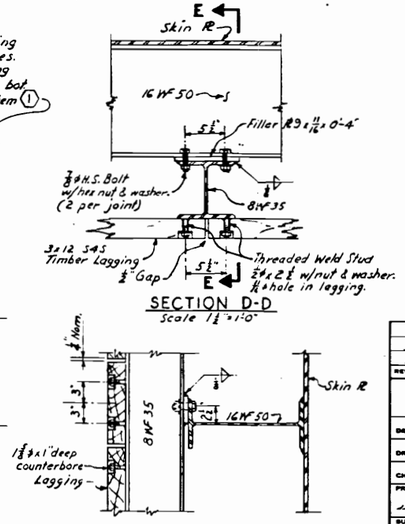


PLAN

EXISTING PINTLE

East one shown. West one opp. hand.

Scale 1 1/2" = 1'-0"



SECTION D-D

Scale 1 1/2" = 1'-0"

SECTION E-E

Scale 1 1/2" = 1'-0"

Req'd: One Gate complete in place, including pintles, Slide Gates complete with hydraulic cylinders and piping, lagging and supports, walkways and railings, and specified modifications of existing features; Gate No. 3, Item (1).

N.T.S. = Not to Scale.

AS CONSTRUCTED
CONTRACT NO. DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 25 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 69
DATE OF ACCEPTANCE 20 June 69

REVISION	DATE	DESCRIPTION	BY
2	13 Aug 68	Revised As Constructed	
1	25 Aug 67	Changed beam spacing (1)-(2), deleted dimension to bracket.	TFH

U. S. ARMY ENGINEER DISTRICT, PORTLAND

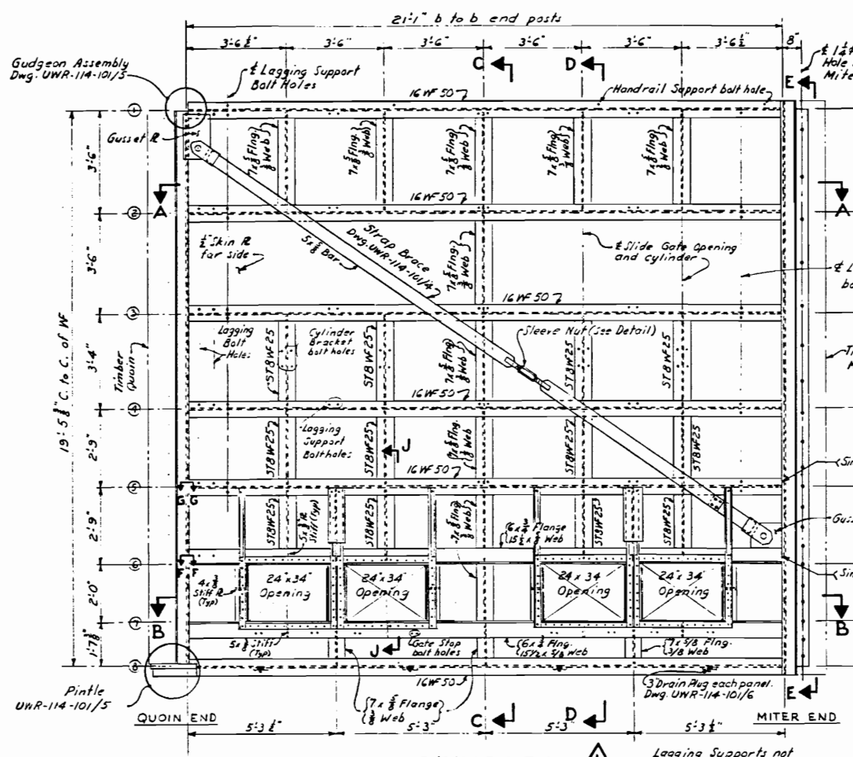
DESIGNED: D.P.S.
DRAWN: S.P.S.
CHECKED: W.E.D.
PREPARED: L. Douglass
SUPERVISED: Roy R. Miller
SUBMITTED:
RECOMMENDED:

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
GATE LEAF ARRANGEMENT

APPROVED: DATE: 19 Aug 67
SCALE AS SHOWN SPEC. NO.
UWR-114-101/2
SHEET 2 OF 6

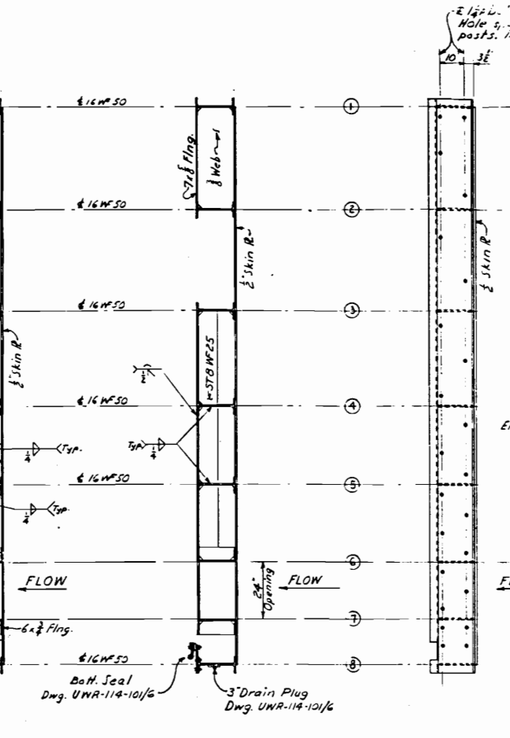
PLATE 4

CORPS OF ENGINEERS — U. S. ARMY



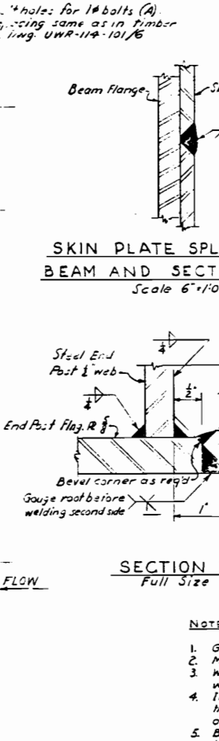
D/S ELEVATION ⚠1

Lagging Supports not shown; bottom seal not shown.



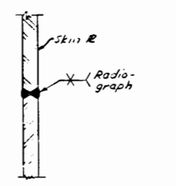
SECTION C-C

SECTION D-D
Scale ½" = 1'-0"



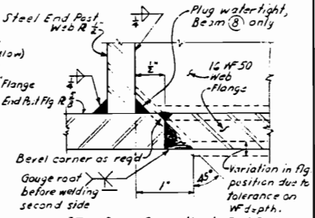
VIEW E-E
Miter End Shown.
Quoin End similar to, but opp. hand

SKIN PLATE SPLICE AT BEAM AND SECTION H-H
Scale 6"=1'-0"



SKIN PLATE SPLICE BETWEEN BEAMS
May be used instead of splice at beams.

SECTION F-F
Full Size

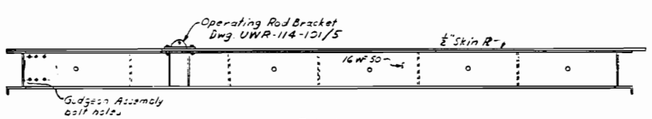


*Typ. Beam Connection to End Post

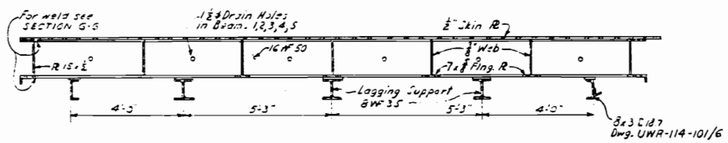
SECTION G-G
Full Size

NOTES:

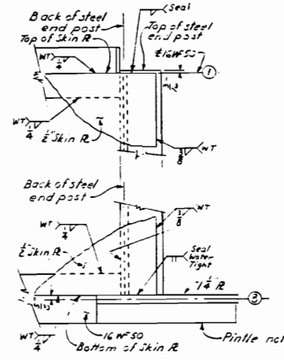
1. General Notes, Dwg. UWR-114-101/2.
2. Material, Structural Steel unless other noted or indicated.
3. Welded Construction unless other noted or indicated. All welding continuous unless intermittent specifically indicated.
4. Install ASTM A325 Bolts in accordance with Specifications of the Research Council on Riveted & Bolted Structural Joints of the Engineering Foundation, dated March 1962.
5. Bolt Holes, nom. dia. of bolt +1/16"; unless other noted. Pin holes ⅛" oversize, except as noted.
6. Drain Holes drilled or heat-burned circular & to size.
7. Skin R and seal mountings watertight.
8. Maintain Leaf Structure to dimensions, square and in plane. Steel End Posts (Quoin & Miter) must be parallel and straight. Hold Slide Gate openings square, to dimension and correctly spaced. Install Guides & Seal Mountings parallel to sides of opening and in plane.
9. Fabricate assembly comprising beams ⑤ & ⑦ as a unit; downstream flanges of assembly must lie in a common plane.



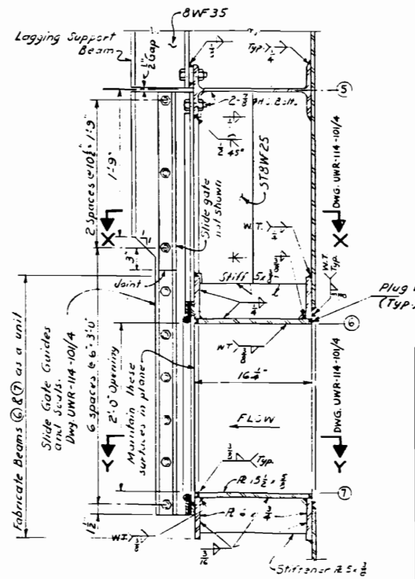
PLAN



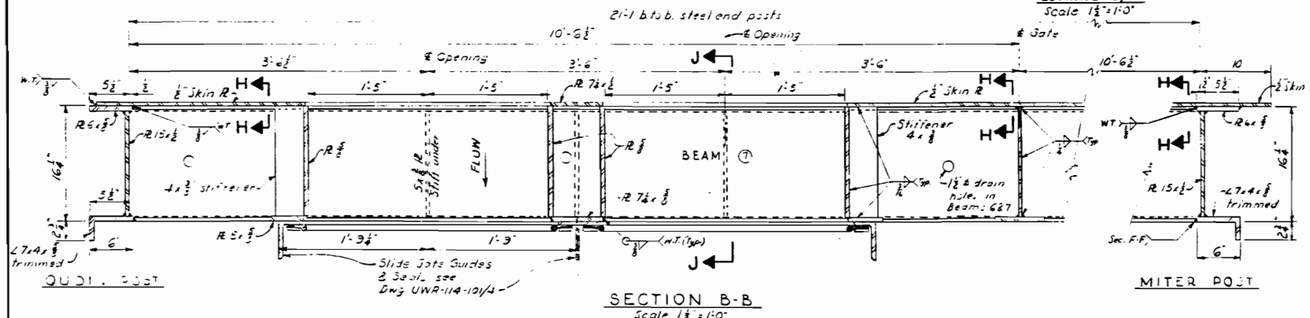
SECTION A-A
Scale ½" = 1'-0"



SKIN R DETAILS AT QUOIN POST
LOOKING D/S
Scale 1½"=1'-0"



SECTION J-J
Scale 1½"=1'-0"



QUOIN POST

SECTION B-B
Scale 1½"=1'-0"

MITER POST

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 25 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
⚠1	25 Aug 67	Removed dimension to bracket. Changed spacing of BM ①-②	

U. S. ARMY ENGINEER DISTRICT, PORTLAND
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER, PORTLAND, OREGON

DESIGNED: D.P.S.
DRAWN:
CHECKED: W.E.D.
PREPARED: W.E.D.
SUPERVISED:
SUBMITTED:
RECOMMENDED:

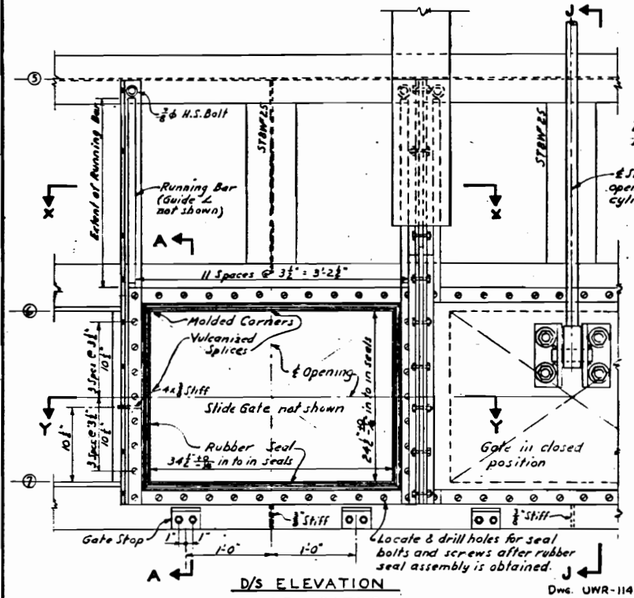
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
GATE LEAF FRAMING

APPROVED:
DATE I. A. W. D.
SCALE AS SHOWN
SPEC. NO.
UWR-114-101/3
SHEET 3 OF 6

PLATE 5

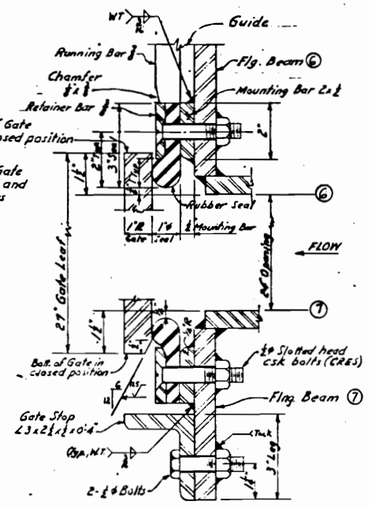
MICROFILMED 10 Sep 1968

CORPS OF ENGINEERS — U. S. ARMY

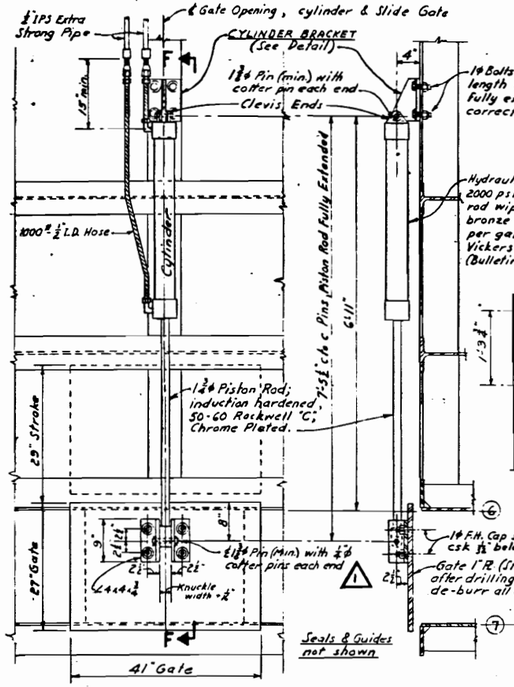


D/S ELEVATION
SLIDE GATES
Scale 1½"=1'-0"

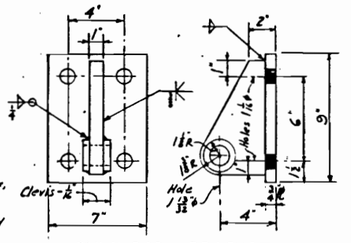
Dwg. UWR-114-101/3



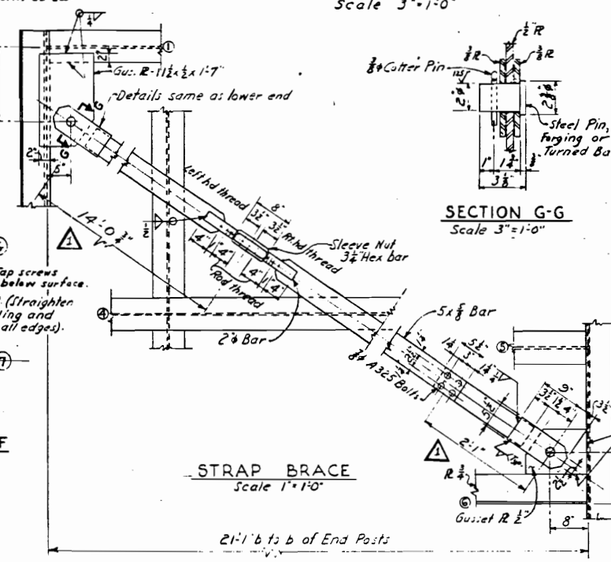
SECTION A-A
Scale 6"=1'-0"



ELEVATION — SECTION F-F
OPERATING CYLINDER
Scale 1"=1'-0"

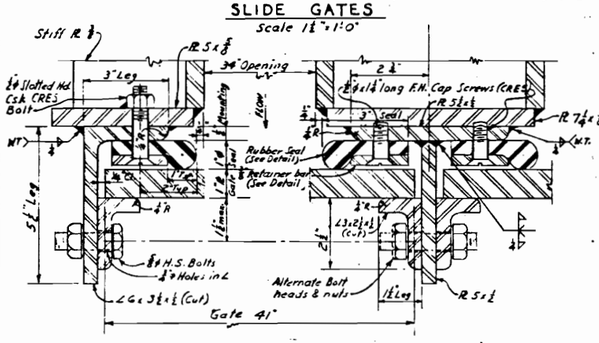


CYLINDER BRACKET
Scale 3"=1'-0"

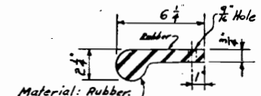


STRAP BRACE
Scale 1"=1'-0"

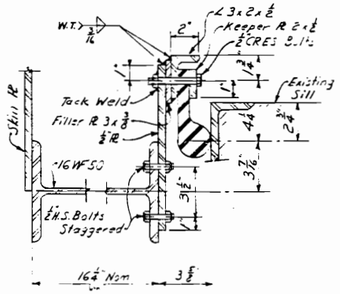
SECTION G-G
Scale 3"=1'-0"



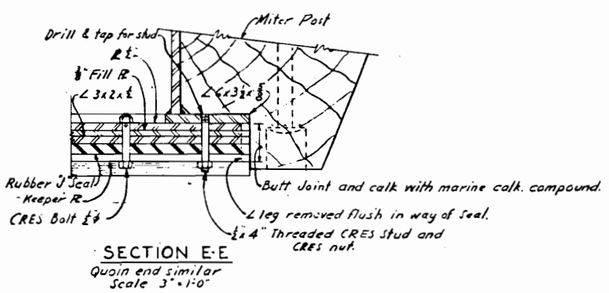
SECTION Y-Y
Scale 6"=1'-0"



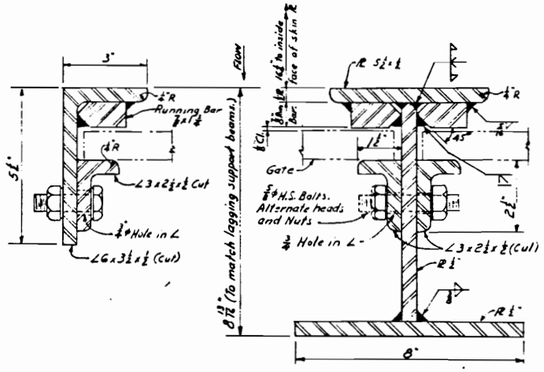
SILL SEAL DETAIL
Scale 3"=1'-0"



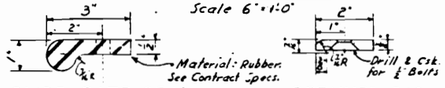
SILL SEAL
SECTION D-D
Scale 3"=1'-0"



SECTION E-E
Quoin end similar
Scale 3"=1'-0"

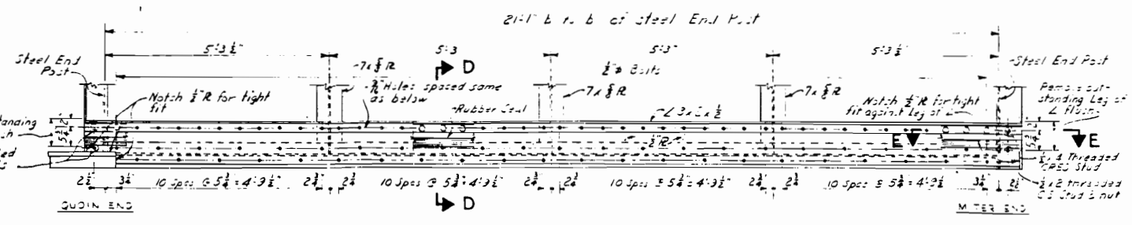


SECTION X-X
Scale 6"=1'-0"



SLIDE GATE SEAL
Scale 6"=1'-0"

RETAINER BAR
Scale 6"=1'-0"



SILL SEAL
Scale ½"=1'-0"

NOTES:

1. Provide Indicating Device for Slide Gates. See Specs..
2. ⚠1 The Slide Gates shall be checked, in closed position, to assure that the Seal is in full contact with Gate Leaf. If any section of Seal is not in contact, adjustment shall be made until seal is in full contact around periferry of Gate Leaf. Care should be taken so that the Seal is not compressed more than necessary.

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 20 June 68
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
⚠1	25 Aug 67	Added Note. Added Cotter Pin size.	

U. S. ARMY ENGINEER DISTRICT, PORTLAND

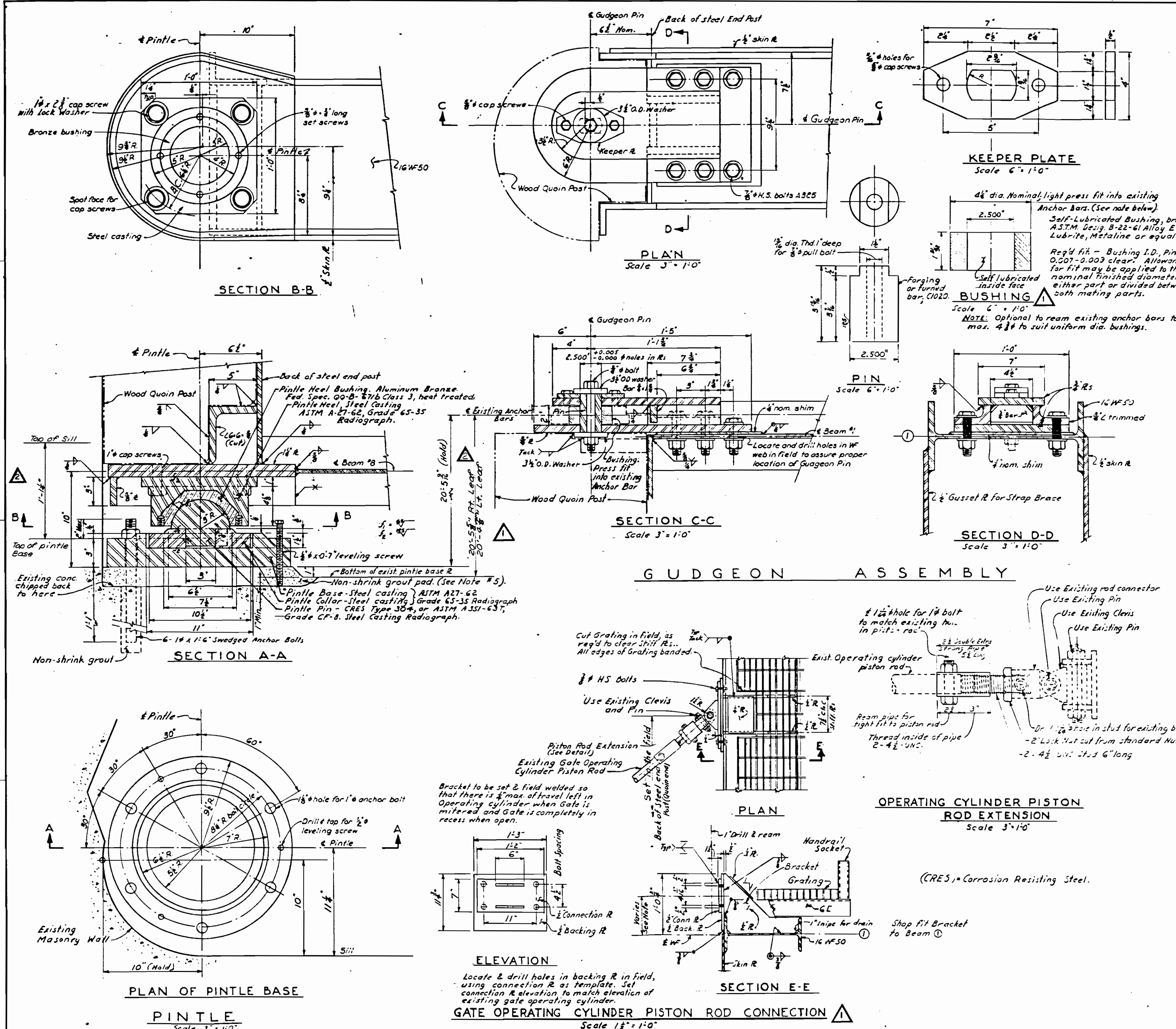
DESIGNED: DPS
DRAWN: [illegible]
CHECKED: W.E.G.
PREPARED: W.E. Dougherty
SUPERVISED:
SUBMITTED:
RECOMMENDED:

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
SLIDE GATES, SILL SEAL, AND MISCELLANEOUS DETAILS

APPROVED: Date 1 Aug 67
SCALE AS SHOWN
SPEC. NO.
UWR-114-101/4
SHEET 4 OF 6

PLATE 6

MICROFILMED 10 Sep 1968



NOTES

1. GENERAL NOTES, DWG. UWR-114-101/2.
2. MATERIAL, STRUCTURAL STEEL, UNLESS OTHER NOTED OR INDICATED.
3. STEEL CASTINGS, ASTM A27-63T GRADE AS NOTED.
4. RADIOGRAPH STEEL CASTINGS ACCORDING TO ASTM E71-52 CLASS 4 SERVICE.
5. ACCURATELY SET PINTLE BASE AND ANCHOR BOLTS IN 1:1 CEMENT-SAND HIGH-EARLY-STRENGTH GROUT. (SEE CONTRACT SPECS.) LEVEL AND SECURE BASE AFTER ANCHOR BOLT GROUT ATTAINS SPECIFIED SET. RELEASE LEVELING SCREWS 2 TURNS AFTER BASE GROUT HAS SET.
6. LOCATE AND DRILL FOR GUDGEON CONNECTION ON GATE LEAF WITH LEAF IN CLOSED POSITION AND MITER POST VERTICAL. MAKE NOMINAL FINAL ADJUSTMENTS AFTER GATE IS INSTALLED, BY ADJUSTING ANCHOR BARS. MITER POST WILL NOT BE VERTICAL WITH GATE IN OPEN POSITION.

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 25 Sept 67
DATE OF COMPLETION OF CONTRACT 20 June 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
2	6 Aug. 68	Revised As Constructed	
1	25 Aug. 67	Revised Rod Extension detail. Revised Connection and dimensions. Revised Bushing & added to Note 6.	

U. S. ARMY ENGINEER DISTRICT, PORTLAND

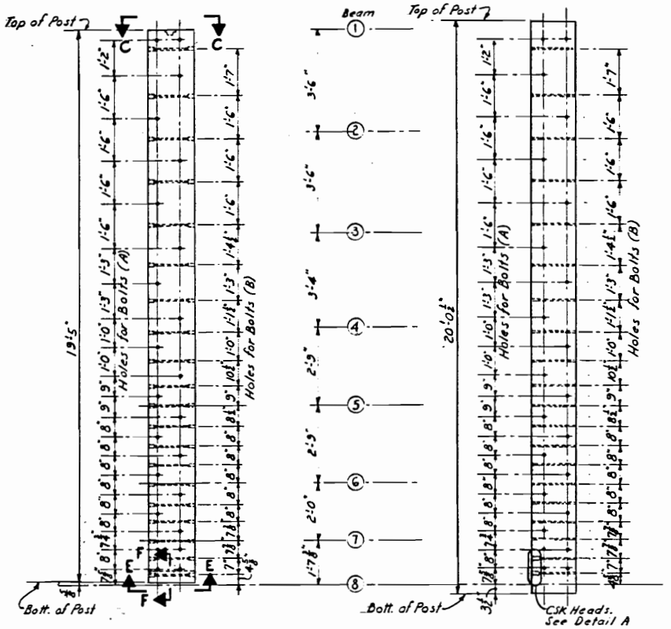
DESIGNED: D.P.S.
DRAWN: I.P.G.P.
CHECKED: W.E.O.
PREPARED: W.E. Dougherty

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
PINTLES, GUDGEON, OPERATING ROD EXTENSION & MISCELLANEOUS DETAILS

SUPERVISED: Ray R. Miller — CHIEF, STRUCTURAL SECTION
SUBMITTED: — CHIEF, DESIGN BRANCH
RECOMMENDED: — CHIEF, ENGINEERING DIVISION
APPROVED: — COLONEL, C.E., DISTRICT ENGINEER

SCALE AS SHOWN | SPEC. NO.
UWR-114-101/5
SHEET 5 OF 6

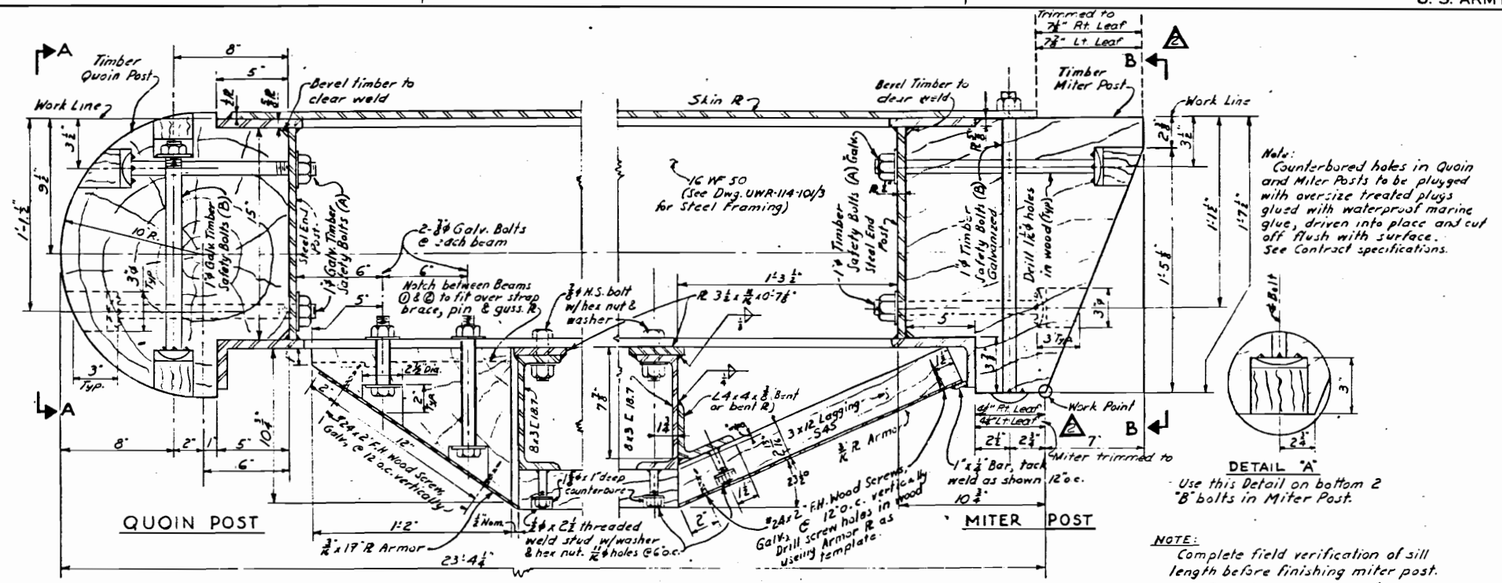
CORPS OF ENGINEERS 4 3 2 1 U. S. ARMY



ELEVATION A-A
TIMBER QUOIN 1

Scale 1/2" = 1'-0"

ELEVATION B-B
TIMBER MITER 1



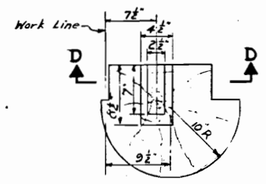
NOTE:
Complete field verification of sill length before finishing miter post. See Plan Dwg. UWR-114-101/2.

QUOIN & MITER DETAILS
Scale 3/4" = 1'-0"

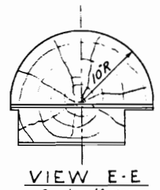
NOTES

1. GENERAL NOTES - DWG UWR-114-101/2.

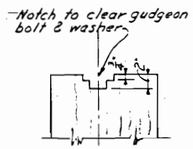
1 2. Plug Bolt holes (A) in Miter Post, in field after gate has been adjusted and Miter Post trimmed. Brush plugs with hot Coal Tar Creosote. (See Specs.)



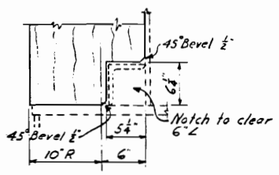
PLAN C-C
Scale 1/2" = 1'-0"



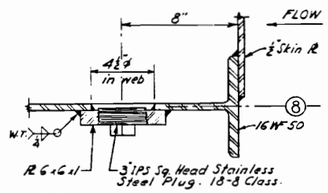
VIEW E-E
Scale 1/2" = 1'-0"



SECTON D-D
Scale 1/2" = 1'-0"



SECTION F-F
Scale 1/2" = 1'-0"



DRAIN & PLUG
Scale 3" = 1'-0"

AS CONSTRUCTED
CONTRACT NO DA-WC-57-68-C-0032
CONTRACTOR Halvorson-Mason
DATE OF RECEIPT OF NOTICE TO PROCEED 28 Sept 67
DATE OF COMPLETION OF CONTRACT 20 JUNE 68
DATE OF ACCEPTANCE 20 June 68

REVISION	DATE	DESCRIPTION	BY
1	6 Aug 68	Revised As Constructed	
1	22 Aug 67	Added Note 2. Revised dim. on Miter & Quoin Posts.	

U. S. ARMY ENGINEER DISTRICT, PORTLAND

DESIGNED D.P.S.
DRAWN
CHECKED W.E.D.
PREPARED
SUPERVISED
SUBMITTED
RECOMMENDED
APPROVED
DATE 2 Aug 67

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK GATE 3 REPLACEMENT
QUOIN, AND MITER POST, AND MISCELLANEOUS DETAILS

SCALE AS SHOWN SPEC. NO.
UWR-114-101/6
SHEET 6 OF 6

PLATE 8

MICROFILMED 10 Sep 1968

CORPS OF ENGINEERS

VALUE ENGINEERING WILL INCREASE YOUR PROFITS

U. S. ARMY

Existing masonry wall
Existing Asphalt Walkway
Bottom of Ramp Sta. 13+25
Existing walkway
Walkway planks shall be trimmed to conform with rock face and existing tree.
Existing gate operating machinery
Existing handrail to be removed, reconditioned, and reinstalled
Existing Air-operated winch
Existing handrail
Existing Light Standard
Existing stairway to remain
Ramp down
Snubbing post (Typ)
Access ladder
Left wall
Steel Grating See Detail A
Remove and replace timber walkway and wall
Walkway continues in front of control house. Approx. 18" wide with handrail
Existing lock control center
Remove and reinstall existing cable lead block to conform with existing installation. Existing bolts, nuts and washers shall be replaced in kind except, replacements shall be hot-dipped galvanized.
Note: Remove and reinstall existing air-operated winch. Replace bolts, nut and washers in kind except, replacements shall be hot-dipped galvanized
℄ Pintle Gate No.3 Sta. 12+10.35
19'-0" Field verify
℄ Lock
FLOW
℄ Pintle Gate No. 2 Sta. 12+10.32
D/S End of Right Construction Wall
Remove and replace timber walkway and wall
Right Wall
Existing masonry
Existing Asphalt Walkway
Existing stairway to remain
Ramp down
31'-0" To Government Boundary Line.
Existing light standard
Existing masonry wall
Remove and replace existing ramp and ramp supports
5 Plank wide ramp walk 2
Remove and replace existing walkway and walkway supports
Sta. 13+73 (Bottom of ramp)
D/S End of construction Left Wall

PLAN
Scale: 1/8"=1'-0"

Mooring ring recess
Existing handrail to be removed, reconditioned and reinstalled Deck El. 41.5
Timber walkway to be replaced @ El. 35.0
Approx. location of rock bolts (Typ.)
Snubbing post (Typ.)
Existing handrail to be removed, reconditioned and reinstalled
Wire fabric (Typ)
12"x12" Posts
Extra posts & strut 8"x12" 2
Existing wall Lock No. 1
Elev 13.5 (Approx.) Gate 2 Sill
Existing masonry
Elev 31.5 (Bottom of chain link fabric)
Crown Zellerbach S & B Pipe encasement
Gate recess wall to be removed and replaced
3"x12" Wall lining (Staggered joints)
℄ Pintle gate No. 2 STA. 12+10.32 (Gate not shown)
Excavate backslope as required to permit horizontal alignment for vertical post installations
Additional backslope excavation required for horizontal & vertical alignment of post installation. 2
Note: Mooring ring recess details shown on Dwg No. UWR-114-110/3
Post and strut connections shown on Detail A and Detail B on Dwg No. UWR-114-110/2.

ELEVATION — LEFT WALL
Scale: 1/8" = 1'-0"

STA 13+40.5
STA 13+20.8
STA 12+91

DETAIL "A"
Typical Post Footing Pedestal 2

12"x12" Post
Embedded 3"x5" angle iron
Lag bolt post to angle iron
Concrete footing
Rock line
Embedded Anchors

Existing handrail to be removed, reconditioned and reinstalled
Timber walkway to be removed and replaced @ El. 35.0
Deck El. 39.5
Existing handrail to be removed, reconditioned and reinstalled
Snubbing post (Typ)
Approx location of rock bolts (Typ.)
Wire fabric (Typ)
Elev 26.5 (Bottom of chain link fabric)
12"x12" Posts
See detail 'A' 2
3"x12" Wall lining (Staggered joints)
Crown Zellerbach Pipe encasement
Existing masonry
℄ Pintle gate No. 2 STA. 12+10.32

ELEVATION — RIGHT WALL
Scale: 1/8" = 1'-0"

Existing masonry wall
Remove and reinstall existing handrail
7'-3"
3"x12" Decking
Rock bolt for chain link fabric support. See Dwg UWR-114-110/2
El. 41.5 Lt. Wall
El. 39.5 Rt. Wall
(Field verify to match exist. walkway elevations)
8"x12" Struts between posts
3'-0" (Typ.)
3"x12"x1'-6" Blocking
Wire Fabric
12"x12" struts
Chip and grout flush (Typ.)
20'-0" (Typ.)
12"x12" Post
1¼" ℄ Rock anchors grouted into 2¼" ℄ holes (Typ.)
3"x12" Wall lining
Turnbuckle (Typ.)
ground line
See detail 'A' 2
Eliminated bottom row of Rock Anchors (Both sides)
El. 15.5 (Approx.)

SECTION A-A, SIMILAR BUT OPPOSITE HAND

SECTION A-A
Scale: 1/16" = 1'-0"

Existing Gate operating machinery
Existing stairway to remain
2'-4"
7'-6"
Reliance Relgrit Abrasive Embedded Grating with 2¼"x⅜" bearing bars @ 1 3/16" o.c. and ⅜"x⅜" cross bars @ 4" o.c. or approved equal. Grating shall be hot-dipped galvanized
Note: Existing handrail not shown.

DETAIL A
Scale: ½"=1'-0"

Fasten grating with saddle clips and ⅝"℄ x 6" lag screws - 4 required
New 2"x12" facing board notch to accomodate grating.
8"x12"
L 2½"x2½"x¼"x4'-0" fastened with 4-⅝"℄x6" carriage bolts w/nut & washer per contract to decking and 2"x12" facing board
Existing stairway to remain. Stairway stringers to be connected to new facing board with Simpson Strong-Tie Reinforcing Angle, Type L70 or approved equal. Fasten with 8-10d nails per angle.

SECTION B-B
Scale: ½"=1'-0"

VICINITY MAP

SEATTLE WASHINGTON
COLUMBIA RIVER
PORTLAND
WILLAMETTE FALLS LOCKS SITE OF PROJECT
WEST LINN
OREGON CITY
OREGON
WILLAMETTE RIVER
TO SALEM

SITE MAP
Scale: 1" = 400' (Approx.)

WEST LINN
GOV'T. PARKING AREA
C Z P CO. OFFICE
LOCKMASTER'S OFFICE
GOV'T. WAREHOUSE
RIVER
FLOW DIRECTION
Lock No. 2 filling culvert
OREGON CITY
STREET
DAM
Gate No. 3 repairs
WILLAMETTE
ZELLERBACH PAPER CO
CANAL
DAM

AS CONSTRUCTED
CONTRACT No. DACW57-74-C-0036
CONTRACTOR GENERAL CONSTRUCTION CO
DATE OF RECEIPT OF NOTICE TO PROCEED 24 AUG 74
DATE OF COMPLETION OF CONTRACT 1 NOV 74
DATE OF ACCEPTANCE

Note:
1. Existing rock anchors shall be cut-off of timber lining leaving projection from rock face. See specifications
2. The Contractor shall field verify all existing conditions, elevations, and dimensions as shown.
3. Elevations referred to on this set of drawings are based on M.S.L. Datum, 1929 Adjustment.
4. All timber and lumber shall be preservative-treated as specified.

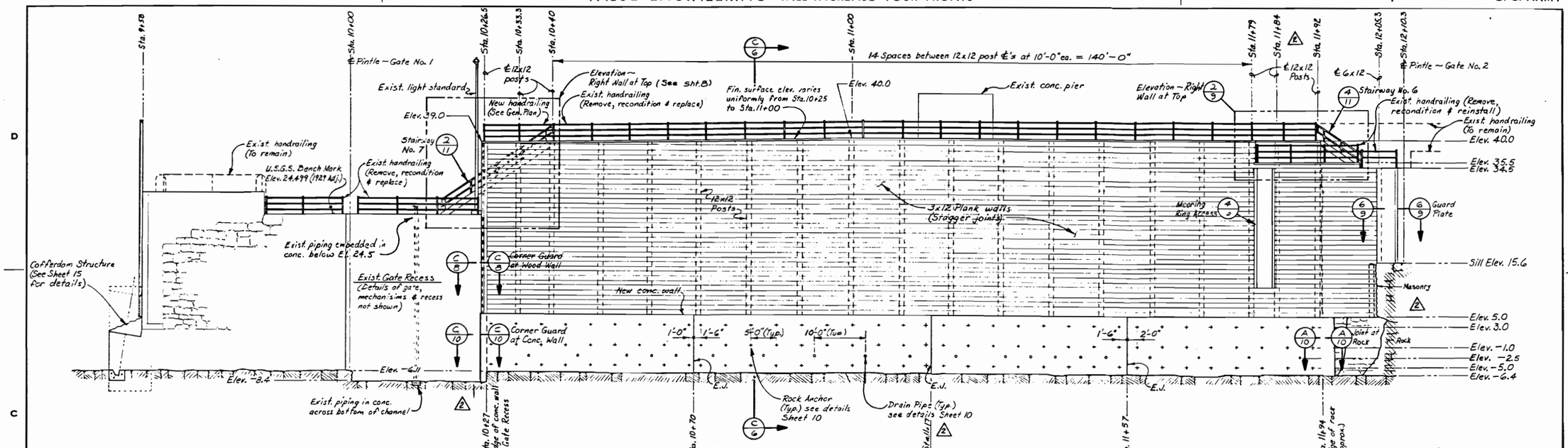
REVISION	DATE	DESCRIPTION	BY
2	Town B	Revised as constructed	DPS
1	7 Wing	Added chain link fabric, rock bolts and notes	

U. S. ARMY ENGINEER DISTRICT, PORTLAND

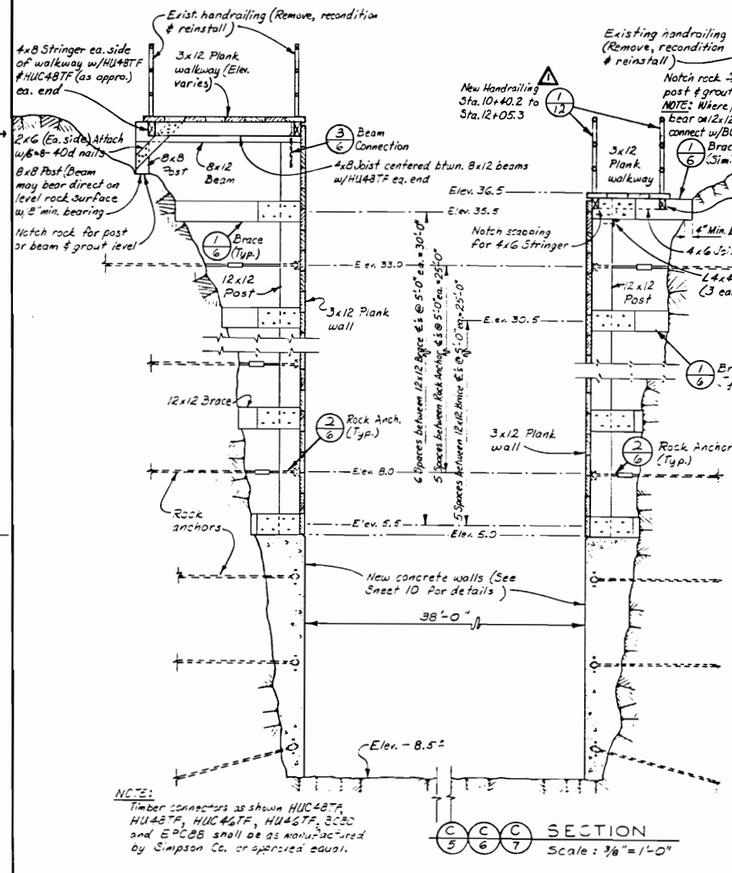
WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK CHAMBER NO. 2
WALL LINING

PREPARED: [signature] CHIEF DESIGN BRANCH
SUBMITTED: [signature] DATE: 1 JUL 75 COLONEL, C.E. DISTRICT ENGINEER
SUPERVISED: [signature] CHIEF ENGINEERING DIVISION
SHEET 1 of 3 UWR-114-110/1

PLATE 9

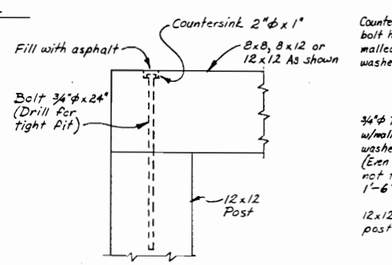


B/5 SECTION ~ RIGHT WALL
Scale: 1/8" = 1'-0"



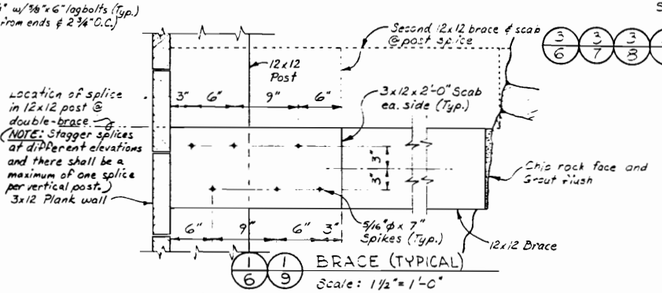
NOTE: Timber connectors as shown HUC48TA, HU48TF, HUC46TF, HU46TF, BC80 and EPC88 shall be as manufactured by Simpson Co. or approved equal.

C/5 C/6 C/7 SECTION
Scale: 3/8" = 1'-0"

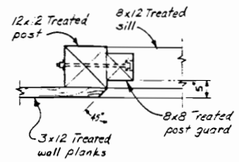


SIDE ELEVATION

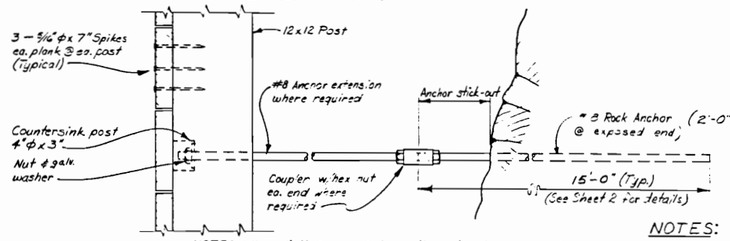
3/6 3/7 3/8 3/9 BEAM CONNECTION
Not to scale



1/6 1/9 BRACE (TYPICAL)
Scale: 1½" = 1'-0"



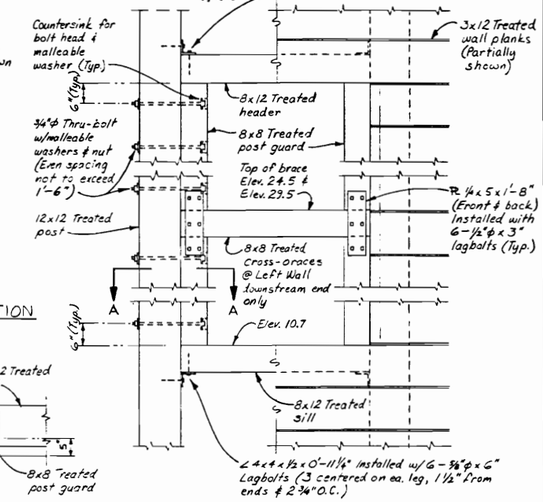
SECTION A-A
Scale: 3/4" = 1'-0"



NOTE: Where limited space between the post and rock prevents the use of a coupler, vary length of anchor stick-out so that post can be bolted directly to rock anchor

⚠ 2/6 ROCK ANCHOR (TYPICAL)
Scale: 1½" = 1'-0"

NOTES:
1. Spikes shall be galvanized, flathead, diamond point & round.
2. All exposed steel shall be zinc coated. Zinc coating of connections not to impair their fit.



4/5 4/6 4/9 ELEVATION ~ MOORING RING ACCESS
Scale: 3/4" = 1'-0"

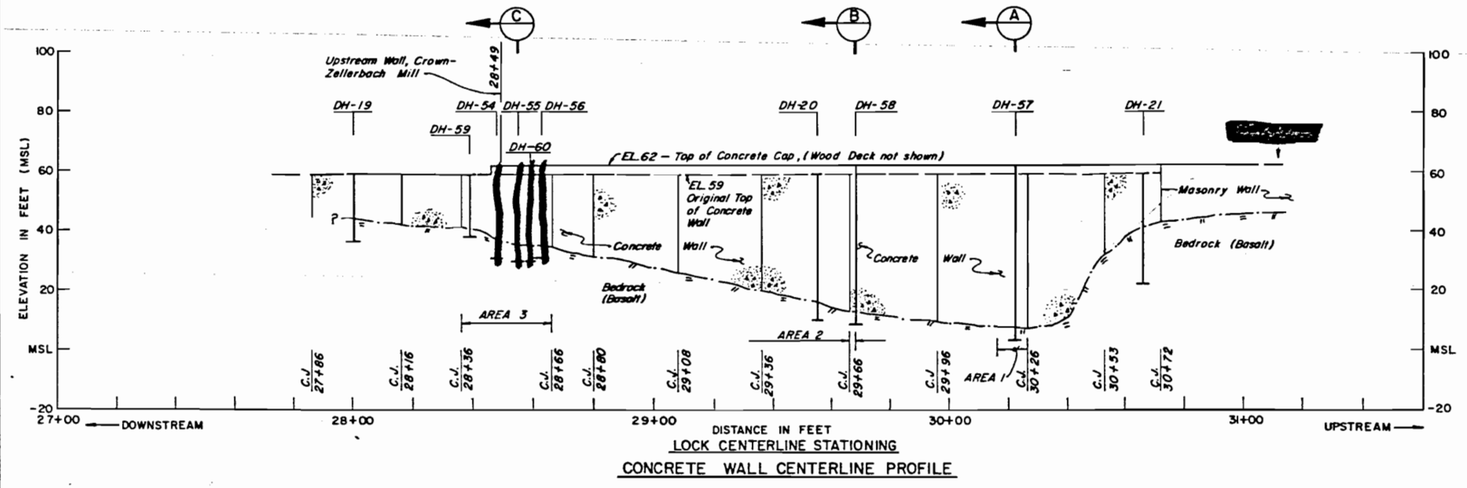
AS CONSTRUCTED
CONTRACT No. DACW57-80-C-0060

REVISION	DATE	DESCRIPTION	BY
⚠	87 July 9	Revised As Constructed	DTS
⚠	80 May 20	Revised new handrail & rock anchor	DTS

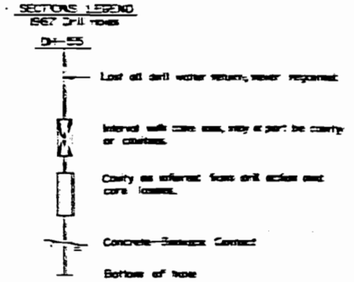
U. S. ARMY ENGINEER DISTRICT, PORTLAND

DESIGNED: M. Flynn	WILLAMETTE FALLS LOCKS WILLAMETTE RIVER NEAR WEST LINN, OREGON LOCK NO.1 REHABILITATION
DRAWN: R. Kirkham	RIGHT WALL ELEVATION & SECTIONS
CHECKED: G. Taxer	
PREPARED:	SUBMITTED: DATE: 83 APR 22
SUPERVISED: CHIEF, STRUCTURES SECTION	CHIEF, DESIGN BRANCH
	SHEET 6 UWR-114-111/6

PLATE 10

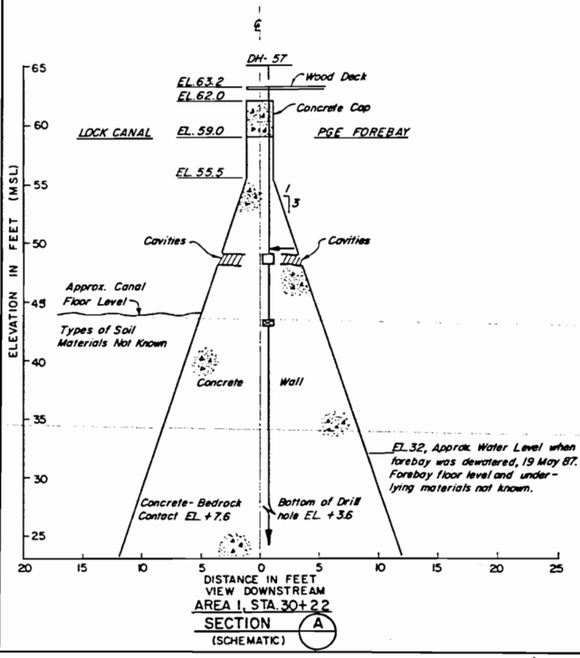


CONCRETE WALL CENTERLINE PROFILE

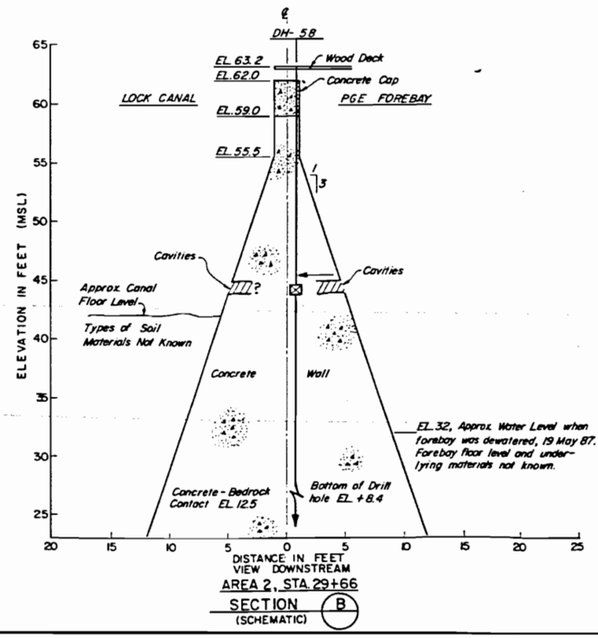


NOTES:

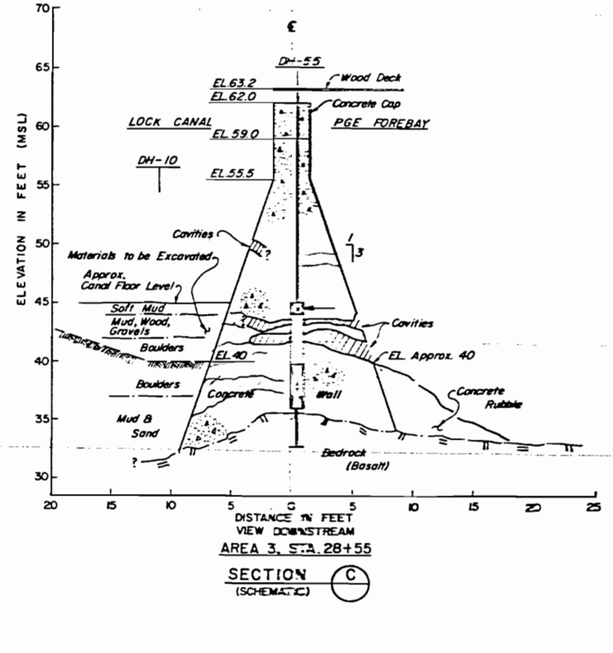
1. The concrete wall was built during construction in 1937. Wall design drawings can not be located. All stations, elevations, and dimensions shown are based on drawings and information furnished by Crown Zellerbach and Portland General Electric, and on field observations, estimates, and rough measurements. Information on materials penetrated in 1939 core holes, DH-C, 19, 21, & 21, are based on summary logs in Portland District files; copies of these logs are shown on drawing, WLA-5-141.
2. Intervals of drill hole core losses with possible caches and of cavities inferred from bit action and core losses are not shown on the profile.
3. The volume of materials to be excavated is estimated to be about 100 cubic yards. Estimated volume of concrete/foot is approximately 25 cubic yards.



AREA 1, STA. 30+22
SECTION (A) (SCHEMATIC)



AREA 2, STA. 29+66
SECTION (B) (SCHEMATIC)



AREA 3, STA. 28+55
SECTION (C) (SCHEMATIC)

THIS PRINT REDUCED TO ONE-HALF SCALE

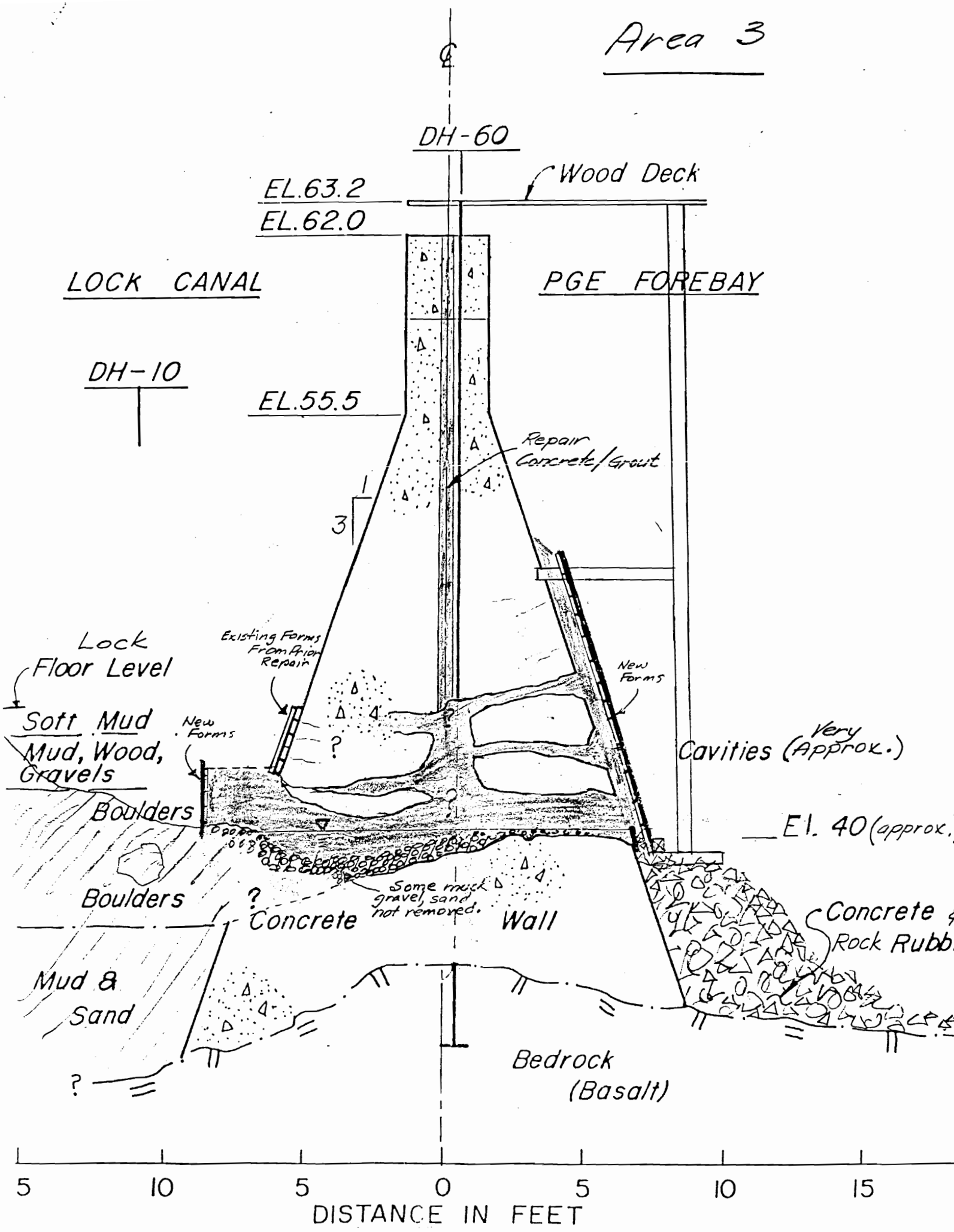
U. S. ARMY ENGINEER DISTRICT, PORTLAND

WILLAMETTE FALLS LOCKS
WILLAMETTE RIVER NEAR WEST LINN, OREGON
LOCK WALL REPAIR

WALL PROFILE & SECTIONS

T. Bottles | C. Perillo | S. Konno

87 JUN 10 | 2 | PLATE 11


Area 3
DH-60
EL.63.2
EL.62.0
Wood Deck
LOCK CANAL
PGE FOREBAY
DH-10
EL.55.5
Repair Concrete/Grout
1
3
Lock Floor Level
Existing Forms From Prior Repair
New Forms
New Forms
Soft Mud
Mud, Wood, Gravels
Boulders
Very Cavities (Approx.)
El. 40 (approx.)
Some muck gravel, sand not removed.
Boulders
Concrete Wall
Concrete
Rock Rubb
Mud & Sand
Bedrock (Basalt)
5
10
5
0
5
10
15
DISTANCE IN FEET

(Paintight Lighting Panel, 120/240V, 3WSN, with 4-20A. SP thermal magnetic breakers.)

Wood Deck-Elev. 38.75

3/4", 2#10

3/4", 2#10

Spare hub

Luminaire Standard No. 3

Ballast

1 Dn.

Elev. 38.75

1"C, 2#8, 2#10

Conduit below board walkway

CHAMBER 1

Sta. 8+70

Sta. 9+00

Sta. 9+29

Sta. 10+00

Sta. 10+90

Top of Gate No. 1 El. 23.65

Luminaire Standard No. 2

El. 39.25

Wood Deck Cut opening in deck for pole

1½"C. Dn.

C.H.-FDCT

C.H.-FDX

3/4", 2#10 Dn.

Ballast

3/4" Conduit, 2#8 Under walkway

1½"C, 2#12, Dn. to Recept. 3/4", 3#10

C.H., FDX

C.H., FDCT

Dn. to Intercomm. Transceiver & connect as directed

1½", 2#12

Dn.

1½", 2#12 up post and connect to existing stairway light.

1¼"C, 4#8, 3#10

Provide Spare 3/4" hub & plug

3/4", 2#12 to Intercomm. Transceiver

PLAN-GATE NO. 1

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

Luminaire Standard No. 1

4'-0"

2#8

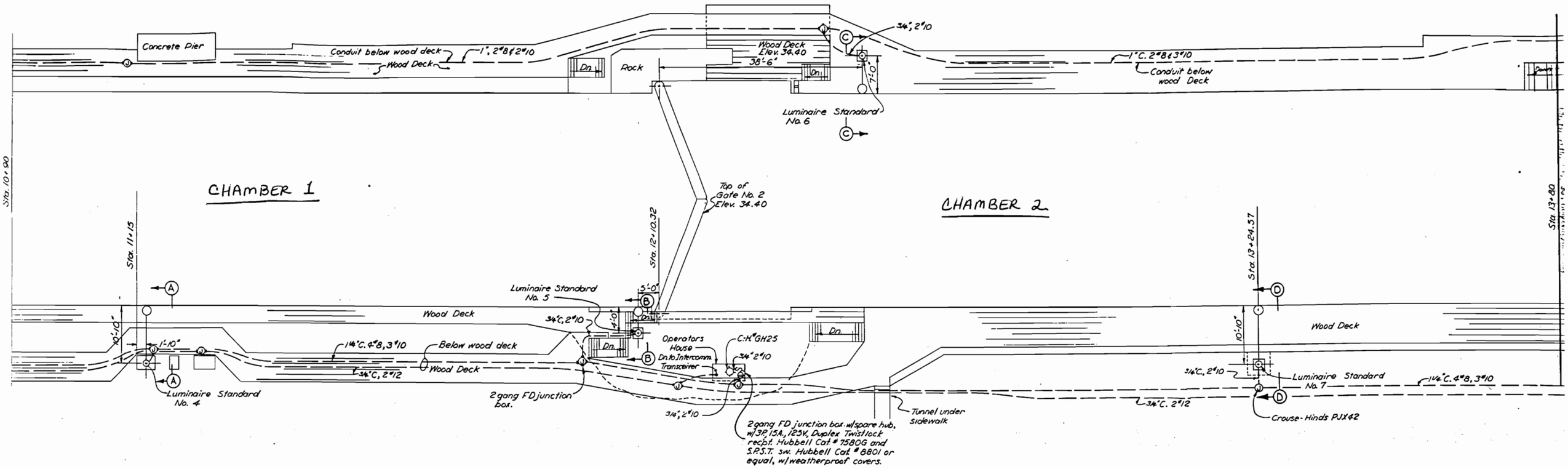
Underground

4"x12" Timber

Concrete Curb

PARKING LOT

FOR Notes, Pg 1



PLAN - GATE NO. 2

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

For Notes, Pg 2

Government Property Line

2" Asphalt on 1' Gravel Fill

1" Conduit, 2#8 & 3#10

Junction Box, Elev. 54.0 provide spare hub.

Luminaire Standard No. 9

Rock

Ramp Dn.

Rock Elev. 44.35

1" Conduit, 2#8 & 3#10

Existing 30'-3"

9'-0"

Sta. 13+80

CHAMBER 2

Sta. 14+20.35

Top of Gate No. 3 Elev. 44.35

2#8 & 3#10 Type USE style R.H. from junction box to junction box.

2 gang FD junction box, w/spare hub, w/ 3P, 15A., 125V, Duplex Twist lock, Hubbell Cat. No. 7580G recpt. & S.P.S.T sw. Hubbell Cat. No. 8801 or equal, with weatherproof covers.

6'-0"

15'-0"

Luminaire Standard No. 8

3/4", 2#10

C-H. #GH25

Tunnel below sidewalk

Existing 1/4" Conduit with weather head at 54.0

3/4", 2#10 To Intercomm Transceiver

1/4" Conduit, 4#8, 3#10

3/4", 2#12

C-H. #DJX2

Install W.T. Junction box at coupling Elev. 44.60

Tunnel below sidewalk

1/4" Conduit, 6#8.

2" Asphalt on 1' Gravel Fill Elev. 44.35

Conduit below Wood Deck

Conduit below Asphalt

Dn.

Wood Deck Elev. 44.35

Sta. 15+34.60

CHAMBER 3

Luminaire Standard No. 10

9'-6"

Wood Deck Elev. 44.35

Dirt Fill

1/4" C, 3#8

3/4" Conduit, 2#12

3/4", 2#10

Tunnel below sidewalk

Concrete Walk

Compressor Room.

Panel CR1

1", 3#8

See Dwg. No. UWR-114/77 for compressor Room Details

1/4" C., 6#8

3/4", 2#12

Locate conduits under wood deck

Storage under Wood Deck

Elev. 57.0

1" Conduit, 2#8 & 3#10 under Wood Deck

Spare hub

1" C, 2#8 & 2#10

3/4" C, 2#10

Dn.

Wood Deck Elev. 54.35

Rock Elev. 54.35

Up

5'-0"

27'-0"

Luminaire Standard No. 12

Sta. 16+30.04

CHAMBER 4

Top of Gate No. 4 Elev. 54.35

Luminaire Standard No. 11

6'-0"

6'-0"

Dn.

Dn.

Rock Elev. 54.35

3/4", 2#10

C-H. #GH25

Wood Deck Elev. 54.35

Slope up

Up

3/4", 2#10.

3/4", 2#12, To Intercomm Transceiver

Ramp Dn

1/4" Conduit, 6#8

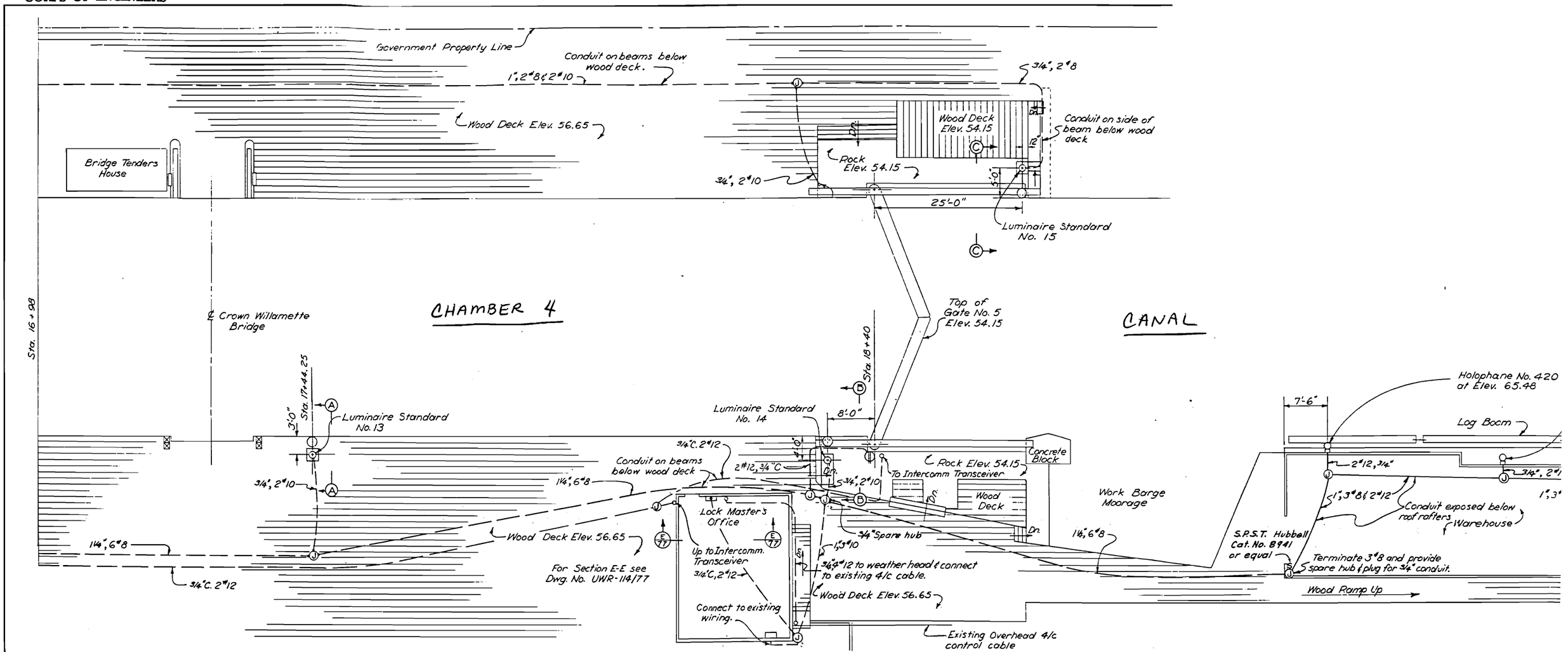
3/4", 2#12

PLAN - GATE NO'S. 3 & 4

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

For NOTES, Pg 3

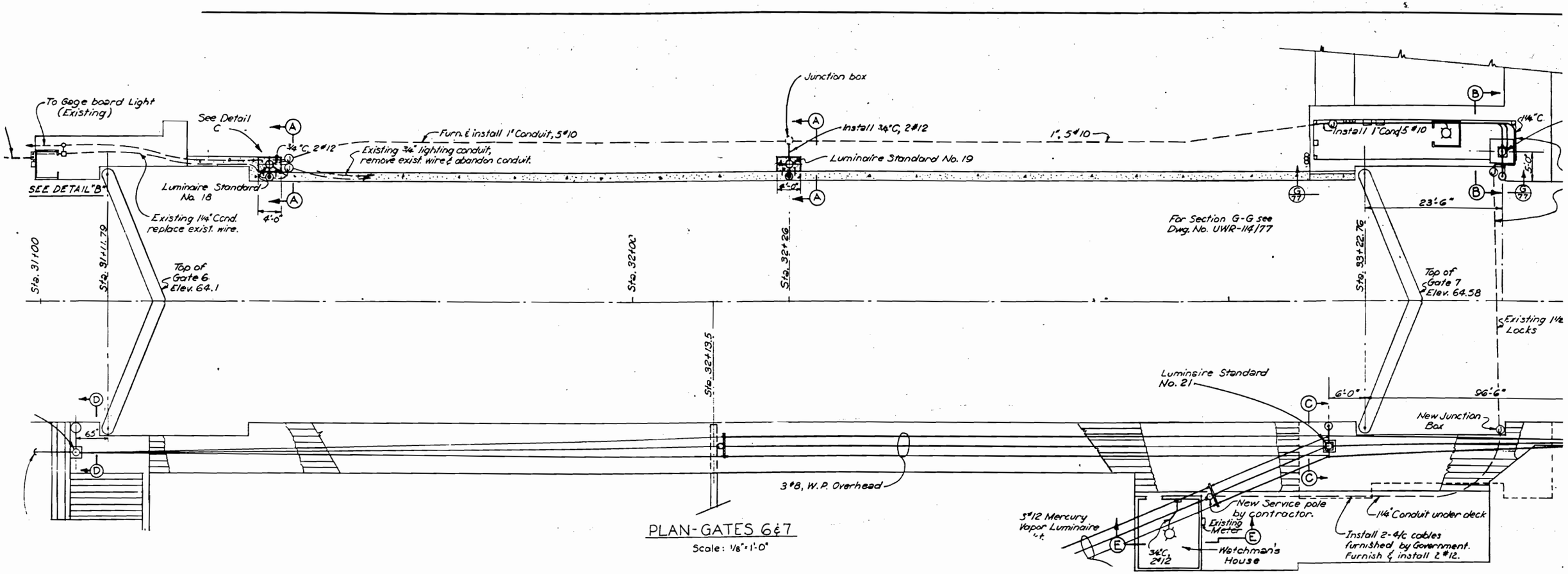
CORPS OF ENGINEERS



PLAN - GATE NO. 5

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

FOR NOTES, Pg 4



PLAN-GATES 6&7

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

UPSTREAM GUARD LOCK

FOR NOTES, Pg 5

SECTION 00010

BIDDING SCHEDULE
FOR
NO. DACW57-01-R-0007

ITEM NUMBER	DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE	ESTIMATED AMOUNT
0001	Rehabilitation of Gate Nos. 2 and 4	1	Job	xxxxxx	$ 632,398 00
0002	Replacement of Utilities Crossing Lock Chamber (Optional)	1	Job	xxxxxx	$ 72,409 00
0003	Skilled Craftsman	xxxxxx	xxxxxx	xxxxxx	xxxxxx
0003A	First 250 hours	250	MH	$ 80 00	$ 20,000 00
0003B	Over 250 hours	250	MH	$ 70 00	$ 17,500 00
	TOTAL FOR THIS PAGE				$ 742,307 00

Quantities estimated except where unit is job.

INVOICE

WCS
West Coast Specialties
11733 S.E. 40th AVENUE • PORTLAND, OR 97222
•503-659-3883 •FAX: 503-654-6791

INVOICE NO.: 30596

USARMYWF

INVOICE DATE: 07/31/97

SOLD TO:
US ARMY CORP ENG/WILL FALLS
WILLAMETTE FALLS LOCKS
PO BOX 2946
PORTLAND OR 97208-2946

SHIP TO:
US ARMY CORP ENG/WILL FALLS
WILLAMETTE FALLS LOCKS
WEST LINN OR 97068-3397

P.O. NUM: DACW57-97-M-0845 ORDERED: 07/31/97 PAYMENT DUE: 08/30/97
SALESPERSON: CHU SHIPPED: 07/31/97 VIA: DIR SHIP
TERMS: NET 30

ITEM	ORDER	SHIP	DESCRIPTION	PRICE	AMOUNT
G	4	4	HYDROLINE N5C-5.00X76.00-N- 3.00-4-N-H-N-1-1 W/FOLLOWING ACCESS: 4) C-134-24 CLEVIS 4) C-9014-3 PINS	1297.00	5,188.00
G	4	4	355-91 STUDS W/QTY 8) OF C-105-36 JAM NUTS	260.85	1,043.40
G	16	16	N5C-4.00X29.00-N- 1.75-2-N-N-N-X W/FOLLOWING ACCESS: 16) C-9308 EYE 16) C-9008-3 PINS	531.00	8,496.00
G	16	16	BRONZE BUSHING ADDER	8.00	128.00
				TOTAL	14,855.40

FILE COPY

1.9 IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY

The Government will furnish to the Contractor the following property to be incorporated or installed in the work or used in performing the Contract.

ITEM	QUANTITY	DESCRIPTION	UNIT PRICE ($)	VALUE ($)
1	4	Main gate hydraulic cylinders	1950	7800
2	4	Gudgeon pins	600	2400
3	4	Gudgeon bushings (standard)	200	800
4	4	Gudgeon bushings (oversize)	200	800
5	4	Pintles	800	3200
6	4	Pintle collars	300	1200
7	4	Pintle heel bushings	500	2000
8	4	Gate bottom "J" seals	500	2000
9	16	Slide gate "J" sea	300	4800
10	2 cases (12 tubes per case)	Multi-purpose food grade grease (Chevron FM NLG12)	40	80
11	55-gallon drum	Chevron clarity 32 hydraulic fluid (oil)	350	350
12	16	Slide gate hydraulic cylinders	750	12,000

1.10 NOT APPLICABLE

1.11 INSURANCE - WORK ON A GOVERNMENT INSTALLATION

In conjunction with SECTION 00700, Clause INSURANCE - WORK ON A GOVERNMENT INSTALLATION, provide and maintain during the entire performance of this contract at least the following kinds and minimum amounts of insurance:

(1) Workmen's Compensation and Employer's Liability Insurance. Workmen's Compensation and Employer's Liability Insurance (including Federal Longshoreman and Harbor Workers' Insurance) in the amounts specified by the applicable Federal and/or State statutes.

(2) Comprehensive General Liability Insurance.

(a) Personal Injury. Minimum limits of $1,000,000 for injury to or death of any person and $1,000,000 for each accident or occurrence.

Contract No. 01-[illegible]-0169

20-Nov-2000
1:16

PURCHASE REQUISITION

PO# W66QKZ0340-5[illegible]07

Purchase Requisition Number: 10513 Requisition Date: Nov 02 2000 03 13PM
Priority: 2

Suggested Vendor:
WEST COAST SPECIALTIES
11733 S.E. 40th
Portland
Or 97222

CHECK LIST FOR VISA ORDERS

	INITIALS	DATE
1. ENTER PR&C IN CEFMS		
2. APPR/CERT., OBL.		
3. ENTER PR&C IN MAXIMO		
4. RECEIVE IN MAXIMO		
5. RECEIVE IN CEFMS		

Contact: Greg DeMars
Tel: 503-659-3883 Fax:

Requested By: KEVIN Date Required: Jan 15 2001 12:00A M
Description: WFL Gates 2 & 4 Main Gate and Slide Gate Cylinders

Qty	Unit	Item	Description	Work Category Code	Unit Price	Line Cost
4	EA	20010995	Main Gate Cylinders (See attached specs)	4-0330-005-01		
				4LHD84	1,950.00	7,800.00
16	JOB	20011146	Slide Gate Cylinders (See Attached Specs)	4-0330-005-01		
				4LHD84	750.00	2,000.00
						3,800.00

REMARKS/JUSTIFICATION:

ROUTING: KPP Pat Gene Julie Tracie/Becky Kim

Approved By:_____ Date: _____

FOR PURCHASING USE ONLY
Vendor:_____
_____
_____
Contact/Telephone: _____

P.O. Number: _____
Order Date: _____
Exp. Delivery Date: _____
Ordered By: _____

COMPLETION CERTIFICATE

1. Reference is made to Contract No. DACW57-96-C-0028, dated 29 April 1996, with Joe Bernert Towing Co., Inc., for the Willamette Falls Locks, 1996 Dock Upstream Dock Restoration, West Linn, Oregon.

2. The work under this contract was completed by the contractor, on 14 June 1996. The date set for completion of the work under this contract was originally 16 June 1996. The work was therefore completed for beneficial occupancy within the time scheduled for completion by the original contract. No liquidated damages are involved.

3. I hereby certify that the work under this contract was inspected on 14 June 1996 and was found to have been completed in full conformance with the original plans and specifications.

4. I further certify that I have no knowledge of any claims made by or adjustments which will be required of the contractor in this instance and that I know of no liability under the contract which has not been settled. I therefore recommend acceptance of the work and that complete and final payment be made the contractor at this time.

REVIEWED

Organization	Typed Name	Initials	Date
CENPP-OC	Turner		10/15/96
CENPP-PE	Jones		10/15
CENPP-LM-OM	Bentley		10/17/96
CENPP-RE-M	Minger		10/17/96

Harry G. Weise

HARRY G. WEISE, P.E.
Administrative Contracting Officer

DATE: 9 Oct 1996

I concur in the recommendation of the Administrative Contracting Officer and recommend approval

THOMAS E. SAVIDGE, P.E.
Chief, Operations, Construction & Readiness Division

DATE: 10/21/96

APPROVED:

Gay M. Hettenhouser

GAY M. HETTENHOUSER
Contracting Officer

DATE: 21 Oct 96

PAYMENT ESTIMATE - CONTRACT PERFORMANCE

For use of this form, see ER 37-2-10 and ER 37-345-10

1. DATE	SHEET
07-Aug-96	1 of 1

2. CONTRACTOR AND ADDRESS	3. CONTRACT NO.	4. DISTRICT
JOE BERNERT TOWING CO., INC. P. O. Box 37, Wilsonville, Oregon 97070	DACW57-96-C-0028	Portland

5. DESCRIPTION OF WORK	6. APPROPRIATION AND PROJECT	7. REQUIRED COMPLETION DATE
Willamette Falls Locks U/S Dock Restoration	96 X 3123 O & M	17-June-96

8. LOCATION	9. PERIOD COVERED BY THIS ESTIMATE	10. JOB ORDER NO.	11. ESTIMATE NO.
West Linn, Oregon	FROM 02-July-96 THRU 07-Aug-96		2 - Final

ITEM NO.	DESCRIPTION	CONTRACT			TOTAL TO DATE	
		QUANTITY AND UNIT	UNIT PRICE	AMOUNT	QUANTITY AND UNIT	AMOUNT
0001	RECONSTRUCT UPSTREAM DOCK	1 JB	XXXX	48,390.00	100 %	48,390.00
INCLUDES MODIFICATION THRU:		TOTAL CONTRACT ---------->		48,390.00	TOTAL EARNINGS TO DATE ——>	48,390.00

12. PRESENTED FOR PAYMENT

PAYEE: Joe Bernert Towing Company, Inc.

PER: Ronald Bernert

DATE: 9/27/96

TITLE: President

13. APPROVED FOR PAYMENT

I CERTIFY that I have checked the quantities covered by this bill or estimate; that the work was actually performed; that the quantities are correct and consistent with all previous computations as actually checked; that the quantities and amounts are wholly consistent with the requirements of the contract or other instrument involved.

SIGNATURE	TITLE	DATE
Scott L Grimes	Civil Engineer	07 August 1996

CONTRACTING OFFICER APPROVAL (Signature): Barry Weist — DATE: 27-SEP-96

14.		
A. PREVIOUS DEDUCTIONS OTHER THAN RETAINED PERCENTAGE	0.00	
B. PREVIOUS RETAINED PERCENTAGE	500.00	
C. PREVIOUS PAYMENTS	47,890.00	
D. PREVIOUS EARNINGS (A+B+C)		48,390.00
E. EARNINGS THIS PERIOD (TOTAL EARNINGS TO DATE MINUS D)		0.00
F. LESS RETAINED PERCENTAGE	0.00	
G. LESS DEDUCTION OTHER THAN RETAINED PERCENTAGE FOR	0.00	
H. TOTAL DEDUCTIONS THIS PERIOD (F+G)		0.00
I. RETAINAGE REFUNDED	500.00	
J. OTHER REFUNDS	0.00	
K. TOTAL REFUNDS THIS PERIOD		500.00
L. AMOUNT DUE CONTRACTOR (E-H+K)		500.00

15. RECAPITULATION:

TOTAL RETAINED (B+F-I): 0.00 — TOTAL PAID (C+L): 48,390.00

ENG FORM 93 FACSIMILE

DACW57-97-C-0031 CENWP-CO-X

OFFER *(Must be fully completed by offeror)*

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
NEW ENGLAND POWER CO. 4 TECHNOLOGY DRIVE WESTBORO, MA 01581 ATTN: S.C. DORET	508-389-9001 97-015
	16. REMITTANCE ADDRESS *(Include only if different than Item 14)*
	NEW ENGLAND POWER CO. 25 RESEARCH DR. WESTBORO, MA 01582
CODE FACILITY CODE	

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.*

AMOUNTS	SEE SCHEDULE PAGES	Willamette Falls Locks, West Linn, Oregon, Willamette Falls Locks Gate 5 & 6 Rehabillitation

RECEIVED
MAY 08 2007
ENGINEER

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS
(The offeror acknowledges receipt of amendments to the solicitation - give number and date of each)

AMENDMENT NO.	1	2								
DATE	5-8-97	5-13-97								

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20B. SIGNATURE	20C. OFFER DATE
J. Levett ~~J.E. BAILEY~~ - VICE PRESIDENT	John F Levett	5/21/97

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED:

0001 thru 0003

PU1:37 REF: 0068

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA
$251,720.00	96x3123 O&M FD CAWFA2210D09501

24. SUBMIT INVOICES TO ADDRESS SHOWN IN *(4 Copies unless otherwise specified)*	ITEM 26	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C 2304(c) ( ) ☐ 41 U.S.C 253(c) ( )
26. ADMINISTERED BY CODE		27. PAYMENT WILL BE MADE BY
U.S. Army Corps of Engineers, Portland District Portland Resident Office 2606 NW Graham Road Troutdale, OR 97060-9512		Disbursing Officer U.S. Army Corps of Engineers, Portland District PO Box 2946 Portland, OR 97208-2946

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return _____ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work requirements identified this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.

☒ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*	31A. NAME OF CONTRACTING OFFICER *(Type or print)*
J. Levett ~~J.E. BAILEY~~ - VICE PRESIDENT	GEORGE R. WIGHT Contracting Officer

30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE
John F Levett	5/21/97	George R. Wight	97 JUL 08

STANDARD FORM 1442 BACK (REV. 4-85)
USAPPC V1.00

DUPLICATE ORIGINAL

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1 1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0002	05/13/97	PEMST0-0097-C012	DACW57-97-B-0012

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
US ARMY CORPS OF ENGINEERS PORTLAND DISTRICT PO BOX 2946 PORTLAND OR 97208-2946 SANDRA L. HILLEBRANDT C08(503) 326-6418	DACW57		

NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) Vendor ID: 00000000	(X)	9A. AMENDMENT OF SOLICITATION NO.
	X	DACW57-97-B-0012
		9B. DATED (SEE ITEM 11) 04/18/97
		10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 13)
CODE 0R94M FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers [X] is extended, [ ] is not extended.

ffers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer bmitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDG-ENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or ter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

ACCOUNTING AND APPROPRIATION DATA (If required)

WILLAMETTE FALLS LOCKS GATE 5 & 6 REHABILITATION

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).

C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

D. OTHER (Specify type of modification and authority)

IMPORTANT: Contractor [ ] is not, [ ] is required to sign this document and return _____ copies to the issuing office.

DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

THE ABOVE SOLICITATION IS AMENDED AS FOLLOWS:

REMOVE AND REPLACE DRAWINGS 114-116/1, 114-116/6, 114-116/8, AND 114/116/9
THAT WERE INADVERTENTLY LEFT OUT OF AMENDMENT 1 (SEE ATTACHED COPY).
BID OPENING DATE AND TIME HAVE BEEN CHANGED TO: MAY 23, 1997 AT 2:00 P.M.
LOCAL TIME AT PLACE OF OPENING.

ept as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1 1

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
0001	05/08/97	PEMST0-0097-C012	DACW57-97-B-0012

6. ISSUED BY	CODE	7. ADMINISTERED BY (If other than Item 6)	CODE
US ARMY CORPS OF ENGINEERS PORTLAND DISTRICT PO BOX 2946 PORTLAND OR 97208-2946 SANDRA L. HILLEBRANDT C08(503) 326-6418	DACW57		

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code) Vendor ID: 00000000	(X)	9A. AMENDMENT OF SOLICITATION NO.
	X	DACW57-97-B-0012
		9B. DATED (SEE ITEM 11) 04/18/97
		10A. MODIFICATION OF CONTRACT/ORDER NO.
		10B. DATED (SEE ITEM 13)
CODE 0R94M FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

WILLAMETTE FALLS LOCKS GATE 5 & 6 REHABILITATION

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(X)	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103 (b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

THE ABOVE SOLICITATION IS AMENDED AS FOLLOWS:
REMOVE & REPLACE PAGES: 00100-1 & 2, 00800-i, 00800-1 THRU 4, 01010-1 THRU 6, 01010-8 & 9, 01025-i, 01025-1 & 2, 01440-3 & 4, 02890-1 THRU 3, 02892-i, 02892-1 THRU 5, 02893-1 & 2, 02895-5 & 6, 09950-5 THRU 8, 15300-3 THRU 6, AND 16050-5 & 6. DAVIS BACON WAGE RATES PAGES 1 THRU 14. ASTERISKS MARK CHANGES
REMOVE AND REPLACE DRAWING NOS. 114-116/1, 114-116/6, 114-116/8, AND 114-116/9.
BID OPENING DATE AT TIME REMAINED UNCHANGED: MAY 20, 1997 AT 2:30 P.M. LOCAL TIME AT PLACE OF OPENING.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)	
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY (Signature of Contracting Officer)	16C. DATE SIGNED

SECTION 00010

BIDDING SCHEDULE
FOR
NO. DACW57-97-B-0012

ITEM UMBER	DESCRIPTION	ESTIMATED QUANTITIES	UNIT	UNIT PRICE	ESTIMATED AMOUNT
0001	Rehabilitation of Gate Nos. 5 and 6	1	Job	xxxxxx	$ 167,870.00
0002	Skilled Craftsman	xxxxx	xxx	xxxxxx	xxxxxxxxxx
0002A	First 100 Hours (HR)	100	HR	$ 55.00	$ 5,500.00
0002B	Over 100 Hours	100	HR	$ 55.00	$ 5,500
0003	Removal and Replacement of Gate No. 6 Anchor Block	1	Job	xxxxxx	$ 72,850.00
		TOTAL		$ 251,720.00	

All quantities estimated except where unit is job.

TECHNICAL REQUIREMENTS

SECTION 02890

REMOVAL AND REINSTALLATION OF GATE NOS. 5 AND 6

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all work and materials (except Government-furnished grease and hydraulic oil) necessary to:

(1) Remove both leaves of Gate No. 6.

(2) Place those gate leaves on a work barge.

(3) Remove both leaves of Gate No. 5.

(4) Place those gate leaves on a work barge.

(5) Reinstall the gate leaves of Gate No. 5.

(6) Return Gate No. 5 to operation.

(7) Reinstall the gate leaves of Gate No. 6.

(8) Return Gate No. 6 to operation.

1.2 AND 1.3 NOT APPLICABLE

1.4 PLANNING

With the lock closure limitations in SECTION 01010, paragraph 1.4, the removal and reinstallation of the gate leaves will require careful planning and scheduling. Submit as part of the Project-Specific Management Plan, a removal and reinstallation plan and schedule which covers a listing of the equipment, lifting devices, and procedures. The procedures shall include measurement and adjustment requirements as stated in paragraphs 3.1.2 and 3.2.

PART 2 - PRODUCTS

2.1 MATERIALS

Pintles, pintle collars, pintle heel bushings, gudgeon pins, gudgeon bushings, hydraulic oil, and grease will be Government furnished.

PART 3 - EXECUTION

3.1 REMOVAL OF GATE LEAVES

3.1.1 Crane Work Barges

A crane of sufficient capacity to lift each gate leaf shall be used. A barge(s) of sufficient size to provide an area for four leaves placed in a horizontal position, skin face down, on the barge deck shall be provided; and a sufficient off site facility and transportation barge(s) to transport the gate leafs to working site. The calculated weight of each leaf is 30 tons. The lifting attachments on each leaf may be used for attachment of lifting slings. Before use, inspect attachments to confirm that they are not damaged. Both leaves of both gates shall be removed and placed on the work barge(s) so that the repair work can be done on the four leaves at the same time. The existing anchor block located on the left side of gate 6 (see SECTION 02895) shall also be loaded and removed with the gates. Repair work on the gates shall take place off site and not within the Willamette Falls Locks Project area.

3.1.2 Lock Transit Times

The typical time to transit the locks, up bound or down bound, between gate No. 1 and the canal area upstream of gate No. 5 is about 20 minutes with all lock gates operational. Transit times increase significantly when the two gates are removed. The gates shall be transported downstream out of the locks. Upstream transport is not possible with gate No. 6 removed. Gates No. 5 and No. 6 may be removed in any order if both are simultaneously transported downstream on one barge because the water level between gate No. 7 and No. 4 can be held constant during the removal process. The downstream lockage process from upstream of gate No. 4 to the lower river, with both gates No. 5 and No. 6 removed, will take about two (2) hours due to the entire canal having to be drained. If each gate is to be transported downstream separately, then gate No. 6 shall be removed and transported downstream before gate No. 5 is removed. The transport of gate No. 6 to the lower river will take about 20 minutes. The subsequent transportation of gate No. 5 will take approximately two (2) hours due to the entire canal having to be drained. After the lock has been dewatered, an upstream lockage from gate No. 1 to upstream of gate No. 4 will take about three (3) hours due to filling the entire canal area and having to limit the initial rate of fill to limit sediment transport. This process will be necessary to reinstall the completed gates and to gain barge access to replace the gate No. 6 anchorage block.

3.1.3 Gate Position Measurements

Before removal of each leaf, measurements shall be taken and recorded to establish the position of the gudgeons and leaves when the gates are seated on their pintles. These reference measurements may then be used when leaves are reinstalled, and may be in the form of elevations and distance to reference points on the existing structure.

3.1.4 Walkways, Handrails, Hydraulic Lines, and Gudgeons

Before removal of the leaves, the walkway and handrails on top of each leaf shall be removed. In strict compliance with Safe Clearance Procedures required in Section 01010, paragraph 1.16, hydraulic lines shall be disconnected to the extent necessary for removal of the leaves. Open hydraulic lines shall be sealed with plugs or caps to prevent entry of dirt or moisture. Gudgeon anchor rods and hydraulic cylinders for operating the leaves shall be disconnected as required to remove the leaves. Dispose of any hydraulic oil in accordance with SECTION 01060.

3.1.5 Gate Warpage Measurements

After lifting each leaf off its pintle and before placing it face down on the work barge, it shall be held securely in a vertical position and measurements made to determine the amount of warpage existing in each leaf. The purpose of these measurements is to obtain an estimate of in-service damage and establish baseline data for monitoring the effect of repairs. After all repair work has been done on the leaves, and before installation of the new lagging, each leaf shall, again, be held securely in a vertical position and measurements repeated in the presence of the GQAR. Warpage after repairs shall not exceed warpage before repairs. All measurements shall be recorded and the records submitted within 48 hours after the measurements are taken. Warpage measurements shall be made as follows:

(1) Attach bar, clamp, etc. as near as practical to each corner of skin plate and perpendicular to the skin plate.

(2) Stretch vertical, horizontal, and diagonal lines between all four corners, with all ends tied an equal distance from skin plate. Assure no interference of the two diagonals.

(3) The distance between the diagonals where they cross, measured perpendicular to the skin plate, is warpage. Record warpage. Using all six lines as a reference, make and record measurements to the skin plate at four-foot intervals to measure curvature and other skin plate irregularities.

3.1.6 Gate Support Measurements

When placed on the work barge, the leaves shall be adequately supported by timbers or similar supports so that the skin plate lies in a plane surface within a tolerance of 1/2 inch in 20 feet. The supporting surface shall be measured by a method approved by the GQAR. If required, shims, wedges, or other means shall be used to bring the supports within tolerances.

3.2 REINSTALLATION OF LEAVES

After all work on the leaves has been completed, they shall be reinstalled. Each leaf shall be weighed as it is lifted into place and the weight provided to the GQAR. After the pintle bases, pintles, pintle collars, pintle heels, and pintle heel bushings are attached and put in-place, the pintle heel bushings shall be coated with Government-furnished grease. Each gate leaf shall then be carefully lowered into position using the quoin recess as a guide, until the pintle heel bushing seats on the pintle. The position of the gate shall be checked with reference measurements taken previously to insure that the leaf is seated on the pintle. New Government-furnished gudgeon pins and bushings shall be installed in the gudgeon anchor rods. Gudgeon anchor rods and leaf operating cylinders shall be reconnected. After all safe clearances have been released, bleed off all hydraulic lines and top off hydraulic reservoirs with Government-furnished oil. Refill the lubrication lines going to the gudgeon pins/bushings and down to the pintle assemblies with Government-furnished grease. Disposal of oil bled from the hydraulic lines shall be in accordance with SECTION 01060. The Government in the presence of the Contractor will operate the gate through several cycles, to the satisfaction of the GQAR, from the fully-opened to the fully-closed position a sufficient number of times to demonstrate that all parts of the gate are functioning properly. The workmanship in the installation of the gates shall be such that the gates will properly miter and form a watertight barrier across the lock under all ranges of water head to the satisfaction of the GQAR. Defects shall be corrected by the Contractor at no cost to the Government. Retesting shall be performed after defects are corrected. For safety, the crane shall remain connected to the leaves with the line slack during these operations. All other items disconnected or removed from the gate leaves shall be reinstalled.

- END OF SECTION -

TECHNICAL REQUIREMENTS

SECTION 02891

CLEANING AND INSPECTION OF GATE NOS. 5 AND 6

TABLE OF CONTENTS

TECHNICAL REQUIREMENTS

SECTION 02891

CLEANING AND INSPECTION OF GATE NOS. 5 AND 6

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all work necessary to prepare both leaves of each gate for inspection.

1.2 AND 1.3 NOT APPLICABLE

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 PREPARATION OF EACH LEAF FOR INSPECTION

After each leaf has been placed on a work barge or moved to an off site facility as specified in SECTION 02890, they shall be cleaned, have all algae, mud, and debris removed, and all of the timber lagging removed, including all lagging behind the 3/16-inch steel plate. All timber lagging shall become the property of the Contractor and be disposed of in accordance with SECTION 01060. The GQAR will perform an inspection of the welded joints, steel members, miscellaneous hardware, slide gates, and gate retaining angles, and overall condition of the four gate leaves. The slide gates and gate leaves shall be available for that inspection between 8 A.M. and 4 P.M. on a weekday. A 24-hour advance notice shall be given when all is ready for inspection.

3.2 PINTLE INSPECTION

The four pintle heels and pintle bases shall be placed on a work barge or moved to an off site facility and cleaned. They shall be available for inspection by the GQAR concurrently with the four gate leaves.

- END OF SECTION -

TECHNICAL REQUIREMENTS

SECTION 02892

REPAIR OF GATE NOS. 5 AND 6

TABLE OF CONTENTS

TECHNICAL REQUIREMENTS

SECTION 02892

REPAIR OF GATE NOS. 5 AND 6

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all work necessary to replace following:

Rubber "J" seals on the slide gate openings and on the bottom edge of each gate leaf.
Gudgeon pins
Gudgeon bushings
Pintles
Pintle collars
Pintle heel bushings
Backing plates
Damaged miscellaneous hardware

The section also covers repair of any broken welds or any other gate damage.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Society for Testing and Materials (ASTM).

ASTM A36/A36M-94 Standard Specifications For Carbon Structural Steel

American Welding Society (AWS).

AWS D1.1-94 Structural Welding Code - Steel, Thirteen Edition

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation. Submittals having a "FIO" designation are for information only. The following shall be submitted as stated in accordance with SECTION 01305, paragraph 1.3(1)(b).

SD-08 Statements

(GA) Welding procedure

(GA) Welders qualifications

AMD#001

PART 2 - PRODUCTS

2.1 MATERIALS

Structural steel shall be ASTM A36 unless otherwise noted. All bolts, screws, and set screws shall be Contractor-furnished and shall match existing or be submitted for approval. All pipes shall be schedule 80 black iron. Use socket weld fittings on all pipes except pipe bend for the conduit. Contractor-supplied materials shall match the existing or be submitted for approval. Refer to information drawings for more information on the existing materials. Hydraulic cylinders, pintles, pintle collars, pintle heel bushings, gudgeon pins, gudgeon bushings, "J" seals, oil, and grease will be Government-furnished material. All other material shall be Contractor-furnished.

PART 3 - EXECUTION

3.1 RUBBER SEALS ("J" SEALS)

All of the existing "J" seals, both the gate sill seals, and the slide gate opening seals as well as all connecting screws, bolts, nuts shall be removed and replaced. The "J" seals will be Government-furnished. The new screws, bolts, and nuts will be Contractor-furnished. The Contractor shall drill mount holes in the new "J" seals for installation. Seals shall be handled and stored in a manner to prevent damage. Seals which have been cut, torn, or otherwise damaged shall not be used. Bending or rolling in tighter coils than those in which the seals are packaged at the factory shall be avoided. Storage shall be indoors, in original package, and without heavy loading or exposure to oils, chemicals, vapors, or ozone. Storage temperatures shall not exceed 100°F. The rubber seals shall meet the requirements set forth below. The durometer hardness of the seals except as specifically otherwise indicated on the drawings shall meet the requirements set forth herein.

3.2 GUDGEON ANCHOR

The existing gudgeon anchors shall be reused.

3.3 GUDGEON PIN AND BUSHING

The gudgeon pin and gudgeon bushing shall be removed from each gate leaf, gudgeon anchor, and new Government-furnished gudgeon pins and gudgeon bushings installed. The Contractor shall furnish and install new grease fittings and piping in the new Government-furnished gudgeon pins.

3.4 PINTLE ASSEMBLY

The pintle, pintle collar, and pintle heel bushing shall be removed from each gate leaf, and new Government furnished of the same installed. The lubrication system shall be removed from each gate leaf, and new Contractor-furnished of the same installed as per GQAR approval. After installation of the pintle heel bushing, the Contractor shall confirm that the lubrication system is in satisfactory operating condition. The pintle base and pintle heel shall be removed from each gate leaf and lock floor area, cleaned, and reinstalled according to SECTION 02891, paragraph 3.2.

3.5 GATE OPERATING CYLINDER PISTON ROD BACKING PLATE REPLACEMENT

The existing gate operating cylinder piston rod backing plates on all four gate leaves shall be removed and replaced with new contractor furnished backing plates. The new backing plates shall be 20 inches high, 30 inches wide, and 0.625 inches thick. The existing backing plates can be seen in the gate operating cylinder piston rod connection detail on informational drawings UWR-114-96/5 and UWR-114-107/5. The existing rod connection details are similar to, but not exactly, as shown on the informational drawings. The existing ½ inch thick brackets that support the backing plate shall not be removed. The new backing plate shall be welded to the existing brackets and to the existing W 16 X 50 using ½ inch fillet welds, as shown in the previously mentioned informational drawings. Locate and drill four vertically short slotted holes in the backing plate in the field, using the connection plate as a template. The holes shall not be flame cut. The dimensions of the short slotted holes as well as the minimum edge distances shall be those designated in the LRFD Specification. The existing bolts, nuts, and washers, that connect the connecting plate to the backing plate, shall be removed and replaced with new of the same. All gate operating cylinders shall be level with a tolerance of ±1/8 inch vertically over the length of the gate operating cylinder (when fully extended). The gate operating cylinders shall be placed so that during gate operation, they do not come in contact with (rub against), any part of the wood planking, rock, or concrete that lies immediately underneath and around the cylinders. The position of the centerline of the clevis and pin shall be located as shown in the previously mentioned informational drawings and shall be field verified. Vertical shimming of the existing bracket plates may be needed to make the cylinders level and unencumbered (see drawing UWR-114-116/7 for shimming detail).

3.6 MISCELLANEOUS HARDWARE

Any nuts, bolts, screws, washers, etc. not covered in SECTION 02892, paragraphs 2.1 and 3.1, and SECTION 02893, paragraphs 2.1, 3.1, and 3.2, that require replacement as specified by the GQAR after the inspection shall be removed and replaced with new Contractor-furnished of the same.

3.7 STRAP BRACE

After all repairs are completed and prior to the installation of the gate, the following diagonal prestressing procedure, in conjunction with the requirements of the contract specifications, is recommended:

(1) Strain gauge installation and "turn of the nut" testing.

(a) Place each leaf in a horizontal supported position on the work barge, skinplate down, and loosen the turnbuckle nut until diagonal in slack (i.e., no tension or compression). Install gate warpage measurement system as outlined in SECTION 02890, paragraph 3.1.4.

(b) As a precautionary measure to insure the diagonals are not overstressed during the prestressing process, strain gauges shall be installed on all diagonals. Two strain gauges will be placed on the upper portion of the diagonal; one gauge on each side of the diagonal. These two readings will be averaged to determine the strain and corresponding stress during prestressing. The gauges should be placed on the diagonal about 6 to 12 inches away from the edge of the eye plates. A small area of paint may need to be removed so the gauges may be glued directly to the steel. Test and calibrate the newly installed strain gauges to assure readings are accurate. Lead wires shall be of sufficient length to allow readings when gate is raised in a vertical position. The removed areas of the paint under the gauges need to be touched-up after the completion of the test.

(c) Apply environmentally safe, heavy lubricant to nut and threads. Clamp the diagonal to the leaf, as close to both ends of the turnbuckle nut as possible, to prevent twisting of the diagonal during the nut turning operation. The clamping during the prestressing procedure, thereby will effect the tensile strain in the diagonal. The bar must be allowed to strain along the entire diagonal length. One way to accomplish this may be to utilize a clamping assembly that consists of sandwiching the diagonal bar between two greased blocks (timber or plastic). The blocks must be thin enough to not induce an eccentricity into the diagonal or to relax the prestressing force when they are removed. This system should allow the diagonal to elongate or shorten, while providing torsional restraint.

(d) With the leaf in a horizontal supported position, tighten the turnbuckle nut without jacking on the leaf to determine the torquing limitations of this "turn of the nut" method. Monitor strain gauge readings during this test and calculate the corresponding stresses in diagonal. The test shall be terminated when the diagonal stress reaches 10 ksi, or when the procedure becomes difficult to perform, or is determined to be adversely affecting the diagonal or leaf.

(e) Loosen turnbuckle nut until diagonal is slack. Verify strain gauge reading is zeroed out.

(2) Diagonal prestressing on barge.

(a) Per specifications SECTION 02890 paragraph 3.1.4, with the diagonal slack, pick the leaf and hold securely in a vertical position and measure the amount of warpage in the leaf. Care should be exercised during the leaf lifting process to assure the diagonal is not subject to sudden compressive stresses that could buckle or damage the diagonal.

(b) Place the leaf back in a horizontal supported position, jack under lower miter corner, and adjust turnbuckle nut accordingly. Record strain gauge readings and calculate diagonal stress.

(c) Raise leaf and measure warpage again. Record strain gauge readings and calculate diagonal stress. Repeat this process until warpage is within 2 inches (+ 1/2"). The diagonal tensile stress shall not exceed 10 ksi (+ 1 ksi) at any time during this process.

(3) Reinstallation of leaves and in-water diagonal prestressing.

(a) Leave sufficient timber and lagging off leaves to provide access to turnbuckle nut and allow room for the diagonal to be clamped to the leaf, as well as provide access to strain gauges.

(b) Reinstall each leaf per contract specifications, SECTION 02890 paragraph 3.2.

(c) Attach lead wires to strain gauges after both leaves have been installed. With leaves in an unmitered, stationary position, record strain gauge readings and calculate diagonal stresses. The stress in the diagonals shall not exceed 18 ksi.

(d) Bring both leaves to a mitered position. Measure the misalignment gaps between the miter posts in both the upstream/downstream directions and laterally along the entire height of the miter posts.

(e) There shall be no gaps between the miter posts. If the upstream /downstream misalignment is greater than 1", the diagonal turnbuckle nut may have to be adjusted.

(f) If necessary, attach a wrench to the turnbuckle nut and a mechanical device mounted on the barge will be utilized to adjust the nut. The mechanical device shall be capable of tightening or loosing the turnbuckle nut. Strain gauge readings shall be monitored and stresses calculated for each adjustment to assure the diagonals are not overstressed. The stress in the diagonals shall not exceed 18 ksi. For a safety reason this procedure should be approved by GQAR.

(g) Perform the prestressing adjustments until the leaves miter within specified tolerances.

(h) Per SECTION 02890 paragraph 3.2, the gates shall be operated through several cycles from the fully-open to the fully-closed position a sufficient number or times to demonstrate to the Government that all parts are functioning properly. The workmanship in the installation of the gates shall be such that the gates will properly miter and form a watertight barrier across the lock under all ranges of water head. While the gates are being opened and closed, strain gauge readings shall be recorded to assure the diagonals are not being overstressed during normal gate operation. Again, the stress in the diagonals during this process shall not exceed 18 ksi.

(i) The strain gages are to remain on the diagonals. Repair any paint around the strain gauges. Reinstall any timber and plastic lagging in front of the turnbuckle nuts and strain gauges.

3.8 OTHER WELDING AND SKILLED CRAFTSMAN REPAIRS

If the gate inspection of SECTION 02891 identifies any broken welds, damaged or misaligned slide gates, damaged slide gate guides, or other needed repairs; qualified welders, welding equipment and other necessary skilled craftsmen and equipment shall be used for welding repair, slide gate repair, and other repair work directed by the GQAR. The GQAR will identify and mark all welds to be repaired. Welding repair shall include removal of broken welds, surface preparations, and welding. Cracked welds shall be repaired in accordance with AWS D1.1, Section 3, paragraph 3.7, Repairs. All welders shall be qualified in accordance with AWS D.1.1 All welding shall meet the requirements of AWS D1.1. The Contractor shall submit welder qualifications and welding procedures (see paragraph 1.3 of this section). Up to 10 percent of all weld repairs will be subject to non-destructive testing (radiograph, ultrasound). The welds to be tested shall be selected by the GQAR. Slide gate repairs may require welder, machinist, and/or other skilled trades. All welded surfaces and other painting work directed by the GQAR shall be painted to comply with the requirements of SECTION 09950. All weld will be measured by the lineal feet of weld equivalent to 3/8 inch fillet weld. Measurement will be the amount marked by the GQAR and will not extend more than 1/2 inch beyond the visible crack.

- END OF SECTION -

TECHNICAL REQUIREMENTS

SECTION 02893

REPLACEMENT OF LAGGING

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TECHNICAL REQUIREMENTS

SECTION 02893

REPLACEMENT OF LAGGING

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all work necessary to remove the existing lagging and studs and to install new studs and lagging on the leaves of Gate Nos. 5 and 6.

1.2 REFERENCES

The publication listed below forms a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.

American Wood Preservers Association (AWPA).

AWPA M4-91 Standard for the Care of Preservative-Treated Wood Products.

American Welding Society (AWS) D1.1.

AWS D1.1-94 Structural Welding Code-Steel, Thirteenth Edition.

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation: submittals having a "FIO" designation are for information only. The following shall be submitted as stated in accordance with SECTION 01305, paragraph 1.3(1)(b).

SD-14 Samples

(GA) Lagging Material. See paragraph 2.1

PART 2 - PRODUCTS

2.1 MATERIALS

All lagging, weld studs, nuts, and washers, shall be Contractor-furnished materials. The existing miter and quoin posts shall be reused. The lagging planks shall be 3 X 12 and consist of Douglas Fir, per WCLIB Grading Rules Number 17, paragraph 123-b, "No.1"-Structural Joists and Planks. Lagging shall be S4S. Prior to application of creosote, all items shall be cut, bored, and counter-bored as shown in drawing UWR-114-116/1. All lumber is to be incised and treated in accordance with AWPA Standard C 2 with creosote to a minimum retention of 10 pounds per cubic foot. Informational drawings should be referred to for more information on the existing materials.

AMD #001

PART 3 - EXECUTION

3.1 REMOVAL

Details and dimensions of the existing lagging is shown on Information Drawings UWR-114-107/2 to -107/6 for gate 5 and Information Drawings UWR-114-96/2 to -96/6 for gate 6. For new lagging dimensions see Drawing UWR-114-116/1. Care shall be taken not to damage the miter and quoin posts since these items will be reused. All lagging nuts and washers, weld studs shall be removed. All lagging weld studs, nuts, and washers, shall be replaced with new Contractor-furnished lagging, bolts, screws, and weld studs. All excess material shall be disposed of off site in accordance with SECTION 01060.

3.2 INSTALLATION

Some trimming and boring of lagging will be required for a proper fit and for new mounting bolts, studs, and screws. Treated plugs shall be driven in after the final bolting is completed. Plugs shall be trimmed flush with the surface. All field cuts made on the timber and flush trimmed plugs shall be thoroughly brush coated with two applications of environmentally safe wood preservative in accordance with AWPA M4-91 and consistent with SECTION 01060, paragraph 3.3. The areas around new studs shall be painted to comply with the requirements of SECTION 09950. All weld shall conform to the requirements of AWS D 1.1. All stud welding shall conform to the requirements of AWS D1.1, Section 7.

- END OF SECTION -

TECHNICAL REQUIREMENTS

SECTION 2895

REPLACEMENT OF GATE 6 LEFT HYDRAULIC CYLINDER ANCHOR BLOCK

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TECHNICAL REQUIREMENTS

SECTION 2895

REPLACEMENT OF GATE 6 LEFT HYDRAULIC CYLINDER ANCHOR BLOCK

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all work and materials necessary for:

(1) Disassembly of lock features associated with the anchor block.

(2) Removal and disposal of the existing anchor block.

(3) Installation of Rock Reinforcement.

(4) Foundation preparation for the new anchor block.

(5) Construction of the new anchor block.

(6) Reassembly of Lock features associated with anchor block

1.2 NOT APPLICABLE

1.3 SUBMITTALS

SD-01 Data

(GA) Qualifications. Specialty rock bolt contractor or Contractor's qualified rock bolt crew that will be installing the rock bolts, include company name and resumes of company and key personnel.

SD-04 Drawings

(GA) Detailed Plan. Detailed plan of rock bolt installation procedures. The plan shall include the following: (1) the name of the bolt and resin manufacturers, the resin batch numbers, setup times and expiration date; (2) drill manufacturer, model, and capability for installing the specified rock bolts in the existing confined space; and (3) a detailed rock bolt installation procedure that includes all steps covered in PART 3 of this Section. Execution, and defines all rock bolt and resin manufacturer recommendations to be used for this job; and 4) the method of plugging open joints encountered during the drilling of the rock bolt holes to render them impermeable.

1.4 SITE CONDITIONS.

1.4.1 General Conditions.

Not all of the site conditions are fully portrayed in this section. It is therefore highly recommended that the contractor inspect the site before preparing a bid on this work as specified in SECTION 00100, paragraph 1.12. The site for this work is located on the left side of the lock, adjacent to the gate 6 recess. The lock wall in this area consists

precast concrete panels, approximately 6 inches in thickness (see drawings). The wall extends from a base elevation of approximately +42 to a top elevation of +64.3. The wall is free standing and is separated from the rock for the full height. The distance between the lock wall and rock face is variable (see drawings). In the vicinity of the anchor block and below elevation +53, only a narrow void exists between the rock face and lock wall. The lock wall is supported by a series of narrow concrete buttresses that extend from the lock wall to the rock face. The top of the buttresses are at elevation +64.5. The existing lock wall is not designed for additional lateral loading.

1.4.2 Work Area Conditions.

The work area for the replacement of the anchor block is confined between two of the existing buttresses that are approximately 18 feet apart. A number of existing lock features are present in the vicinity of the anchor block. These features will require disassembly to remove the existing block and reassembly following the construction of the new block. These features include a wood plank deck, hand rails, electrical conduits, hydraulic line and the hydraulic cylinder and anchor plate.

1.4.3 Rock Conditions.

The rock at the site consists of a series of thick lava flows of the Columbia River Basalt Group. This rock is generally unweathered, dense and of high strength. At the site of the anchor block, the back wall and immediately above consists of a blocky jointed basalt. Rock blocks are generally greater than 2 feet and can be as large as 10 feet in size. However, many of the joints in the vicinity of the site are open. Immediately below the existing concrete block is a horizontal altered and brecciated basalt zone that defines the base of the lava flow above. This zone appears to be about 5 feet in thickness and is considerably weaker than the overlying blocky jointed basalt.

1.4.4 Existing Concrete Block.

The existing concrete anchor block is formed on 3 of its lateral sides. The fourth side is cast against the rock slope. The base of the block sits on a small rock pedestal that slopes toward the lock (see drawing). The top is flat. The existing block is approximately 4 feet long by 3 feet wide by 4 feet high. Its weight is approximately 8 kips. The block is supported only by the frictional resistance of the foundation and is not attached to the rock by any rock bolts or dowels.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Rock Bolt Assemblies.

Rock bolt assemblies shall consist of rock bolts, bearing plates and nuts. All components of the assembly shall come from the same company. The rock bolts shall be manufactured by a reputable company regularly engaged in the manufacture of rock bolts. The components shall conform to the following specifications.

(1) Rock Bolts.

a. Type and Grade, high strength rock bolts conforming to ASTM A 722, Grade 150, 1 3/8-inch-diameter, Type II.

b. Length, 20 feet, continuous with no couplings.

c. At least 5 feet of the upper end of the bolts shall be threaded and able to accept a rock bolt nut for the entire 5 feet. Rock bolts shall be new, and manufactured by a reputable rock bolt manufacturer. The bolts shall be clean and free of rust and pits. The bolts shall be straight with no bends of any kind.

(2) Bearing Plate. The bearing plate shall consist of a 1 1/2-inch thick, 7-inch square plate with a spherical depression in the center for accepting a spherical rock bolt nut.

(3) Rock Bolt Nut. The rock bolt nut shall consist of a spherical nut as shown on the drawings.

2.1.2 Rock Dowels.

Rock dowels shall consist of unthreaded 5/8-inch diameter deformed rebar and shall conform to ASTM A 614, Grade 60.

2.1.3 Polyester Resin.

Resin shall be used to anchor and completely encapsulate the rock bolts only. All resin shall be contained in cartridges that contain both resin and a curing agent. Resin shall be the product of a company specializing in the manufacture of polyester resin for use with rock bolts. Polyester resin has a limited shelf life. No polyester resin shall be used that has passed its expiration date. Resin of two setup times shall be provided; a fast setup time for anchoring the bolts and a slower setup time to allow tensioning of rock bolts prior to final set.

2.1.4 Cement Grout.

Cement grout shall be used to anchor and encapsulate the rock dowels. Cement grout shall consist of a Portland cement and water. Portland cement shall conform to ASTM C 150 Type I or II. Water shall be clean and free of injurious quantities which could affect the cement quality. Additional additives shall be used only as approved. The grout mixture shall have a water cement ratio no greater than 0.45 by weight. This is equivalent to a volume proportion of no more than 0.68 cubic feet of water for each 94 pound sack of cement. The mixture shall be mixed with a suitable mixer that will assure 100 percent hydration of the cement.

2.1.4 Rock Bolt Installation Personnel.

All rock reinforcement specified in this contract shall be performed by an experienced and reputable rock bolt specialty contractor with at least 10 years of successful work in installing resin anchored rock bolts, or by qualified Contractor personnel who meet these same standards.

2.1.5 Rock Bolt Drill.

The drill used to drill and install the rock bolts and dowels shall be capable of installing resin anchored and encapsulated rock bolts of the lengths specified by the recommended procedures of both the rock bolt and resin manufacturers and as covered in the specifications. The drill shall also be able to fit into the confined working space behind the lock wall and to drill and install the rock bolts at the position and alignment shown.

PART 3 - EXECUTION

3.1 DISASSEMBLY OF LOCK FEATURES

The existing deck, deck support, hand rail, electrical conduits, hydraulic lines, the hydraulic cylinder and the hydraulic cylinder anchor plate that is attached to the concrete anchor block shall be disassembled to provide clearance for removing the existing anchor block and drilling the specified rock reinforcement and rock dowels. All items shall be disassembled in such a way that they can be reassembled following the installation of the new anchor block. Any items that cannot be reused shall be replaced with new similar materials.

3.2 REMOVAL OF CONCRETE BLOCK

The existing concrete block shall be removed from the site. Disposal of the concrete block shall be the responsibility of the contractor. It shall not be disposed of on government property.

3.3 ROCK REINFORCEMENT INSTALLATION

3.3.1 General.

A total of 7 rock bolts and 2 rock dowels shall be installed as shown. Qualifications for personnel and installation equipment and material specifications are presented in Part 2, Materials. All rock bolts shall be anchored and completely encapsulated in polyester resin. The rock dowels shall be anchored and encapsulated in cement grout.

3.3.2 Storage.

Polyester resin is sensitive to temperature and must be stored in adequately heated and air-conditioned storage buildings, within the temperature range recommended by the resin manufacturer. All rock bolts shall be stored in a suitable facility to prevent corrosion, bending and contact with undesirable substances such as grease, oil, paint and any other materials that could adhere to the rock bolts. If such materials are found on the bolts, they shall be removed prior to installation.

3.3.3 Rock Bolt Installation.

Rock bolt installation shall follow the following procedures.

(1) Tolerances.

(a) The three rock bolts that are to be embedded in the concrete anchor block shall meet all of the following tolerances: (1) deviate no more than 2.0 inches from the specified alignment at the specified end of the bolt, (2) deviate no more than 2.5 inches from the specified alignment at the collar of the each hole and (3) the bearing and dip of the bolt installation shall not vary by more than 1 degree from the bearing and angle shown on the drawings.

(b) The remaining rock bolts should also be installed as close to the same tolerances as possible. However, if obstructions prevent the bolts from being installed as shown on the drawings, the bolts can be adjusted on an individual basis. Unless consented to by the Contracting Officer, these bolts shall not exceed a deviation from the

specified bolt alignment of more than 1.0 foot nor exceed a deviation of 5 degrees of the specified bearing and dip.

(2) Preparation Work. The collar of each rock bolt hole shall be prepared before drilling to allow for seating the required bearing plate on a relatively flat surface that is nearly perpendicular to the axis of the rock bolt.

(3) Rock Bolt Drilling.

(a) All bolt holes shall be drilled with a rotary percussion or percussion drill.

(b) The diameter of the drill hole is critical to the proper mixing of the resin. The hole diameter shall be within the range recommended by the rock bolt and resin manufacturers.

(c) The bolt bearing and inclination are shown on the drawings.

(d) The rock bolt holes shall be drilled to the depth and within the tolerances recommend by the bolt and resin manufacturers.

(e) If water is encountered during the drilling of any rock bolt hole, the drilling shall cease and the open zone shall be rendered impermeable before advancing the hole. One method of plugging an open zone is to insert an epoxy (not polyester) cartridge and mixing with the drill. Once the resin sets up it would be drilled out. A plan for plugging open zones shall be submitted with the installation procedures.

(4) Hole Preparation. Holes shall be blown clean of cuttings and water. Water is detrimental to the bonding of resin. If water continues to seep into a hole after blowing it dry, any seeps shall be sealed off prior to installation of the bolt.

(5) Polyester Resin Cartridge Insertion.

(a) Resin shall consist of both a quick set and a slow set time to allow for anchoring the bolt and tensioning the non anchor part of the bolt before the slow set resin cures.

(b) The anchor zone in which the quick set resin is used shall be the bottom 5 feet of the hole. The remainder of the hole shall be filled with slow set resin.

(c) All bolts shall be fully encapsulated in resin. The amount of resin to achieve full encapsulation and the insertion procedures shall be as recommended by the resin manufacturer.

(d) The cartridges shall be inserted in the bolt holes without damaging the cartridge.

(e) The temperature of the resin cartridges at the time of insertion shall be within the range recommended by the resin factory representative.

(6) Insertion of Rock Bolts.

(a) Installation of the bolt shall be performed by spinning the rock bolt as it is inserted for the entire length of the hole. Spinning is vital for the proper mixing of the resin.

(b) The direction of spin rotation shall be as specified by the rock bolt manufacturer and as necessary to assure complete encapsulation.

(c) The rate of spin and insertion rate of the bolt into the cartridge filled hole, shall be as recommended by both the resin and rock bolt manufacturers.

(d) The three rock bolts that are to be embedded within the concrete anchor block shall protrude beyond the rock face to the point where shown.

(7) Tensioning of Rock Bolts. All rock bolts shall be tensioned to the value shown on the drawings immediately following the set up of the anchor zone resin. Tensioning shall be completed and the bolt locked off at the specified value before the slower set encapsulating resin sets up.

3.3.4 Rock Dowel Installation.

Two rock dowels consisting of number 5 rebar, shall be installed vertically into the foundation rock of the concrete anchor block. The dowels shall be installed as shown on the drawings. Cement grout shall be used to anchor and fully encapsulate the part of the dowel embedded in rock. The grout shall be pumped into the hole using a tremie tube placed just above the bottom of the hole. The dowel shall be pushed into the hole immediately after the grout is placed.

3.3.5 Preparation for Embedment in Concrete.

The three rock bolts that are to be embedded into the concrete block shall be prepared before placement of concrete. Preparation shall consist of removing the bearing plate and nut and repositioning them and an extra nut as shown. Preparation shall also include filling any void within the annular space between the rock bolt and the rock bolt hole with dry pack mortar. Under no circumstances shall the bolt be bent from its original alignment. If any of the rock bolts are bent from their original installed alignment, regardless of the deviation from the specified alignment, the bolts will not be accepted and shall be replaced at no additional expense to the Government.

3.4 FOUNDATION PREPARATION

The foundation rock shall be excavated to firm rock. Firm rock is defined as in-place rock with no open discontinuities. Rock surfaces upon which concrete is to be placed shall be clean, free from oil, standing or running water, ice, mud, drummy rock, coatings, loose debris, semi detached and unsound fragments. Immediately before concrete is placed all rock surfaces shall be cleaned thoroughly by the use of air-water jet, high-pressure water jet, or other approved methods. All devises necessary to produce a foundation free of running or standing water shall be installed and securely fastened in-place so as to prevent their being jarred loose by concrete placement. All rock surfaces shall be wet at the time of concrete placement. All foundation surfaces flatter than a 1V on 1H shall be covered immediately before the concrete is placed with a layer of mortar composed of the same sand and cementitious materials used in the concrete. The sand/cementitious materials ratio and the water cement ratio of the mortar should be approximately the same as those used in the concrete mixture.

3.5 CONCRETE PLACEMENT

The concrete anchor block shall be formed on all free sides. The top of the block shall be troweled smooth and level. The dimensions of the concrete block shall be as shown on the drawings.

3.6 REASSEMBLY OF LOCK FEATURES

3.6.1 General.

Following the construction of the new concrete anchor block, the lock features that were disassembled to remove the original anchor block and to gain access to the work site, shall be reassembled. Reassembly shall be as specified below and in other sections and drawings of this contract. If some features are not specified, they shall follow the same design as the original assembly. Changes to be made from the original design are in part specified below.

3.6.2 Hydraulic Cylinder Anchor Block.

The assembly of the hydraulic cylinder attachment to the new anchor block is as shown. Minor changes in the wood beam decking may be necessary to accommodate the new attachment.

- END OF SECTION -

TECHNICAL PROVISIONS

SECTION 03300

CONCRETE

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TECHNICAL PROVISIONS

SECTION 03300

CONCRETE

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section includes all activities for the preparation, production, and placement of concrete around the floor and wall conduits and for the replacement concrete anchor block. The work involves demolition, disposal, forming, and placement of concrete.

1.2 REFERENCES

American Concrete Institute (ACI)

ACI 304R-89	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 315R-94	Details and Detailing of Concrete Reinforcement
ACI 318-95	Building Code Requirements for Reinforced Concrete

American Society for Testing and Materials (ASTM)

ASTM C31-91	Standard Practice for Making and Curing Concrete Test specimens in the Field
ASTM C33-93	Standard Specification For Concrete Aggregates
ASTM C39-94	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94-94	Standard Specification for Ready-Mixed Concrete
ASTM C143 REV A-90	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM A615/A615M REV B-92	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C150-95	Standard Specification for Portland Cement
ASTM C231 REV B-91	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

1.3 SUBMITTAL

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted as stated in accordance with SECTION 01305, paragraph 1.3(1)(b).

SD-01 Data

(GA) Name and Location of Source of Concrete Aggregates. See paragraph 2.1.3

SD-09 Reports

(GA) Test Results. See Paragraph 3.1

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Concrete Mix

Concrete shall be composed of 3/4-inch maximum size aggregate, Type I or Type II, low alkali, Portland cement, 6.0± 1.5 percent total air content in accordance with ASTM C-231, and slump range of two to four inches in accordance with ASTM C-143. Concrete mix design shall be submitted to the Contracting Office for approval. Concrete shall be designed for minimum compressive strength of 4,000 psi at 28 days. Mix and transport concrete in accordance with ASTM C94-94 and ACI 304R-89. When concrete is truck-mixed the concrete shall be discharged into the forms within 1-1/2 hours after introduction of the water to the aggregate. The concrete shall be internally vibrated with mechanical vibrators in the forms and moist-cured or membrane cured for a minimum of 14 days (7 days for Type I cement). Defective concrete shall be removed and replaced as directed.

2.1.2 Reinforcement

The Contractor shall furnish and place bar reinforcement which shall be deformed, grade 60 billet steel conforming to ASTM A615, ACI 318, and ACI 315R. Reinforcement bars may be mill or field bent. All bars shall be bent cooled unless otherwise authorized. All hooks or bends shall be in accordance with ACI 318. Reinforcement placing tolerances shall be in accordance with ACI 318.

2.1.3 Aggregates.

Concrete aggregate, shall be in conformance with ASTM C-33 Standard Specification for Concrete Aggregate. Fine aggregate shall consist of natural sand, manufactured sand, or a combination of natural and manufactured sands. Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, or a combination thereof. The name and location of the source of concrete aggregates shall be submitted for approval. If insufficient data is available on the source its adequacy will be determined by tests.

2.1.4 Curing Materials

Curing materials shall be burlap, impervious sheets, or membrane-forming compounds.

2.1.5 Form Materials

Forms for concrete surfaces shall be metal, plywood, or hardboard capable of producing the required surface without adverse effect on the concrete. Form coating shall be non-staining form oil or form release agent that will not adversely affect the concrete surfaces or impair subsequent applications to the concrete. Form ties shall be metal, factory-

fabricated, removable or snap-off type that will not leave holes less than ¼ inch nor more than 1 inch deep and not more than 1 inch in diameter.

PART 3 - EXECUTION

3.1 QUALITY

In accordance with SECTION 01440, the Contractor shall inspect for mix proportions at the batch plant, forming, placing, curing and embedded items. Air content and slump checks shall be conducted at the site during placement. The Contractor shall furnish molds and shall cast four standard 6 x 12 inch test cylinders during each placement of concrete and test the concrete used for air content and slump. He shall handle and standard-cure test specimens, and make tests for compressive strength at 7 and 28 days, 2 cylinders each age. Results of the tests shall be submitted. All tests shall be in compliance with standard tests listed in paragraph 1.2.

-END OF SECTION-

TECHNICAL REQUIREMENTS

SECTION 09950

CLEANING AND PAINTING

TABLE OF CONTENTS

TECHNICAL REQUIREMENTS

SECTION 09950

CLEANING AND PAINTING

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all operations in connection with the preparation of surfaces and application of paint and other specific materials to the miter gates and cylinder bracket assembly. The work shall be done off-site except for touch-up painting as required.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

American Conference of Governmental Industrial Hygienists (ACGIH).

ACGIH-02	(1991) 1991-1992 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
ACGIH-03	(1986) Guidelines to the Selection of Chemical Protective Clothing.

American National Standards Institute (ANSI).

ANSI Z87.1-89	Practice for Occupational and Educational Eye and Face Protection.
ANSI Z358.1-90	Emergency Eyewash and Shower Equipment.

American Society for Testing and Materials (ASTM).

ASTM D153-84	Standard Test Methods for Specific Gravity of Pigments.
ASTM D281-95	Standard Test Methods for Oil Absorption of Pigments by Spatula Rub-Out.
ASTM D520-89	Standard Test Methods for Zinc Dust Pigment.
ASTM D561-82	Standard Specification for Carbon Black Pigment for Paint.
ASTM D740-94	Standard Specification for Ethyl Ethyl Ketone.
ASTM D841-95	Standard Specification for Nitration Grade Toluene.
ASTM D843-95	Standard Specification for Nitration Grade Xylene.

ASTM D1045-86	Standard Test Method for Sampling and Testing Plasticizers Used in Plastics.
ASTM D1152-89	Standard Test Method for Methanol (Methyl Alcohol).
ASTM D1153-94	Standard Specification for Methyl Isobutyl Ketone.
ASTM D1186-93	Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base.
ASTM D1200-94	Standard Test Method for Viscosity by Ford Viscosity Cup.
ASTM D1210-79	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems.
ASTM D2917-91	Standard Specification for Methyl Isoamyl Ketone.
ASTM D3721-83	Standard Specification for Synthetic Red Iron Oxide Pigment.
ASTM D4417-93	Field Measurement of Surface Profile of Blast Cleaned Steel.
ASTM E1347-90	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry.

Code of Federal Regulations (CFR).

CFR 29 Part 1910	Occupational Safety and Health Standards.
CFR 29 Part 1926	Safety and Health Regulations for Construction.
CFR 29 Part 1926-62	Lead in Construction

Federal Standards (FED-STD).

FED-STD 313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities.
FED-STD 595B	Color Used in Government Procurement.

National Institute for Occupational Safety and Health (NIOSH).

NIOSH Pub No. 84-100	(1984; Supple 1985, 1987, 1988 & 1990) NIOSH Manual of Analytical Methods.
NIOSH Pub No. 87-108	(1987) Respirator Decision Logic.

Steel Structures Painting Council Specifications (SSPC)

SSPC SP 1-82	Solvent Cleaning.

SSPC SP 3-89	Power Tool Cleaning.
SSPC SP 5-91	White Metal Blast Cleaning.
SSPC SP 7-91	Brush-Off Blast Cleaning.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01305.

SD-08 Statements

(GA) Statements shall, as a minimum, include each of the topic areas listed and shall include safety and health provisions as stated in the appropriate paragraphs and may include other criteria as deemed necessary. Each topic shall be developed in a manner to include management and operational aspects. The statements as called for in paragraph 1.4 are as follows:

(a) Qualifications and Experience
(b) Accident Prevention Plan
(c) Activity Hazard Analysis Procedures
(d) Confined Space Procedures
(e) Respiratory Protection Program
(f) Material Safety Data Sheets
(g) Airborne Sampling Plan
(h) Ventilation Assessment
(i) Worker Hazard Communication Program
(j) Medical Surveillance

SD-09 Reports

(FIO) Paints and Thinners Less than 50 Gallons. Either of the following, when the required quantity of any type of paints or thinners is 50 gallons or less:

(a) A certified test report showing the results of required tests made on the material and a statement that it meets all of the specification requirements.

(b) A certified test report showing the results of required tests made on a previous batch of paint and/or thinner produced by the same firm using the same ingredients and formulation except for minor differences necessitated by a color change and a statement that the previous batch met all of the specification requirements. A report of tests on the proposed batch showing the following properties applicable to the material specifications shall be furnished: color, gloss, drying time, opacity, viscosity, weight per gallon, and fineness of grind.

SD-13 Certificates

(FIO) Proprietary Brands of Paints. When the required quantity of a particular type or color of a paint is 10 gallons or less, a proprietary name brand, shelf item paint of the same type and with similar properties to the material specified may be proposed without sampling. To receive consideration, the paint must be in the original container with the manufacturer's label affixed. Certification from the supplier stating that the paint is appropriate as to type, color, and gloss and is a premium grade of paint, shall be furnished.

SD-14 Samples

(FIO) Two 1-quart samples of each batch of paint and thinners not covered by standard specifications. Label and submit in accordance with paragraph 2.3.

(FIO) Ingredient materials and thinners for special paint formulations shall be 1/2 pint in size and shall be labeled and submitted in accordance with paragraph 2.3.

(FIO) A signed certificate from the paint manufacturer showing the percentage of each ingredient used to produce the material and a statement that the material complies with all of the requirements of the formulation will be accepted in lieu of samples when the required quantity of any paint is 10 gallons or less.

(FIO) Paints and Thinners More than 50 Gallons. 1-quart sample of each batch of Federal Specifications paints and thinners to be used when the required amount of a material of a particular type or color is more than 50 gallons. Label and submit in accordance with paragraph 2.3.

SD-18 Records

(FIO) Results of Airborne Sampling

(a) Laboratory Conducted - within 5 working days after taking samples.
(b) Direct Reading Instrumentation - same day as sample taken.

1.4 SAFETY AND HEALTH PROVISIONS

All painting and removal processes shall be executed according to the applicable OSHA requirements for worker safety.

1.5 HEALTH PROTECTION

1.5.1 Respirators

Contractor shall implement respirator protection as required by OSHA. During all spray-painting operations, spray painters shall use approved SCBA or SAR (air line) respirators, unless valid air sampling has demonstrated contaminant levels to be consistently within concentrations that are compatible with air purifying respirator protection factors. All respirator equipment shall be selected and used in accordance with EM 385-1-1, CFR 29 Part 1910, Section 134, and consistent with the guidance contained in NIOSH-Pub No. 87-108. During all confined space spray-painting operations, only MSHA/NIOSH-approved SCBA with half or full facepiece operated in pressure demand or other positive-pressure mode or an SAR (air line) with a half or full facepiece or painter's helmet, hood, or suit operated in pressure demand or other positive-pressure mode in combination with an auxiliary SCBA A(emergency escape bottle) operated in pressure demand, or other positive-pressure mode shall be used. Auxiliary SCBA must be of such duration to permit escape to safety if air supply is interrupted. All employees who wear air-purifying type respirators shall be quantitatively or qualitatively fit-tested, using NIOSH-approved procedures, for the specific type air-purifying respirators they will wear. Persons with facial hair that interferes with the sealing surface of the facepiece to faceseal or interferes with respirator valve function shall not be allowed to perform work requiring respirator protection. Air-purifying chemical cartridge/canister half- or full-facepiece respirators that have a particulate prefilter and are suitable for the specific type(s) of gas/vapor and particulate contaminant(s) may be used for nonconfined space painting, mixing, and cleaning (using solvents) provided the measured or anticipated concentration of the contaminant(s) in the breathing zone of the exposed

worker does not exceed the APF for the respirator and the gas/vapor has good warning properties or the respirator assembly is equipped with a NIOSH-approved end of service life indicator for the gas(es)/vapor anticipated or encountered. Where paint contains toxic elements such as lead, cadmium, chromium, or other toxic particulates that may that may become airborne during painting in nonconfined spaces, air-purifying half-and full-facepiece respirators or powered air-purifying respirators equipped with appropriate gas vapor cartridges, in combination with a high-efficiency filter or an appropriate canister incorporating a high-efficiency filter shall be used. Standby personnel used for all confined-space operations shall be equipped with SCBA with a minimum breathing air supply of 30 minutes. Individuals selected to act as standby personnel shall be medically evaluated to ensure that they are physically and psychologically able to perform rescue duties while wearing a SCBA. In addition, they shall be thoroughly trained in confined-space monitoring techniques, communications to be used, and emergency rescue techniques. Communications (i.e., visual, voice, signal line, radio, or other means) shall be maintained between workers inside confined space and outside standby personnel at all times.

1.5.2 Protective Clothing and Equipment

All workers shall wear safety shoes or boots, appropriate gloves to protect against the chemical to be encountered, and breathable protective full-body covering during spray-painting applications. Where necessary for emergencies, protective equipment such as life lines, body harnesses, or other means of personnel removal shall be utilized during confined-space work.

1.6 MEDICAL STATUS

Prior to the start of work and annually thereafter, all Contractor employees working with or around paint systems, thinners, blast media, those required to wear respiratory protective equipment, and those who will be exposed to high noise levels shall be medically evaluated for the particular type of exposure they may encounter. The evaluation shall include:

(1) Audiometric testing and evaluation of employees who will work in the noise environments.

(2) Vision screening (employees who use full-facepiece respirators shall not wear contact lenses).

(3) Medical evaluation shall include but shall not be limited to the following:

(a) Medical history, including but not limited to alcohol use, with emphasis on liver, kidney, and pulmonary systems, and sensitivity to chemicals to be used on the job.

(b) General physical examination with emphasis on liver, kidney, and pulmonary system.

(c) Determination of the employee's physical and psychological ability to wear respiratory protective equipment and to perform job-related tasks.

(d) Determination of baseline values of biological indices for later comparison to changes associated with exposure to paint systems and thinners of blast media, which include: Liver function tests to include SGOT, SGPT, GGPT, alkaline phosphates, bilirubin; Complete urinalysis; EKG (employees over age 40); Blood urea nitrogen (bun); Serum creatinine; Pulmonary function test, FVC, and FEV; Chest x-ray (if medically indicated); Blood lead (for individuals where it is known there will be an exposure to materials containing lead); Other criteria that may be deemed necessary by the Contractor's physician; and Physician's statements for individual employees that medical status would permit specific task performance.

1.7 CHANGE IN MEDICAL STATUS

Any employee whose medical status has changed negatively due to work related chemical and/or physical agent exposure while working with or around paint systems and thinners, blast media, or other chemicals shall be evaluated by a physician, and the Contractor shall obtain a physicians statement as described in paragraph 1.6 prior to allowing the employee to return to those work tasks. The Contractor shall notify the Contracting Officer in writing of any negative changes in employee medical status and the results of the physicians reevaluation statement.

1.8 DELIVERY, STORAGE, AND HANDLING

Paints shall be processed and packaged to ensure that within a period of 1 year from date of manufacture, they will not gel, liver or thicken deleteriously, or form gas in the closed container. Paints, unless otherwise specified or permitted, shall be packaged in standard containers not larger than 5 gallons in size, with removable friction or lug-type covers. Containers for vinyl type paints shall be lined with a coating resistant to the solvent in the formulations and capable of effectively isolating the paint from contact with the metal container. Each container of paint or separately packaged component thereof shall be clearly and durably labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification, and the designated name, formula or specification number of the paint together with special labeling instructions, when specified. Paint shall be delivered to the job in unbroken containers. Paints that can be harmed by exposure to cold weather shall be stored in ventilated, heated shelters. All paints shall be stored under cover from the elements and in locations free from sparks and flames.

PART 2 - PRODUCTS

2.1 EXISTING MITER GATES DESCRIPTION

2.1.1 General

Miter gates 5 and 6 in this contract shall be rehabilitated and painted. The existing bracket plates that connect the hydraulic gate operating cylinders to the abutments and the connection plates that connect the cylinders at the gates, as well the new backing plates, shall also be painted. Each gate consists of two leaves. The upstream side of each leaf is a relatively smooth surface that consists of a steel skin plate supported on the downstream side by horizontal and vertical beams. See the informational drawings for more details. The system to be applied shall incorporate three single component, moisture-cured polyurethane coats. All products furnished for this project shall be produced by the same manufacturer and shall be compatible with one another.

2.1.2 Existing Paint

The existing paint on miter gates 5 and 6 consists of vinyl and lead primer on both sides. Both gates were tested for lead with the following results:

Gate 5 contains 160 mg/Kg of lead
Gate 6 contains 990 mg/Kg of lead

The sample preparation was by AOAC 974.02. The sample analysis was SW-846 Method 7420, flame AA. Refer to SECTION 01060, paragraph 3.10, for proper disposal of paint chips and sand-blast grit.

2.2 SAMPLING AND TESTING

Batches of paint that the Contractor proposes to use shall be stored in an approved shelter on the project site or segregated at the source of supply sufficiently in advance of need to allow 30 days for sampling and testing. The Government shall be notified when the paint is available for sampling. Sampling of each batch shall be witnessed by GQAR unless otherwise specified or directed. Samples of paint submitted for approval shall be clearly labeled to indicate formula or specification number and nomenclature, batch number, batch quantity, color, date made, and applicable project contract number. Where specifically indicated herein or where indicated in a standards specification for a finished product, separate samples of ingredient materials shall be furnished. The ingredient samples shall be clearly identified by commercial name, trade designation, manufacturer, batch or lot number, and such other data as may be required. Testing of paint for compliance with the specifications will be performed at the USACERL laboratory at no expense to the Contractor except that the cost of testing any samples representing material that replaces previously rejected material will be deducted from payments to the Contractor at the rate of $400 for each replacement sample. The Contractor shall send the samples to the following address for testing:

USACERL
PO Box 9005
Champaign, IL 61826-9005
Attn.: Paint Lab-Al Beitelman
(regular mail)

or

USACERL
2902 Farber dr.
Champaign, IL 61826-9005
Attn.: Paint Lab-Al Beitelman
(Federal Express)

PART 3 - EXECUTION

3.1 CLEANING AND PREPARATION OF SURFACES TO BE PAINTED

3.1.1 General Requirements

Surfaces to be painted shall be clean before applying paint or surface treatments. Deposits of grease or oil shall be removed in accordance with SSPC SP 1, prior to mechanical cleaning. Solvent cleaning shall be accomplished with mineral spirits or other low toxicity solvents having a flash point above 100°F. Clean cloths and clean fluids shall be used to avoid leaving a thin film of greasy residue on the surfaces being cleaned. Items not to be prepared or coated shall be protected from damage by the surface preparation methods. Machinery shall be protected against entry of blast abrasive and dust into working parts. Cleaning and painting shall be so programmed that dust or other contaminants from the cleaning process do not fall on wet, newly painted surfaces, and surfaces not intended to be painted shall be suitably protected from the effects of cleaning and painting operations. Welding of, or in the vicinity of, previously painted surfaces shall be conducted in a manner to prevent weld spatter from striking the paint and to otherwise reduce coating damage to a minimum; paint damaged by welding operations shall be restored to original condition. Surfaces to be painted that will be inaccessible after construction, erection, or installation operations are completed shall be painted before they become inaccessible.

3.1.2 Ferrous Surfaces

Ferrous surfaces shall be dry blast-cleaned to SSPC SP 5. The blast profile unless otherwise specified shall be 1.5 to 2.5 mils as measured by ASTM D 4417, Method C. Appropriate abrasive blast media shall be used to produce the desired surface profile and to give an angular anchor tooth pattern. If recycled blast media is used, an appropriate particle size distribution shall be maintained so that the specified profile is consistently obtained. Steel shot or other abrasives that do not produce an angular profile shall not be used. Weld spatter not dislodged by blasting shall be removed with impact or grinding tools and the areas reblasted prior to painting. Surfaces shall be dry at the time of blasting. Within 8 hours after cleaning, prior to the deposition of any detectable moisture, contaminants, or corrosion, all ferrous surfaces blast

cleaned to SSPC SP 5 shall be cleaned of dust and abrasive particles by brush, vacuum cleaner, and/or blown down with clean, dry, compressed air, and given the first coat of paint.

3.1.3 Paint Removal Information

All paint layers found on miter gates 5 and 6, and the cylinder bracket assembly shall be removed in accordance with this specification. See paragraph 2.1.2 for more information about the paint. The paint residue shall be disposed of in accordance with SECTION 01060.

3.2 PAINT APPLICATION

3.2.1 General

The finished coating shall be free from holidays, pinholes, bubbles, runs, drops, ridges, waves, laps, excessive or unsightly brush marks, and variations in color, texture and gloss. Application of initial or subsequent coatings shall not commence until a Government representative has verified that atmospheric conditions and the surfaces to be coated are satisfactory or has waived specific verification. All paint coats shall be applied in a manner that will produce an even, continuous film of uniform thickness. Edges, corners, crevices, seams, joints, welds, rivets, corrosion pits, and other surface irregularities shall receive special attention to ensure that they receive an adequate thickness of paint. Spray equipment shall be equipped with traps and separators and where appropriate, mechanical agitators, pressure gages, pressure regulators, and screens or filters. Air caps, nozzles, and needles shall be as recommended by the spray equipment manufacturer for the material being applied. Airless-type spray equipment may be used only on broad, flat, or otherwise simply configured surfaces, except that it may be employed for general painting if the spray gun is equipped with dual or adjustable tips of proper types and orifice sizes. Airless type equipment shall not be used for the application of vinyl paints.

3.2.2 Mixing and Thinning

Paints shall be thoroughly mixed, strained where necessary, and kept at a uniform composition and consistency during application. Paste or dry-powder pigments specified to be added at the time of use shall, with the aid of powered stirrers, be incorporated into the vehicle or base paint in a manner that will produce a smooth, homogeneous mixture, free of lumps and dry particles. Where necessary, to suit conditions of surface, temperature, weather, and method of application, the packaged paint may be thinned immediately prior to use by the addition of not more than 1 pint per gallon of the proper thinner, provided that this general limitation shall not apply when more specific thinning instructions are provided. Paint that has been stored at low temperature, shall be brought up to at least 70°F before being mixed and thinned, and its temperature in the spray tank or other working container shall not fall below 60°F during the application. Paint that has deteriorated in any manner to a degree that it cannot be restored to essentially its original condition by customary field-mixing methods shall not be used and shall be removed from the project site. Paint and thinner that is more than 1 year old shall be sampled and submitted for testing to determine its suitability for application.

3.2.3 Atmospheric and Surface Conditions

Paint shall be applied only to surfaces that are above the dew point temperature and that are completely free of moisture as determined by sight and touch. In no case shall any paint be applied to surfaces upon which there is detectable frost or ice. Except as otherwise specified, the temperature of the surfaces to be painted and of air in contact therewith shall be not less than 45°F during paint application nor shall paint be applied if the surfaces can be expected to drop to 32°F or lower before the film has dried to a reasonably firm condition. During periods of inclement weather, painting may be continued by enclosing the surfaces and applying artificial heat, provided the minimum temperatures and surface dryness requirements prescribed previously are maintained. Paint shall not be applied to surfaces heated by direct sunlight or

other sources to temperatures that will cause detrimental blistering, pinholing, or porosity of the film.

3.2.4 Time Between Surface Preparation and Painting

Surfaces that have been cleaned and/or otherwise prepared for painting shall be primed as soon as practicable after such preparation has been completed but, in any event, prior to any deterioration of the prepared surface.

3.2.5 Method of Paint Application

3.2.5.1 General

Unless otherwise specified, paint shall be applied by brush or spray to ferrous and nonferrous metal surfaces. Special attention shall be directed toward ensuring adequate coverage of edges, corners, crevices, pits, rivets, bolts, welds, and similar surface irregularities. Other methods of application to metal surfaces shall be subject to approval. All coats on plaster, concrete, or other nonmetallic surfaces shall be applied by brush, roller, spray, or a combination thereof provided that the latter methods, in the opinion of GQAR, produce films that are suitable in appearance and equivalent in quality to those obtained by brush application. Whenever application of paint by a specific method to a surface is permitted or directed, it is to be understood that all areas inaccessible to that method shall be coated by alternate means.

3.2.5.2 Touch-Up Painting

3.2.5.2.1 General

Each item requiring repair by touch-up shall be cleaned and inspected by the Contractor to determine the type of deficiencies and the method of rehabilitation required. The method of paint rehabilitation will depend on whether the specific paint deficiency is only surface oriented or if it extends to base metal. The general guideline is if the paint deficiency is superficial only and is not detrimental to the long-term life of the coating, rework of the defect does not require sandblasting to base metal. If the deficiency extends through the coating to base metal or is the type of defect which will preclude a long-term life of the coating, the area shall be sandblasted to base metal. All weld splatter, existing or new, shall be removed. Final determination of method of rehabilitation shall be by the GQAR.

3.2.5.2.2 Repair

The general conditioning of the overall item to receive touch-up paint shall be such as well give adequate surface adhesion as specified when the paint coating is applied. Adequacy of surface preparation preparatory to painting is subject to approval. The method of repair of surface deficiencies will vary considerably and will depend on the type and magnitude of the deficiency. Methods used shall be as follows:

(1) Paint Deficiencies Which Do Not Extend to Base Metal. After cleaning area with a thinner or cleaner recommended by the coating manufacturer, daub the area with a stiff bristled brush so as to work the paint into the pinhole, bubble, or abrasion. Final paint application(s) to produce the specified mil thickness and/or number of coats required shall be spray or brush applied.

(2) Paint Deficiencies Which Extend to Base Metal. Require sandblasting to a grade approaching white metal grade as previously specified, and careful attention since the edges of the remaining paint will be frayed and curled. Edges shall be hand steel brushed to remove the

frays and curls, and immediately thereafter a thinner or cleaner as recommended by the coating manufacturer shall be applied which shall be rubbed into the edge with lint free cotton rags. The surface shall then be painted to reach the required mil thickness.

3.2.6 Coverage and Film Thickness

3.2.6.1 General

The actual surface area covered per gallon of paint shall not exceed the spreading rates prescribed for specific paints. Where no spreading rate is specified, the paint shall be applied at a rate normal for the type of material being used. In any event, the combined coats of a specified paint system shall completely hide base surface and the finish coats shall completely hide undercoats of dissimilar color.

3.2.6.2 Measurement on Ferrous Metal

Where dry film thickness requirements are specified for coatings on ferrous surfaces, measurements shall be made with one of the thickness gages listed below. They shall be calibrated and used in accordance with ASTM D1186 . They shall be calibrated using plastic shims with metal practically identical in composition and surface preparation to that being coated, and of substantially the same thickness (except that for measurements on metal thicker than 1/4 inch, the instrument may be calibrated on metal with a minimum thickness of 1/4 inch). The instruments shall be calibrated in the thickness range expected to be encountered and the range of accuracy determined. If thickness readings are encountered outside of the calibrated range, the instrument shall be recalibrated and measurements retaken. The instruments shall be calibrated or calibration verified prior to, during, and after each use. Authorized thickness gauges:

- Mikrotest, Elektro-Physik, Inc.
- Inspector Gage, Elcometer Instruments, Ltd.
- Positest, Defelsko Corporation
- Minitector, Elcometer Instruments, Ltd.
- Positector 2000, Defelsko Corporation

3.2.7 Progress of Painting Work

The complete painting operation, including priming and finishing coats, on that portion of the work, shall be completed as soon as practicable, without prolonged delays. Sufficient time shall elapse between successive coats to permit them to dry properly for recoating, and this period shall be modified as necessary to suit adverse weather conditions. Paint shall be considered dry for recoating when it feels firm, does not deform or feel sticky under moderate pressure of the finger, and the application of another coat of paint does not cause film irregularities such as lifting or loss of adhesion of the undercoat. All coats of all painted surfaces shall be unscarred and completely integral at the time of application of succeeding coats. At the time of application of each successive coat, undercoats shall be cleaned of dust, grease, overspray, or foreign matter by means of air blast, solvent cleaning, or other suitable means. Cement and mortar deposits on painted steel surfaces, not satisfactorily removed by ordinary cleaning methods, shall be brush-off blast cleaned and completely repainted as required. Undercoats of high gloss shall, if necessary for establishment of good adhesion, be scuff sanded, solvent wiped, or otherwise treated prior to application of a succeeding coat. Field coats on metal shall be applied after erection except as otherwise specified and except for surfaces to be painted that will become inaccessible after erection.

3.2.8 Contacting Surfaces

Bushing surfaces are not to be painted or sand blasted. Rubber seals shall not be painted. Painted surfaces under seals shall be thoroughly dry before the seals are installed.

3.2.9 Drying Time Prior to Immersion

The drying time prior to handling and immersion in water shall be as specified by the coating manufacturer.

3.2.10 Protection of Painted Surfaces

Where shelter and/or heat are provided for painted surfaces during inclement weather, such protective measures shall be maintained until the paint film has dried and discontinuance of the measures is authorized. Items that have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is fully dry and hard. All metalwork coated in the shop or field prior to final erection shall be stored out of contact with the ground in a manner and location that will minimize the formation of water-holding pockets, soiling, contamination, and deterioration of the paint film, and damaged areas of paint on such metalwork shall be cleaned and touched-up without delay. The specified first overall field coat of paint shall be applied within a reasonable period after the shop coat and in any event before weathering of the shop coat becomes extensive.

3.2.11 Painter and Quality Control Personnel

3.2.11.1 Painters shall be well versed and experienced in the use of painting equipment, preparation of the specified paints, and application of the specified paints. Deficiencies in any paint coating shall be removed and repainted. The painter or painters responsible will not be allowed to perform more painting until the Contractor demonstrates that the painter or painters are competent.

3.2.11.2 The Contractor's quality control personnel shall be experienced in paint inspection of the specified paints and methods of application proposed. Credentials of each quality control person that will be inspecting paint shall be furnished, showing the individual is versed in inspection techniques. Each quality control person shall have had training and experience in inspection of the specified paints heretofore specified.

3.2.12 Paint Records

Data shall be recorded on each coat of paint applied as follows:

(1) Date and time - start and finish.

(2) Description of item painted.

(3) Temperature of item to be painted (°F), start and finish.

(4) Temperature of air in immediate area (°F), start and finish.

(5) Average paint thickness.

(6) Type and lot number of paint and paint manufacturer.

(7) Name of painter and company.

(8) Method of application.

(9) Comments.

(10) Dewpoint temperature, start and finish.

(11) Drying time.

(12) Type and amount of thinner(s) used.

(13) Time between start and finish of surface preparation and start of painting.

Temperature shall be recorded from the noted areas to portray the minimum and maximum range of temperature. The CQCR shall sign and date the data sheet after they have inspected the paint coating and is assured of its adequacy. The GQAR shall then sign the data sheet when assured of the adequacy of the paint coating. The Contractor will not be permitted to apply the next coating of paint until a signature of the GQAR is affixed to the data sheet. The CQCR shall utilize, but not be limited to, the following tools for inspection: a thickness gauge as specified herein and a pinhole tester equal to the model 169/2 pinhole tester manufactured by Zormco Electronics Corporation, and a magnifying glass. Instrumentation shall be provided to record, either directly or indirectly, dewpoint temperature, ambient temperature, and surface temperature of the item to be painted or a representative item as approved. The records of the above data shall be given to the GQAR.

3.3 PAINT SYSTEMS TO BE APPLIED

3.3.1 General

The required paint systems and the surfaces to which they shall be applied are shown in this paragraph and paragraph 3.4. Supplementary information is described in the following paragraphs.

3.3.2 Colors and Tints

Colors and tints shall match the respective color specimen designated by, or otherwise be subject to the approval of, the Contracting Officer. Where specified or directed, alternate applications of successive undercoats having the same color shall be tinted with small amounts of lampblack or other approved ingredients, ground in a vehicle compatible with the paint being tinted, to ensure that all surfaces are properly coated with the specified number of paint coats.

3.3.3 Surface Preparation

Cleaning and pretreatment of surfaces prior to painting shall be accomplished in accordance with detailed requirements previously described.

3.4 PAINTING SCHEDULES

The painting schedule below prescribes the number and types of coats of paint required. A pre-approved system conforming to the schedule is manufactured by Wasser High-Tech Coatings, Inc., telephone (206) 850-2967. An approved equivalent may be used.

PAINT COATS	PAINTING SCHEDULE
(1) Primer	
Type:	Zinc-rich, single-component, moisture-cured polyurethane
Weight:	23 lbs/gal minimum
Volume	60 percent minimum
Pigment Type:	Zinc dust
Color:	Different from intermediate coat
Coverage:	3 to 4 mils DFT (Dry Film Thickness)
VOC:	2.8 lbs/gal maximum
(2) Intermediate Coat	
Type:	Micaceous Iron Oxide, single-component, moisture-cured polyurethane
Weight:	12 lbs/gal minimum
Volume	58 percent minimum
Pigment Type:	Micaceous Iron Oxide (Micaceous Hematite)
Color:	Different from primer and top coat
Coverage:	4 6 mils DFT
VOC:	2.8 lbs/gal minimum
(1) Top Coat	
Type:	Micaceous Iron Oxide, single-component, moisture-cured polyurethane
Weight:	12 lbs/gal minimum
Volume	58 percent minimum
Pigment Type:	Micaceous Iron Oxide (Micaceous Hematite)
Color:	Gray, approximate color 26231, Federal Standard 595
Coverage:	4 to 6 mils DFT
VOC:	2.8 lbs/gal maximum

3.5 PROTECTION OF NON-PAINTED ITEMS AND CLEANUP

Walls, equipment, fixtures, and all other items in the vicinity of the surfaces being painted shall be maintained free of damage by paint or painting activities. Prompt cleanup of any paint spillage and prompt repair of any painting activity damage shall be required.

- END OF SECTION -

TECHNICAL REQUIRMENTS

SECTION 15300

REPLACE HYDRAULIC CYLINDERS

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TECHNICAL REQUIRMENTS

SECTION 15300

REPLACE HYDRAULIC CYLINDERS

PART 1 - GENERAL

1.1 GENERAL INFORMATION

This section covers all work necessary to replace and modify portions of the hydraulic system on gates no, 5 and 6. Work includes removing 16 slide gate cylinders and 4 lock gate swing cylinders and replacing each with new Government-furnished hydraulic cylinders. Work also includes modifying or replacing the slide gate cylinder mounting hardware to suit the new GFE hydraulic cylinders, which are shorter than the existing cylinders. In addition, two existing hydraulic lines and an air line crossing under the lock at each gate shall be replaced. The informational drawings indicate the extent and general layout of the hydraulic cylinders and piping. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of the same classification shall be of the same make and model. All dimensions in the field shall be verified and the Government advised of any discrepancies before performing the work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

American National Standards Institute (ANSI)

ANSI B18.2.1-81	Square and Hex Bolts and Screws Inch Series
ANSI B18.2.2-87	Square and Hex Nuts
ANSI B18.6.2-83	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws

American Society for Testing and Materials (ASTM).

ASTM A106	(1994) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A234	(1995) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A574	(1992) Alloy Steel Socket-Head Cap Screws

Manufacturers Standardization Society of Valve and Fittings Industry, Inc. (MSS)

MSS SP-58-93	Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69-91	Pipe Hangers and Supports - Selection and Application

Society of Automotive Engineers (SAE)

SAE J516-94	Hydraulic Hose Fittings
SAE J517-94	Hydraulic Hose

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation. Submittals having a "FIO" designation are for information only. The following shall be submitted in accordance with SECTION 01305, paragraph 1.3(1)(b).

SD-01 Data

(GA) Components and Equipment. Manufacturer's catalog data including detail drawings for the following items. The data shall be highlighted to show model, size, options, etc. that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements:

(a) Pipe
(b) Pipe fittings
(c) Hydraulic hose
(d) Stop valves

1.4 DELIVERY AND STORAGE

Equipment delivered but not immediately installed shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 PIPING SYSTEM

The replacement piping system shall be fabricated with welded joints. Piping used in the fabrication of the installation shall be purchased pickled, oiled, and plugged.

(1) Pipe. Hydraulic pipe shall be seamless steel pipe conforming to ASTM A 106, Grade B. Piping weight class shall be extra strong.

(2) Pipe Fittings. Pipe fittings shall be steel. Fittings that incorporate separate synthetic, or metal-to-metal seals, or seals that seal with pressure, shall be equipped with SAE straight thread port connections. The seals shall be compatible with the hydraulic fluid used in the system. Welded fittings shall conform to ASTM A 234, Grade WPB.

(3) Hoses. Flexible hydraulic hoses shall be wire reinforced, high-pressure type hose with synthetic rubber lining and outer cover. Synthetic rubber shall be selected for maximum compatibility with the hydraulic fluid specified for use in the system. Flexible hose shall be rated by the manufacturer for a working pressure of at least 1000 psi. Fittings shall be specifically designed for use with the hose selected and shall be as recommended by the hose manufacturer. Fittings shall be stainless steel and shall have straight or elbow ends as best suited to the installation conditions. Each hose assembly shall be assembled using procedures and tools recommended by the manufacturer of the hose.

2.2 STOP VALVES

Ball valves shall be stainless steel with PTFE seats, rated for at least 2000 psi, with SAE straight thread ports. Valves shall be specially designed and rated for use in hydraulic systems. Valve materials shall be compatible with the system hydraulic fluid.

2.3 HYDRAULIC FLUID

A sufficient amount of Chevron Clarity 32 hydraulic fluid shall be Government furnished to refill the system. Extra fluid to make up all losses resulting from installation and testing shall also be provided. The fluid level shall be checked and brought to the proper operating level immediately after satisfactory completion of final acceptance tests. The hydraulic fluid shall be delivered to the site in unopened containers with factory seals intact. Containers shall be clearly labeled. Fresh hydraulic fluid shall be filtered to 10 micron level.

2.4 PACKING, GASKETS, AND SEALS

Hydraulic components shall be equipped with seals, packings, gaskets, and 0-rings selected and recommended by the respective manufacturers for maximum compatibility with the hydraulic fluid specified for use in the system.

2.5 ACCESSORIES

The accessories shall conform to the following:

(1) Bolts, Nuts and Cap Screws. ANSI B18.2.1, B18.2.2, B18.6.2 or ASTM A 574, as applicable. All bolts, cap screws, and nuts not otherwise indicated or specified shall be medium carbon steel.

(2) New Pipe Hangers and Supports. MSS SP-58 and SP-69.

PART 3 - EXECUTION

3.1 REMOVAL

3.1.1 General

All of the removed hydraulic cylinders and hydraulic oil drained from removed or modified portions of the system shall be disposed of by the Contractor. Where piping or components are removed, open ends of remaining piping shall be temporarily capped to prevent the entry of contaminants.

3.1.2 Slide Gate Cylinders

The existing slide gate hydraulic cylinders and associated hoses, piping and piping fittings shall be drained of hydraulic oil and removed from each leaf of gates 5 and 6.

3.1.3 Swing Cylinders

The existing lock gate hydraulic swing cylinders and associated hoses shall be drained of hydraulic oil and removed from gates 5 and 6.

3.1.4 Cross-lock piping

Existing piping (two lines at each gate) from the hydraulic power unit to the swing cylinder on the opposite side of the lock shall be drained of oil. The piping shall be removed from the swing cylinder back to the hydraulic power unit. The lines are routed down the sides of the lock and across the bottom. The air and oil lines along the lock chamber floor are embedded in concrete. These portions shall be removed form the concrete and replaced in new concrete. The adjacent, parallel air line shall also be removed. Remove the air line between the first exposed, accessible joints at the top of each lock wall. Temporarily cap or plug the open ends.

3.2 PIPING INSTALLATION

3.2.1 General

Wherever possible, new piping shall follow the routing of the existing, removed piping runs, repairing and reusing the existing supports and hangers. New hangers shall be provided as needed to suit modifications made to install the new slide gate cylinders and stop valves. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains.

3.2.2 Slide Gate System

All of the existing hydraulic piping on each leaf of gates 5 and 6 shall be replaced with new piping of equal size, including the hoses at the cylinders and shore connections.

3.2.3 Swing System

The cross-canal hydraulic lines (two lines at each gate) of gates 5 and 6 shall be replaced with new 1-in ips piping, including the cylinder hoses. The piping shall be routed along the same path as the lines removed. If the removed piping was embedded in concrete, the new piping shall be embedded in new concrete which shall conform to SECTION 03300. Piping similar to the existing shall be provided on each cylinder to bring the rod end hose connection to the back of the cylinder.

3.2.4 Air Line

The cross-canal air line (two lines total) of gates 5 and 6 shall be replaced with new 3/4-in ips piping. The piping shall be routed along the same path as the line removed.

3.2.5 Welded Piping

Piping joints shall be welded in accordance with SECTION 02892, paragraph 2.1. Hydraulic pipe shall be securely mounted and anchored to structural members. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not adversely affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.2.6 Stop Valves

New 1/2-inch ips ball stop valves shall be provided in each slide gate cylinder branch line. Valves shall be located adjacent to the branch elbow for each supply and return line, oriented to

be accessible from the walking flat above. Valves which cannot be easily operated by hand from the walking flat shall be provided with accessible reach rods. New 1-inch ips ball valves and piping shall be provided to cross-connect the piping on each swing cylinder to allow circulation of fluid through the supply piping by bypassing the cylinder.

3.2.7 Flexible Conductors

Existing hose assemblies at the cylinder connections and at the gate leaf hinges shall be replaced with new hose assemblies. Flexible conductors shall be installed in accordance with the manufacturer's recommendations. Special care shall be exercised to avoid imparting any twist in the conductors during tightening of fittings. Supports shall be provided and located to prevent conductors from contacting and chafing against fixed members. Clamps and straps used to support hoses shall be provided with soft resilient sleeves, linings or bushings to prevent cutting and abrading of the hose. The routing of flexible hoses shall be arranged to preclude imparting a twist in the hose due to relative motion between the components to which the hose is connected. The minimum bend radius of the hose shall not be less than that recommended for the particular hose size and maximum system operating pressure. Hydraulic hose shall meet the requirements of SAE J517 100R2, with SAE J516 fittings.

3.3 CYLINDER INSTALLATION

3.3.1 General

The Government-furnished hydraulic cylinders shall be installed to replace the cylinders removed. The new cylinders are NFPA style MP1. New clevis pivot pins are furnished with the new cylinders. Seals shall not be removed from pipe assemblies or ports on components until the lines are ready for connection. Provision, including but not limited to providing portable screens and shelters, shall be taken to minimize the entrance of abrasives, dirt, metal chips, and other foreign materials into the hydraulic system through open ends of lines and ports, including those of the existing system to be reconnected.

3.3.2 Slide Gate Cylinders

(1) Cylinder Mounting Bracket. The cylinders are 4" x 1.75" x 29" with female rod eye. The cylinder mounting brackets and bracket locations shall be modified to suit the new NFPA configuration. Because the new cylinders are shorter then the old cylinders, the existing mounting holes on the flange of the vertical beam are not in the correct location to reinstall the mounting brackets. Relocate the mounting brackets below their existing position on the vertical beam to suit the shorter length of the new cylinders. Adjust the position so that the gate slide travels to within 1/8 to 1/4 inch of the slide stops when the cylinder rod is fully extended. Match drill new mounting holes in the flange and install the brackets with new 1-inch stainless fasteners. Install the clevis pivot pins with new stainless cotter pins.

(2) Slide Gate Brackets. Provide new 1 3/8" diameter stainless rod end pivot pins to match the length of the existing pins. Install the pivot pins with new stainless cotter pins.

(3) Swing Cylinders. The cylinders are 5" x 3.00" x 76" with JIC-49 rod clevis.

3.4 TESTING

All new lines shall be proof tested to not less than 750 psi. All connections, including welded joints shall be carefully examined for leakage and all lines shall be inspected for evidence of deflection caused by inadequate anchorage. The proof test medium shall be either the fluid approved for use in the system or a flushing compound specifically approved for use by the

manufacturer of the fluid approved for use in the system. Proof test pressure shall be maintained long enough to permit thorough and complete inspection but in no case less than 1 hour for each test.

3.5 CLEANING

The slide gate hydraulic system and the new swing cylinder lines crossing the lock shall be cleaned prior to re-connection to the existing hydraulic power system. The new piping shall be flushed for a period of at least 1/2 hour, using a Contractor-furnished pump/filter unit with 10 micron filtering. The flushing agent shall be either the normal system oil or a flushing oil compatible with the system oil. Flow shall be at least 20 gpm in the 3/4-inch lines. Install temporary jumpers to bypass each cylinder. Flushing oil shall be discarded by the Contractor at the completion of cleaning.

3.6 FIELD TOUCH-UP PAINTING

Chips, scratches, and other damage to shop-applied painted surfaces shall be repainted in the field by the Contractor. Finish field colors shall match those of marred finishes.

3.7 FIELD TESTS

The hydraulic reservoirs shall be checked to ensure that fluid is at the proper level. The hydraulic pumps shall be started using the controls at the control console. The Contractor shall obtain permission and clearance from project personnel as well as the GQAR before using the control console. Hydraulic lines and components which are under pressure shall be inspected for evidence of leakage and for evidence of distortion because of inadequate or improper support. Response of components to operation of applicable controls shall be inspected to ensure that all connections have been made properly. Each deficiency or maladjustment disclosed by the tests shall be corrected immediately and the test repeated until satisfactory results are obtained.

- END OF SECTION -

TECHNICAL REQUIREMENTS

SECTION 16050

ELECTRICAL WORK, GENERAL

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TECHNICAL REQUIREMENTS

SECTION 16050

ELECTRICAL WORK, GENERAL

PART 1 - GENERAL

1.1 GENERAL INFORMATION

1.1.1 Work Description

The work covered by this section consists of removing existing cables and wires, replacing embedded conduits, and reinstalling existing cables and wires for circuits which cross under the lock at Gate No. 5 and Gate No. 6. Work includes reconnecting the wires and cables to existing device terminals and terminal blocks, and verifying proper operation of the lock gates after installation.

1.1.2 Coordination of Work

The work shall be coordinated so that interference with other work will be avoided. Outages of any type shall be coordinated at least two days in advance with the GQAR.

1.1.3 Inspections and Tests

The installation shall be inspected to ensure compliance. The final installation shall be tested to ensure proper operation of the installation. Work found not to meet applicable codes or any equipment found defective shall be replaced. Wire or cable, including wire number labels, damaged during removal and reinstallation shall be replaced.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

American National Standards Institute (ANSI)

ANSI C2	(1993) National Electrical Safety Code
ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C80.4	(1983) Fittings for Rigid Metal Conduit and Electrical Tubing

American Society for Testing and Materials (ASTM)

ASTM A123	(1989, REV A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

National Electrical Manufacturers Association (NEMA)

NEMA FB-1	(1993) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
NEMA WC-7	(1988) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

National Fire Protection Association (NFPA)

NFPA 70	(1996) National Electrical Code

Underwriters Laboratories (UL)

UL 6	(1993) Rigid Metal Conduit
UL 360	(1986; Rev thru Dec 1994) Liquid-Tight Flexible Steel Conduit
UL 508	(1993) Industrial Control Equipment
UL 870	(1995) Wireways, Auxiliary Gutter, and Associated Fittings

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation. The following shall be submitted in accordance with SECTION 01305.

SD-01 Data

(GA) Conduit and fittings.

(GA) Wire and cable.

GA) Pullboxes.

1.4 WARRANTY

The equipment to be furnished under this section shall be warranted to be free from defects in materials, design and workmanship for a period of at least 1 year from the date of acceptance thereof, either for beneficial use, or final acceptance, whichever is earlier. Upon receipt of notice of failure of any part of this equipment during the warranty period, new replacement parts shall be provided.

1.5 CODES

The installation shall be in accordance with the National Electrical Code (NFPA 70) and the National Electrical Safety Code (ANSI C2). Omission of details on the drawings or in the specifications shall not be construed as permitting deviations from code requirements.

1.6 PROTECTION OF ELECTRICAL EQUIPMENT

Proper protection of all material and equipment, before, during, and after installation (until final acceptance) is the Contractor's responsibility. All stored items shall be protected from the

weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter. Existing wire and cable pulled out for reinstallation shall be protected from damage.

1.7 INFORMATIONAL DRAWINGS AND SKETCHES

The informational drawings and the informational sketches in the Appendix indicate the existing conditions where the work is to be accomplished in as much detail as practicable. They are not warranted to be absolutely correct and are not to be used for dimensioning or exact material requirements. The informational sketches also show new work which is to be performed. The Contractor shall field verify all existing conditions and requirements prior to performing any work or ordering materials.

PART 2 - PRODUCTS

2.1 MATERIAL REQUIREMENTS

2.1.1 General

All electrical materials shall be new, unused and listed by the Underwriters' Laboratories, Inc., where standards for like equipment have been established by the UL, Inc. Defective equipment or equipment damaged in the course of installation shall be replaced. All materials and equipment shall be designed for the use intended.

2.1.2 Standard Products

The materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such items and shall be the manufacturer's latest standard design that complies with the specification requirements.

2.2 CORROSION PREVENTION MATERIALS

2.2.1 General

All equipment furnished under these specifications shall be designed to prevent deterioration from corrosion. The general requirements are specified below; any additional special treatment or requirement considered necessary for any individual item is specified under the respective item. Other corrosion-resisting treatments that are the equivalent of these specified herein may be used when approved:

(1) Fastenings and Fittings. All screws, bolts, nuts, pins, studs, springs, washers and such other miscellaneous fastenings and fittings shall be of an approved corrosion-resisting material or shall be treated in an approved manner to render them resistant to corrosion.

(2) Corrosion-Resisting Materials. Stainless steel, copper, brass, bronze, copper-nickel and nickel-copper alloys are acceptable corrosion-resisting materials. Contact between dissimilar metals shall be avoided as much as practicable, except where the dissimilar metal is steel, or in the case of wiring and connections.

(3) Corrosion-Resisting Treatments. Hot-dip galvanizing is an approved corrosion-resisting treatment. Other corrosion-resisting treatments may be used if approved. Treatments shall be in accordance with ASTM A153.

2.3 CONDUIT

2.3.1 Rigid

All conduit shall be rigid steel conforming to the requirements of ANSI C80.1 and shall be hot-dip galvanized on inside and outside surfaces. Conduit sizes shall be the same as the existing conduits being replaced.

2.3.2 Flexible Steel

Flexible steel conduit shall be liquid-tight conforming to the requirements of UL 360, and shall be limited to use for connecting rigid conduit to boxes or devices. Conduit sizes shall be the same as the existing conduits being replaced.

2.3.3 Fittings

Fittings for rigid conduit shall be threaded and conform to the requirements of ANSI C80.4 and NEMA FB-1

2.4 INSULATED WIRE AND CABLE

2.4.1 Governing Standards

Materials, construction, fabrication, and tests unless otherwise specified shall conform to the applicable requirements of NEMA WC-7.

2.4.2 Rated Circuit Voltages

All wire shall be rated 600V.

2.4.3 Conductors

Conductors shall conform to all the applicable requirements of part 2 of NEMA WC 7 as applicable and shall be annealed copper. Copper conductors shall be tin or lead alloy coated, or bare, as required by the type of insulation used. Cable types, sizes, and number of conductors per cable shall be the same as the cables being replaced. All stranded conductors shall have Class B or C stranding.

2.4.4 Insulation

Insulation shall be a cross-linked thermosetting-polyethylene type (XLPE) meeting the dimensional, electrical and physical requirements of Part 3 or Part 7.8 of NEMA WC 7.

2.5 PULLBOXES

The intercom cable pullbox shall be a NEMA 4 wiring trough with gasketed hinged cover and external screws or screw clamps. The Gate limit switch pullboxes shall be NEMA 4 with gasketed cover and external screws or screw clamps. Pullboxes shall be 14 gauge steel, or an approved polycarbonate or reinforced fiberglass construction similar to Hoffman "A" series. Pullboxes shall conform to the applicable requirements of UL 508 or UL 870. Strut for mounting the pullboxes shall be galvanized steel similar or equal to Unistrut or B-Line.

PART 3 - EXECUTION

3.1 CONDUIT

3.1.1 General

The conduit installation shall include all conduit, pullboxes, and all necessary fittings. Precautions shall be taken to prevent the entrance and lodgement of grout, concrete, dirt, or trash in conduit, fittings and boxes during installation. Conduit which has been crushed or deformed in any way shall not be installed. Bends and offsets in rigid conduit shall be made with a conduit hickey or conduit bending machine. Electrical continuity of the conduit system shall be maintained to provide safe ground path for fault current. Damaged galvanized surfaces shall be repaired with galvanizing repair compound. Nonmetallic pullboxes shall have grounding bushings with a grounding conductor run through the pullbox connecting all bushings. Liquid-tight flexible conduits shall use grounding bushings and connectors with a grounding conductor run through the conduit connecting all bushings and connectors. Sketches 1 through 4 in the appendix of these specifications show existing conduits and new work in diagrammatic form, see paragraph 1.7. Existing wires and cables are to be pulled out prior to conduit removal and reinstalled after new conduit is installed, see paragraph 3.2. Segments of conduit which are imbedded in concrete shall be removed from the concrete and replaced in new concrete which shall conform to SECTION 03300. Conduit sizes for embedded conduits shall be as shown on the Informational Drawings.

3.1.2 Exposed Conduit

Exposed conduit not dimensioned shall be installed approximately where shown with limited adjustment to avoid interference with other work. Structural steel shall not be cut, drilled or bent to avoid interference except with written approval. Exposed conduit shall be installed to conform to the shape of the surface over which it is run and shall be parallel to structural lines. Diagonal runs shall be avoided. Individual conduits shall be mounted with hot-dip galvanized straps and clamp backs clear of the surface over which they are run. Maximum spacing for supports shall not be greater than 7 feet. Supports shall be used at entrance or exit from all conduit fittings, boxes, cabinets and changes of direction of conduit. Bolts, pipe straps and all other supporting hardware for exposed conduit shall be hot-dip galvanized after fabrication. Cast fittings shall be used on exposed conduit.

3.1.3 Cutting and Threading

All cuts shall be made with an approved hacksaw or a cutter-type tool. Roller-type pipe cutters shall not be used on conduits. All cuts shall be square and shall not decrease the conduit opening. Conduit ends shall be reamed to remove burrs and all cuttings, dirt and oil removed from the interior. Threads shall be clean cut. No running threads will be permitted. Conduit unions shall be used where standard couplings cannot be used.

3.1.4 Thread Compound

Conduit joints and connections shall be made watertight, rust-proof, and electrically continuous by the application of a blend of colloidal copper and rust inhibitors. Each threaded joint shall be thoroughly cleaned to remove all cutting oil before the compound is applied.

3.1.5 Bends

Wherever possible, bends in conduit runs shall have a radius of not less than 10 times the nominal conduit diameter. All bends shall be free from cracks and indentations.

3.1.6 Coordination

The conduit shall be installed in the most direct and workmanlike manner so that interference between piping, ducts, conduit, mechanical, electrical and structural features will be avoided. Previously installed work shall be examined prior to developing layout and installation plans for conduit and accessories to determine that installation can be made without interference with other work.

3.1.7 Gate Limit Switch Conduits

Remove the existing embedded conduit at Gate No. 5 and replace with new rigid steel embedded conduit of equal size. Remove the existing embedded conduits at Gate No. 6 and replace with new rigid steel embedded conduits of equal size. Remove the existing cast iron pull boxes on either side of Gate No. 6 and replace with new NEMA 4 pull boxes of equal or larger size. Gasketed conduit outlet bodies may be provided at Gate No. 5 as required to connect to existing conduits which run to the Gate Open limit switches or to Gate No. 4 Control House. Maximum 12-inch lengths of liquid-tight flexible conduit may be used for final connection to limit switches.

3.1.8 Miscellaneous Conduits at Gate No. 6

3.1.8.1 Conduits Above Deck

Remove the conduits as shown on Sketch 4 and provide new conduits and pullbox as shown.

3.1.8.2 Conduits Below Deck

After the existing wood deck has been removed, remove the existing 3/4-inch exposed lighting conduit and replace with new rigid steel exposed conduit of equal size. Remove the existing 1-inch exposed conduit and replace with new rigid steel conduit of equal size. This conduit appears to be an air line, but has fittings and routing similar to electrical conduit. Field verify and comply with applicable requirements of SECTION 15300. Connection points for the conduits include existing couplings (near the couplings for the conduits above the deck) and existing conduit outlet bodies (near the Multi-Purpose Terminal Enclosure).

3.2 WIRE AND CABLE

3.2.1 General

Wire and cable shall be removed and reinstalled without damage to the existing insulation. Wire or cable damaged during removal shall be replaced. Wire and cable pulled out of existing conduits shall be coiled and stored along the deck and protected from damage by weather or physical damage by work performed by others. Conductors shall be coiled and uncoiled slowly to prevent damage to the sheath by sudden bending. Coiling or uncoiling shall be stopped if kinks appear and shall not proceed until kinks have been removed. Wire damaged by improper handling shall be replaced. Exposed ends or terminals shall be protected with plastic wrap or vinyl tape during work, then scraped clean prior to reconnection. Each wire or cable shall be reconnected to the associated equipment or terminals at both ends. "Gate" limit switch circuits shall be reconnected to the associated limit switch terminals at each gate, or the associated terminal blocks in the control console of the Gate Control House. The Dupline cable shall be reconnected to the associated terminal blocks in the control console of Gate No. 6 Control House. The intercom cable shall be reconnected to the associated terminal blocks in the Multi-Purpose Terminal Enclosure and in Gate No. 6 Control House. Lighting conductors shall be reconnected as described in para. 3.2.3.2. The Contractor shall verify that each wire of any

multi-conductor cable removed from a terminal block is reconnected to the original terminal number of the terminal block.

3.2.2 Gate Limit Switch Circuits

Circuits to be pulled out and reinstalled at Gate No. 5 include 2#14 for "Gate Open" indication. Circuits to be pulled out and reinstalled at Gate No. 6 include 3#14 for "Gate Open" indication, 3#14 for "Slide (Wicket) Gate Position" indication, and a 12/c #18 twisted shielded pair cable for the "Dupline" system. The Dupline cable is critical to lock operations and must not be damaged. It runs continuously from Gate No. 4 Control House to Gate No. 6 Control House via an overhead line which runs over the top of the bluff along the length of the locks. In the event that the Dupline cable is damaged by improper handling during removal or reinstallation, the Government shall be notified immediately, and the damaged portion of cable replaced at no additional cost to the Government, including new NEMA 4 pullboxes and terminal blocks as required to accommodate the replaced segment of cable.

3.2.3 Miscellaneous Circuits at Gate No. 6

3.2.3.1 Circuits Above Deck

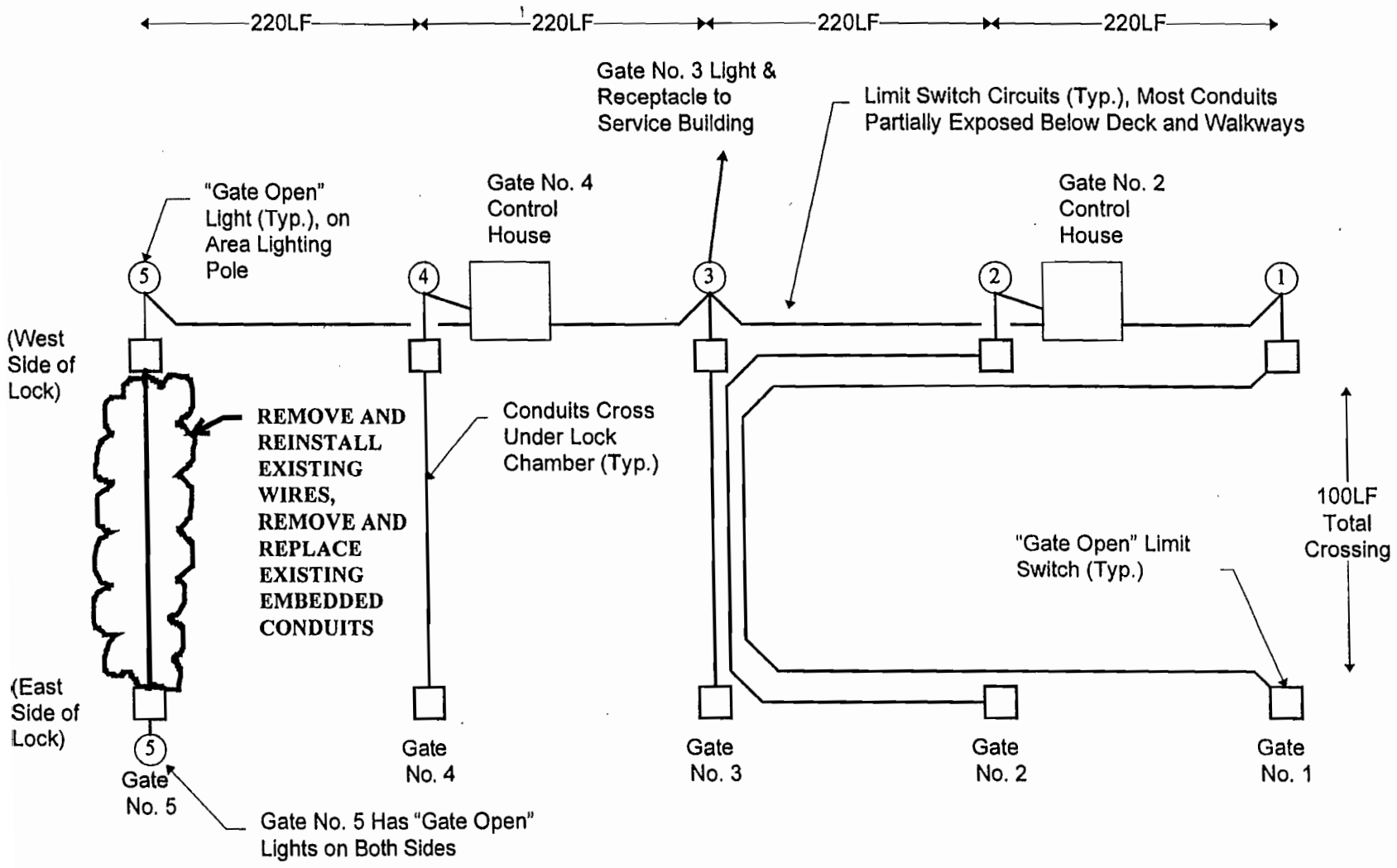
Circuits to be pulled out and reinstalled at the Multi-Purpose Terminal Enclosure include 2#12 for the duplex receptacle, two coax cables for CCTV, and a 12-pair #14 cable for intercom. The existing Amphenol connectors on the coax cables shall be removed if required to facilitate pulling the cables out of the conduit. The Contractor shall leave sufficient slack in the cables to facilitate installation of new Amphenol connectors. The Contractor has the option of leaving the existing Amphenol connectors attached if he can demonstrate that the cables can be removed and reinstalled without damage to the cables or connectors, or jamming the connectors in the conduit.

3.2.3.2 Circuits Below Deck

Circuits to be pulled out and reinstalled include 2#12 for lighting. Field verify circuits that may be in the conduit that appears to be an air line, pull out and reinstall as required. Field verify nearest points of termination for removal and reinstallation. If necessary, wires may be cut and spliced with wire nuts and then wrapped with vinyl tape inside the nearest accessible box or conduit outlet body.

3.3 OPERATIONAL TESTS

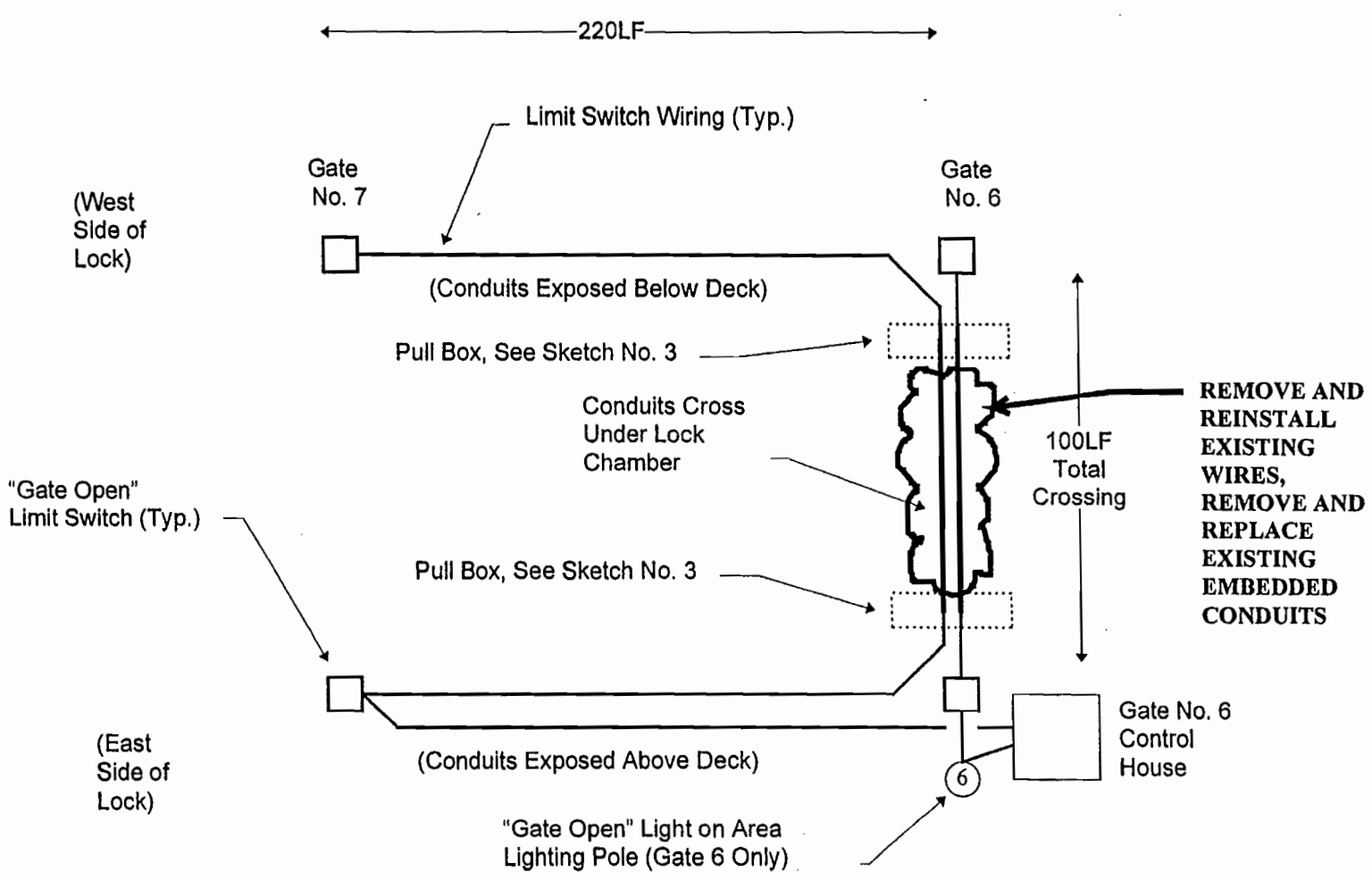
The lock gates and the intercom system shall be operated to verify proper operation after work is completed. All testing shall be conducted in the presence of and witnessed by the GQAR and be properly coordinated prior to the commencement of the test.



SKETCH No. 1: ONE-LINE DIAGRAM - "GATE OPEN" LIMIT SWITCHES, GATES 1-5

(NO SCALE)

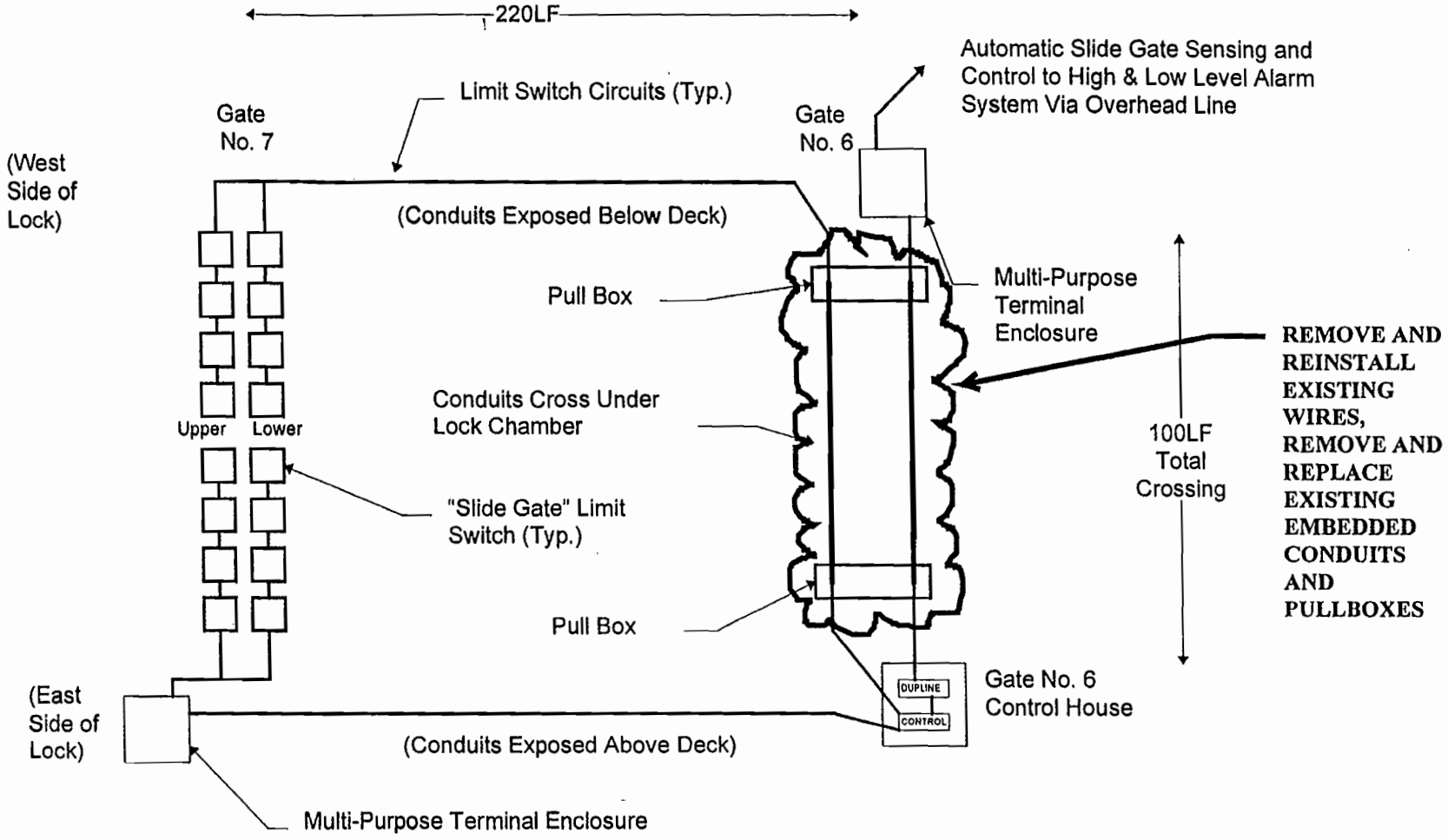
For information only, dimensions shown are approximate. New work is shown bold and clouded, see 16050 for requirements.



SKETCH No. 2: ONE-LINE DIAGRAM - "GATE OPEN" LIMIT SWITCHES, GATE NOS. 6 & 7

(NO SCALE)

For information only, dimensions shown are approximate. New work is shown bold and clouded, see 16050 for requirements.

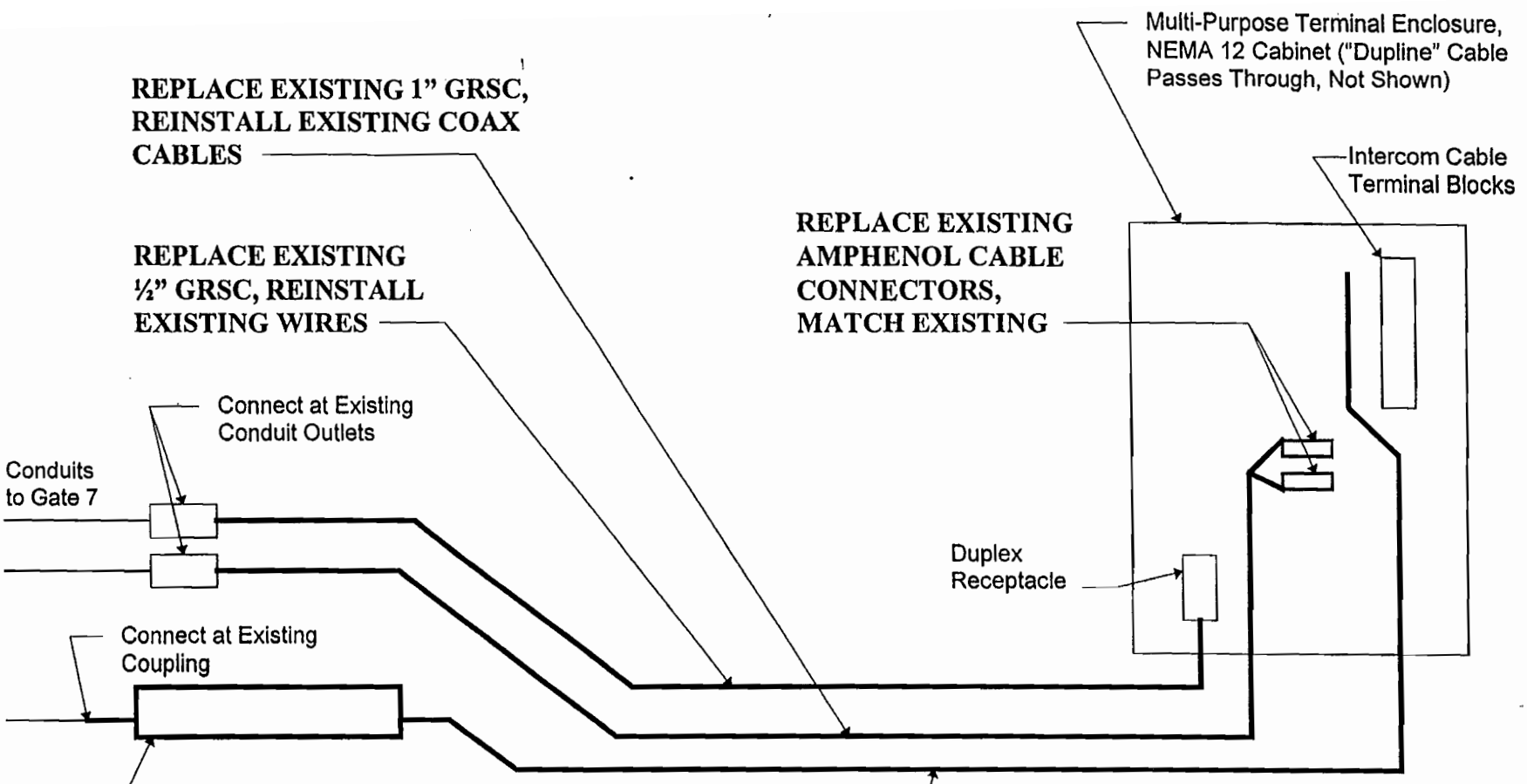


16050-10

SKETCH No. 3: ONE-LINE DIAGRAM - "SLIDE GATE" LIMIT SWITCHES, GATE NO. 7

(NO SCALE)

For information only, dimensions shown are approximate. New work is shown bold and clouded, see 16050 for requirements.



SKETCH No. 4: DIAGRAM - MULTI-PURPOSE TERMINAL ENCLOSURE AND PULL BOXES, GATE 6

(NO SCALE)

For information only. New work is shown in bold; two conduits below the wood deck are similar, not shown.

See 16050 and drawings UWR-114-116/10 and 116/11 for requirements.

- END OF SECTION -