North Shore Levee West Segment

Hoquiam, Washington

Operations and Maintenance Manual – CLOMR Submittal

December 30, 2020

kpff Consulting Engineers

CITY OF HOQUIAM

North Shore Levee West Segment Operations and Maintenance Manual - CLOMR

City of Hoquiam, Washington

Hoquiam River and Grays Harbor

KPFF Project No. 10181900007

December 30, 2020

This Operations and Maintenance (O&M) Manual is a living document and must be reviewed and updated as appropriate. This O&M Manual should be reviewed at the following times:

1. At the completion of this project, and prior to the LOMR application for levee accreditation.
2. After modifications to the levee
3. After major repairs
4. Annually

Prepared by:

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Accepted by:

Brian Shay, City of Hoquiam

12/30/2020

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APPENDICES

1.0 INTRODUCTION

1.1 General

This manual is intended to outline the necessary operations and maintenance items associated with an accredited levee by FEMA. At this stage of the project, this manual is for the CLOMR review only. Once the levee is designed, permitted, and constructed, the City of Hoquiam will submit a LOMR that will include completion of this manual with all known information that is currently left blank.

This manual has been compiled to assist local officials of the City of Hoquiam in complying with the regulations for operations and maintenance of the flood control works, and should be used in conjunction with the U.S. Army Corps of Engineers (USACE) "Levee Owner's Manual for Non-Federal Flood Control Works" also referred to in this document as the Levee Owner's Manual.

This manual contains a copy of approved regulations, maps, drawings, and references pertaining to the project.

The levee, as designed and constructed, will reduce the risk of flooding. However, continued successful functioning of the levee will depend upon how it is maintained by responsible local officials.

Serious flood damages, which could result from failure of any part of the levee system, can be prevented through careful inspection, proper maintenance, and establishment of effective operational procedures.

1.2 Location

A map of the project location is provided as Appendix A.

For this project, the mouth of the Hoquiam River is at the Simpson Ave Hoquiam River Bridge (US 101).

The project is entirely located within the City of Hoquiam in Grays Harbor County, Washington. The north terminus of the levee alignment starts at the intersection of Highway 101 and Queen Avenue and heads northeast along Queen Avenue. The levee follows the Hoquiam River meander south utilizing existing high ground, proposed earthen levee, concrete, and sheet pile structures. At the mouth of Hoquiam River and Grays Harbor, the levee alignment turns west, utilizing portions of high ground where it reaches the south terminus at Paulson Road.

1.3 Description

Project plans are provided as Appendix B.

The levee alignment is approximately 5.2 miles long and consists of raised roadways, concrete and sheet pile flood walls, earthen levees, and removable stop log closures. The Base Flood Elevation for the levee is 13.71 feet (NAVD88). Required freeboard for the levee is one foot, resulting in a minimum design height of 14.71 feet.

Settlement is anticipated to occur at areas where earthen levee and concrete walls are proposed (sheet pile walls are not anticipated to settle) per the Geotechnical Analysis and Certification Report 3-17-2020. The earthen portions of the levee alignment are anticipated to settle a total of 11.2" and concrete walls are anticipated to settle a total of 1" over 1200 months. Therefore, earthen portions are to be built to elevation 15.7' and concrete wall sections to elevation 15.3', resulting in all levee improvements to remain above the BFE plus one-foot of freeboard (elv: 14.71') following short-term and long-term settlement. Furthermore, additional fill material is planned to be added to the earthen levee sections as settlement occurs to maintain a levee structure height of 15.2' to account for potential sea level rise and inaccuracies in FEMA flood maps.

The project begins as a concrete flood wall at existing high ground on the south side of the Highway 101 and Queen Avenue intersection. Concrete walls then follow along the Queen Avenue until Minor Street where the levee turns north to Kuhn Avenue. The levee continues along Kuhn Avenue to the corner of Queen Avenue where the levee then turns east and heads towards the Hoquiam River. At the end of Queen Avenue, the project changes from a concrete flood wall to earthen berm, utilizing portions of high ground as it follows the Hoquiam River southeast to Washington Avenue. At Washington Avenue the levee structure transactions to a sheet pile flood wall.

The sheet pile flood wall heads south on Tyler Street to Chenault Avenue, where it turns west and runs down Chenault Avenue to Polk Street. At Polk Street, the sheet pile flood wall heads southwest down City Right-of-way along the Hoquiam River to Karr Avenue where it transitions back to a concrete flood wall. The levee continues as a concrete flood wall, following the Hoquiam River to 5th Street where it transitions to an earthen berm.

The earthen levee continues along the Hoquiam River ties into existing high ground at the Riverside Ave Bridge (Highway 101). Existing high ground ends at Levee Street where concrete walls are proposed to run southeast along the west side of Levee Street to the City of Hoquiam Police Station. Concrete walls encompass the police station and the run under the Simpson Avenue Bridge (Highway 101).

At the southwest corner of the police station the project crosses under the Simpson Avenue Bridge to I Street and crosses I Street to 11th Street. It runs southwest down 11th Street to K Street.

Concrete walls the run southwest down the north side of 11th Street. At K Street the levee transitions to a sheet pile flood wall and turns southeast. Running southeast along the K Street right-of-way, the levee crosses the railroad tracks twice and wraps around the K Street pump station. The levee extends through the Port of Grays Harbor and Anderson Middleton property via earthen levee raised road where large sections of existing high ground are utilized to provide levee protection to the intersection of Paulson Road and W Emerson Avenue. At this intersection, sheet pile flood walls are proposed to tie-in to high ground and complete the proposed levee and provide a continuous line of protection around the project area.

1.4 Protection Provided

The levee is designed to protect portions of the City of Hoquiam against damages from floods with a 1% probability of exceedance (100-year flood).

1.5 Construction History

Minor localized flood protection measures have been constructed in the past the along the right bank of the Hoquiam River. These flood measures have included earthen berms. The new levee supersedes prior minor protection measures.

2.0 PROCEDURES

2.1 General

General rules and guidelines for the maintenance and operation of local flood control works are provided in the USACE “Levee Owner’s Manual for Non-Federal Flood Control Works.” The following paragraphs give more detailed suggestions for complying with the requirements.

2.2 Duties of the Superintendent

The City of Hoquiam shall designate a Superintendent to be responsible for carrying out the maintenance and operation of the levee system. The Levee Superintendent shall be the City of Hoquiam’s Public Works Director/Superintendent or an individual formally designated by the Public Works Director/Superintendent.

The Levee Superintendent shall be provided with the authority to direct personnel and resources to operate and maintain the levee system. In addition to the duties outlined in other portions of this manual, the Superintendent has a general responsibility for maintaining and operating structures and facilities, particularly in flood periods. The name, address, and telephone number of the Superintendent shall be furnished to the contacts on the Distribution List (Appendix E). The contacts on the Distribution List shall be notified of any change in this information.

2.3 Improvements or Alterations to the Project

Drawings of proposed improvements or alterations in the levee, structures, or riverbanks shall be submitted to the City of Hoquiam Public Works Department. Drawings shall be submitted sufficiently in advance of the time proposed for initiation of construction permit to adequately study and consider the possible effects of the work. Drawings showing the improvements or alterations as finally constructed shall be furnished to the Distribution List and incorporated into this manual.

2.4 Annual Reporting

The annual report shall cover inspection and maintenance of the project works and shall include dated copies of inspection check/report sheets prepared during the period covered by the report. In the event repairs have been made, either temporary or permanent, the nature and dates of such repairs shall be included. Photographs showing the river and levee during flood periods are desired whenever available.

2.5 Periodic Inspections

Periodic inspections shall be made at the following times:

1. Prior to the beginning of a major flood season (winter floods may be expected annually in November through February). Typically, the second half of August has the lowest water levels of the year, allowing for observations below ordinary high water.
2. Immediately after each major high-water period.
3. Immediately after a significant seismic event (seismic events that can be felt in the City of Hoquiam are considered significant).
4. At such other times as may be considered necessary by the Superintendent.

Periodic operations of all closure structures for testing and training purposes are to occur at not less than at one-year intervals.

2.6 Check Sheets

In Appendix C of this manual, there is a suggested multipage check sheet which can be used to facilitate routine and emergency inspections. This, or a similar form, should be used at each inspection to ensure that no feature of the levee system has been overlooked. Any needed repairs should be indicated thereon, with a check indicating satisfactory items. Completed check sheets and maintenance records from previous inspections should be reviewed prior to the periodic inspection to help identify chronic problem areas. Special consideration should also be given to areas that have been improved or altered.

3.0 PROJECT FEATURES

3.1 General

The project consists of earthen berm levees, concrete flood wall levees, sheet pile flood wall levees, and raised roadway levees, as described in Section 1.3. Stoplog closures span openings for streets, sidewalks, and property access. The City of Hoquiam has an existing storm sewer system to collect and convey drainage inside of the levee.

Where storm sewer pipes pass through the levee to outfall in the Hoquiam River or Grays Harbor, control structures and pump stations provide discharge during flood events. See project plans in Appendix B for details.

3.2 Levees

3.2.1 Earthen Berm Levees

The crests of the constructed earthed levees are 10 feet wide with an elevation of the 15.7 ft. Side slopes of the levees are 2H:1V (horizontal:vertical). Levee slope faces are vegetated to provide erosion protection. Some levees may include a gravel path along the top for driving inspections.

3.2.2 Concrete Flood Wall Levees

Concrete flood wall levees are reinforced concrete T-walls on shallow footings. Footings generally have one foot of cover over footings. The walls are eight inches thick and their footings are 9 feet wide.

3.2.3 Sheet Pile Flood Wall Levees

Sheet pile levees are used when space for a concrete flood wall levee is limited. The sheet pile levee is approximately 1.5 feet thick and has a depth two-thirds of the levee height.

3.2.4 Raised Roadway Levees

An access road is raised to the Design Elevation by constructing an earthen berm with at least a 20-foot width on the crests of the berm.

3.3 Openings and Closures

There are 59 closures along the levee spanning openings for streets, sidewalks, railroad tracks, and property access. Two (2) of these closures are aluminum railroad stoplogs. The remainder of the closures consist of interlocking wooden stoplogs and bollards. All wooden stoplogs are five feet in length so that any stoplog can be utilized at any location. The materials for the closures are stored in trailers that will be parked on City property easily accessible for hookup. City vehicles will then be able to tow the trailers to every stoplog closure when assembly is needed.

3.4 Drainage Structures

Internal drainage is provided by the City of Hoquiam's independent storm sewer systems. Where storm sewer pipes pass through the levee to outfall in the Hoquiam River or Grays Harbor, drainage control structures will prohibit any backflow into the protected areas and pump stations provide discharge during flood events. The internal drainage for this levee is discussed further in the Interior Drainage Analysis as a separate attachment. Table 1 below provides a summary of Outfalls and Table 2 provide a summary of all levee penetrations.

Table 1 Outfall Summary

Outfall Name/Number	Drainage Basin	Existing Outfall Type	Description	Outfall Improvements
Cottage Street Pump Station	Cottage Street	Pumped	Outside Levee Protection	None
Ramer Street Pump Station	Ramer Street	Pumped	Interior Drainage	Backflow Prevention Structure
8th Street	8th Street	Gravity	Interior Drainage	Remove Outfall
Adams Street Extension	5th Street	Gravity	High Ground Drainage	Replace Tide Gate
Queen Avenue Pump Station	Queen Avenue	Pumped	Interior Drainage	Backflow Prevention Structure
Emerson Avenue Pump Station	Emerson Avenue	Pumped	Interior Drainage	Backflow Prevention Structure
10th Street Pump Station	10th Street	Pumped	Interior Drainage	New Forcemain Outfall
K St Pump Station	K Street	Pumped	Interior Drainage	Backflow Prevention Structure
Adams S Extension Pump Station	Adams Street	Pumped	Interior Drainage	Backflow Prevention Structure
Outfall #1	Industrial Basin 01	Gravity	High Ground Drainage	None
Outfall #2	Industrial Basin 02	Gravity	High Ground Drainage	None
Outfall #3	Industrial Basin 03	Gravity	High Ground Drainage	None
Outfall #4	Industrial Basin 04	Gravity	High Ground Drainage	None
Outfall #5	Industrial Basin 05	Gravity	High Ground Drainage	None
Outfall #6	Industrial Basin 06	Gravity	Interior Drainage	Remove Outfall
Outfall #7	Industrial Basin 07	Gravity	Interior Drainage	New Forcemain Outfall

Table 2 Stormwater Penetration Summary

Levee Station	Diameter	Type of Closure Device	Name (if applicable)
9+38	18"	Backflow Prevention Structure	Conveyance System Connection
9+59	18"	Backflow Prevention Structure	Conveyance System Connection
9+76	18"	Backflow Prevention Structure	Conveyance System Connection
17+26	8"	Backflow Prevention Structure	Conveyance System Connection
29+23	14"	Backflow Prevention Structure & Pump Station Double Check Assembly	Queen Street Pump Station Outfall
54+53	48"	Backflow Prevention Structure & Pump Station Double Check Assembly	Ramer Street Pump Station Outfall
100+85	72"	Backflow Prevention Structure & Pump Station Double Check Assembly	Emerson Street Pump Station Outfall
121+92	48"	Backflow Prevention Structure & Pump Station Double Check Assembly	10th Street Pump Station Outfall
130+76	12"	Backflow Prevention Structure	Conveyance System Connection
134+93	12"	Backflow Prevention Structure	Conveyance System Connection
138+82	36"	Backflow Prevention Structure	Conveyance System Connection
145+55	36"	Backflow Prevention Structure & Pump Station Double Check Assembly	K Street Pump Station Outfall
N: 615,813 E: 791,582	36"	Existing Tide Gate & Backflow Prevention Structure	Adams Pump Station/ 5th Street Extension Outfall
201+06	48"	Backflow Prevention Structure & Pump Station Double Check Assembly	Outfall #7 / Paulson Road Pump Station Outfall

3.5 Pump Stations

Where storm sewer pipes pass through the levee to outfall in the Hoquiam River or Grays Harbor, pump stations provide discharge during flood events. This project proposes to relocate and upgrade the 10th Street pump station. Storm drainage control manholes are proposed at all outfalls as manual backup to prevent backflow in case of pump station failure. The internal drainage for this levee is discussed further in the Interior Drainage Analysis as a separate attachment.

Table 3 Pump Station Summary

Pump Station	Existing Pump Capacity		Proposed Capacity		# of Pumps	Notes
	(cfs)	(gpm)	(cfs)	(gpm)		
Cottage Street	5.6	2,500	N/A	N/A	1	Serves areas outside levee protection.
Ramer Street	7.8	3,500	N/A	N/A	2	Does not require improvements for CLOMR / LOMR approval.
Queen Avenue	25.4	11,400	N/A	N/A	2	Does not require improvements for CLOMR / LOMR approval.
Emerson Avenue	73.5	33,000	N/A	N/A	2	Does not require improvements for CLOMR / LOMR approval.
10th Street	4.5	2,000	21.6	9,700	2	8th Street basin rerouted to improved pump station
K Street	15.6	7,000	N/A	N/A	2	Does not require improvements for CLOMR / LOMR approval.
Adams Street	73.5	33,000	N/A	N/A	2	Does not require improvements for CLOMR / LOMR approval.
Paulson Road	N/A	N/A	129.1	58,000	2	New pump station

Backup Pump	A trailer mounted, 3,000 GPM pump will be available in case of pump station failure.
Emergency Power	A trailer mounted generator will provide emergency pump station backup power when necessary.

4.0 MAINTENANCE

4.1 General

The Superintendent shall be directed to make periodic inspections (minimum annually), take immediate steps to remedy adverse conditions disclosed by such inspections, and provide periodic repairs and cleaning required for the proper function of the levee. Inspections and maintenance shall be conducted in general accordance with the Levee Owner's Manual. Records of inspections, maintenance, and repairs should be kept for reference for future inspections.

The final type and configuration of some items will be determined during the detailed design and Contractor procurement process. Operation and maintenance requirements for these items will be updated prior to LOMR.

4.2 Levees

4.2.1 Earth Berm Levees

Settlement, sloughing, erosion, animal burrows, and any other changes in the levee cross section should be restored to the original shape and measures should be taken to prevent the return of the condition.

Vegetation on levees should be maintained as follows:

1. The levee, to include the waterward of the levee to within 15 feet of the landward toe, will be inspected and all woody plants (trees) will be evaluated on a case-by-case basis. Grass should be mowed at least four times yearly with one mowing occurring once in August, September, and October, right before flood season.

2. Trees smaller than 10 inches Diameter at Breast Height (DBH) may remain on the levee (DBH is the diameter of the tree at a height of 4.5 feet from the ground on the uphill side of the tree).
3. Trees larger than 10 inches DBH will be evaluated on a case-by-case basis and will be removed if determined to negatively affect the stability of the levee. Trees larger than 10 inches DBH should be documented in the inspection check sheets to facilitate continued monitoring in following inspections.

Trees that could negatively affect the stability of the levee and should be considered for removal consist of:

1. Dead trees or diseased trees that will likely die or significantly deteriorate prior to the next scheduled inspection.
2. Trees that are leaning or show signs of instability such as tension cracks or erosion around the rootwad.
3. Trees below the 100-year flood elevation with a significant amount of large, low limbs that could cause snags during high water periods.
4. Any other trees that are determined to be unstable by the inspection team.

Trees that are to be removed should be removed in a manner that reduces the disturbance to the bank and levee slope to the greatest extent practical. Trees should be cut off 2 to 4 feet from the ground surface. To prevent future seepage or piping, a 2-foot-wide trench should be cut through the uphill side of the root wad and backfilled with compacted structural fill. If practical, the majority of the root wad should remain to provide stability and erosion protection to the riverbank until new vegetation can be established.

Areas where vegetative slope protection has died or not been established should be replanted. Temporary slope protection such as jute matting may be required while permanent measures are established. Alternative slope protection measures should be considered for areas that are found to have chronic issues with maintaining a grass or sod cover.

4.2.2 Concrete and Sheet Pile Flood Wall Levees

Concrete and sheet pile flood walls should be checked for tilting or settlement. The steel of the sheet pile flood walls should be checked for signs of corrosion. If signs of tilting, settlement, or corrosion are observed for any concrete or sheet pile flood wall system, a licensed engineer should be contacted to determine the best approach to correct the problem. The extent of any observed movement or corrosion should be documented so that the engineer can make a determination on the rate of movement of the structure or the rate of progression of the corrosion.

The bottom of concrete flood wall footings are approximately 2 feet 4 inches below the surface. Roots from vegetation and trees could extend underneath the walls. Therefore, trees shall not be allowed to grow such their driplines cross over the foundations of walls. Areas within 15 feet of the concrete and sheet pile flood wall face shall be grass and shall be mowed at least four times per year, with one mowing occurring once in August, September, or October, right before flood season.

4.2.3 Raised Roadway Levees

Roadway surfaces, curbs, and sidewalks should be checked for settlement, cracking, and other damage. If damage is observed, a licensed engineer should be contacted to determine the best approach to correct the problem. The extent of any settlement or cracking should be documented so that the engineer can make a determination on the rate of movement and progression.

Roots from vegetation and trees could extend underneath the roadways. Therefore, trees shall not be allowed to grow such their driplines cross over roadway surfaces, curbs, or sidewalks. Areas within 15 feet of roadway surfaces, curbs, and sidewalks shall be grass and shall be mowed at least twice per year, with one mowing occurring once in August, September, or October, right before flood season.

4.3 Openings and Closures

Openings shall be inspected and maintained during concrete and sheet pile flood wall inspection and maintenance. Stoplogs and bollards shall be inspected and inventoried annually each October before the flood season to ensure that they are on-hand and in condition to provide protection. Stoplogs that have become chipped, cracked, worn, rotted, or otherwise degraded shall be replaced immediately.

Bollard casings shall be inspected and maintained for the following items: working casing hinge and cover, casing free of debris and rocks, casing inspected for cracking, chipping, or signs of failure, and visual inspection of casing grade to the adjacent pavement.

The final type and configuration of the closure devices will be determined during the detailed design and Contractor procurement process. Operation and maintenance requirements for these devices will be updated prior to LOMR.

4.4 Drainage Structures and Backflow Prevention Structures

All drainage structures should be kept clear of debris and sediment. The interior of concrete storm drain manholes should be checked for spalling, cracking, settlement, or wear due to abrasion. Corrugated metal pipe culverts should be checked for interior and exterior rust, reduction in metal thickness, joint separation, holes, and settlement.

All mechanical flap gates or check valves should be checked and lubricated at least once per year. Cracked or damaged gates must be repaired or replaced. Rubber gaskets should be checked for cracks, tears, or brittleness. Full inspection and maintenance of drainage structures will require compliance with confined space entry regulations.

4.5 Pump Stations

The pump stations are on a supervisory control and data acquisition (SCADA) system for remote monitoring of the pumps by the Levee Superintendent and City staff. Additionally, the pump stations are physically inspected bi-weekly October through April and monthly May through September. They are maintained as necessary as part of routine maintenance of the City of Hoquiam's independent storm sewer system. A copy of the pump maintenance schedule and checklist is provided in Appendix D. A complete record of inspections, tests, maintenance actions, and repairs shall be kept at the pump site. Levee inspections shall review the pump maintenance records and confirm that routine maintenance and repairs are occurring in accordance with the schedule.

4.6 Riverbanks & Shoreline

The riverbanks are not part of the flood control works; however, they may affect the levee to some degree. Any slumps or erosion should be noted and evaluated to determine what if any reports are necessary.

Snags and debris deposited high on the bank during flood events should be evaluated for impacts to the levee and possible removal. Large trees that could potentially destabilize the levee foundation if they were to become unstable should also be evaluated. See maintenance requirements for earthen berm levees, and concrete and sheet pile flood wall levees above.

4.7 Bridges

Maintenance issues with the bridges may lead to maintenance issues with the adjacent flood control works. Bridges along this levee include:

1. Riverside Ave Bridge (US 101)
2. Simpson Ave Bridge (US 101)

The levee passes under the Simpson Ave Bridge via concrete flood wall. See Appendix G for the WSDOT Agreement. Check for snags under the bridges and directly upstream of the bridge structures, for erosion along the downstream wing walls, for open cracks in and spalling of reinforced concrete, and for any evidence of movement of the abutments. Any damage to the bridges should be reported to the owner of the bridge and a licensed engineer should be contacted to determine the best approach to correct the problem.

4.8 Seismic Event Damage and Restoration

Seismic evaluation indicates that soil liquefaction and/or loss of soil strength due to cyclic softening during the 100-year return period event is possible throughout the City and along the proposed levee alignment. Where the levee alignment is located adjacent to the Hoquiam River or Grays Harbor, this loss of soil strength could in turn lead to lateral spreading of the ground surface. Constructing a levee system capable of withstanding such a significant seismic event is not considered practical and is not consistent with the overall approach to risk and disaster management in the City. Therefore, the levee is designed for the predicted 100-year flood and not for seismic events.
In the event that seismic ground motions damage the levee, an earthquake remediation plan will be implemented:

1. The Levee Superintendent will develop an estimate of the general magnitude and locations of damage throughout the levee system, along with the amounts and locations of material needed to restore the levee system's grade and dimensions sufficient for protection against the BFE.
2. Levee repairs shall be consistent with the levee's original design plans and any subsequent approved modifications.
3. Interim repairs need to restore the flood protection within eight weeks or less to avoid prolonged exposure of the community during flood season.
4. The Levee Superintendent shall maintain a list of borrow areas, stockpiles, pits, and other sources of material needed for interim repairs. Such material should be consistent with the design plans and any subsequent approved modifications.
5. The Levee Superintendent will notify the public as quickly as possible by internet/alert media or other appropriate method after a damaging earthquake as to system damages and the resulting interim level of protection that will be provided.

5.0 HIGH WATER PERIOD

5.1 General

Flooding events in the area are highly dependent on a combination of high seasonal tides, storm surges, atmosphere pressures, river flows, and interior runoff from precipitation, all of which are highly predictable. High water events are a result of coastal tidal events and low pressure systems only and are not subject to riverine flow events.

The Levee Superintendent orders the closure of the levee within six (6) hours of when river and harbor water levels are anticipated to reach within one foot of the Base Flood Elevation of 13.71' (Elv: 12.71' & above). High tides are predictable several days prior to the event occurrence and can be tracked using the National Oceanic and Atmospheric Administration (NOAA) website (noaa.gov). One (1) week before the anticipated storm event, the levee superintendent will perform an operational pre-check to ensure all the levee system is ready to adequately perform during a flood event. Operational pre-check information, contact lists, schedules, and checklists will be added to this manual prior to levee accreditation.

The time needed to close the levee is approximately 185 minutes, therefore providing adequate time for maintenance personnel to operate/install all 59 closure structures. Closure activities shall be installed in accordance with the Closure Plan included in Appendix H

Pump stations associated with the levee activate automatically, no specific action is required for the activation or operation of the mechanized drainage system components.
The pump stations controlling interior drainage are set to turn on automatically as needed. It is not necessary to establish an elaborate flood-fighting organization other than what is needed for the Closure Plan, but it is imperative that the levees be maintained in accordance with this manual.

There are no other actions required to prepare the levees for a flood event aside from thorough inspections and maintenance as described in the preceding sections and patrols and inspections as described in the following sections.

5.2 Operations

It is not intended that this manual will restrict the Superintendent, or others concerned, to a rigid set of rules. With individual initiative, difficult conditions can usually be corrected in the manner recommended in the manual by methods acceptable in standard engineering practice.

5.3 Patrols

There should be regular patrolling of the levee during periods of high water. The Superintendent shall ensure that sufficient personnel are familiar with the basic requirements of inspection and maintenance and that they are available to maintain the patrol. Following large events, river/harbor banks should be checked for serious bank erosion and levee banks should be returned to design slopes as soon as practicable after the high water has receded.

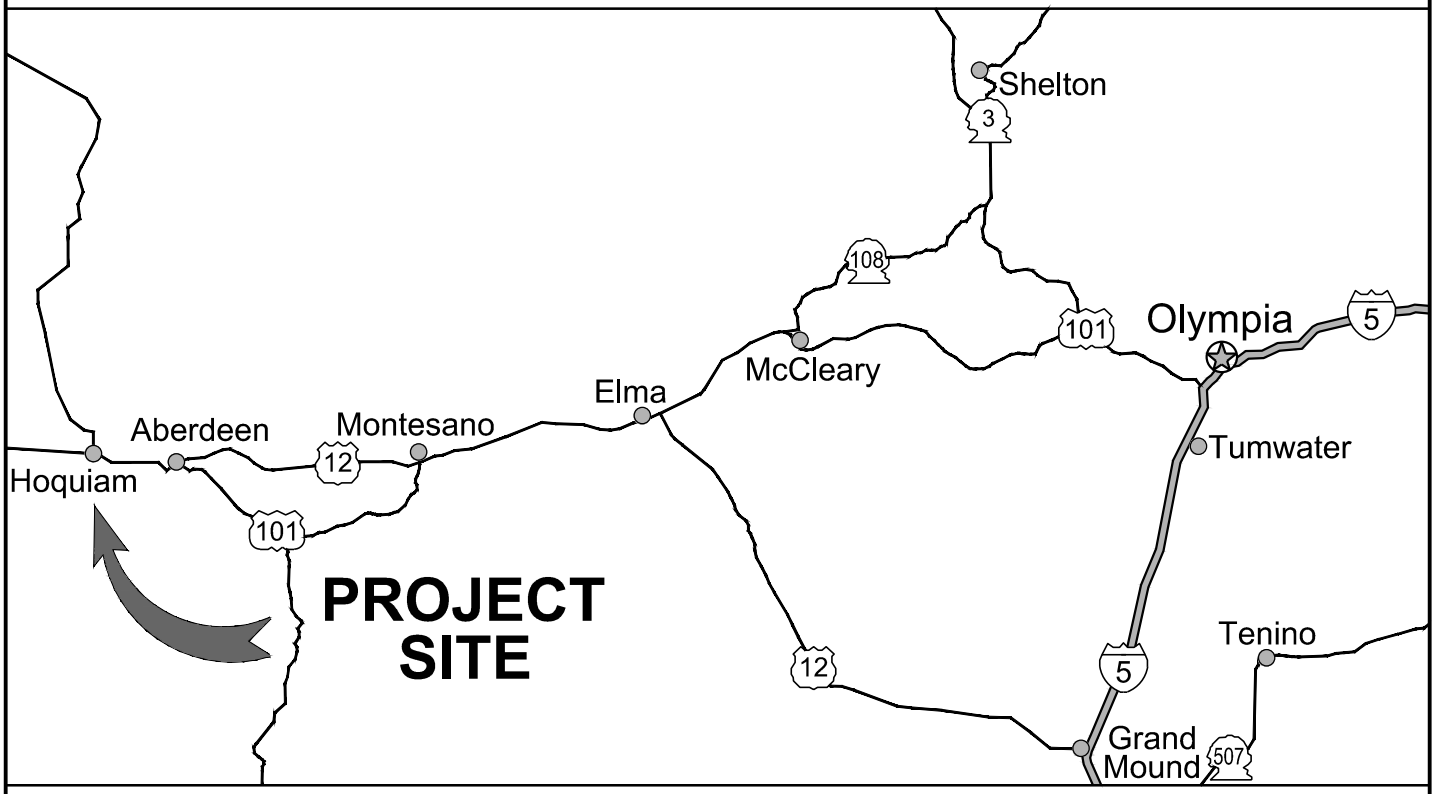
5.4 Pump Stations

The pump stations will activate automatically when the storm sewers fill on the landward side of the levee and when the outfall to the river is blocked by the flap gates because of elevated flood waters. Manual backup will be implemented by placing storm drainage control manholes at all outfalls to prevent backflow in case of pump station failure. The pump stations should be monitored during high water periods to confirm that they are operating as required.

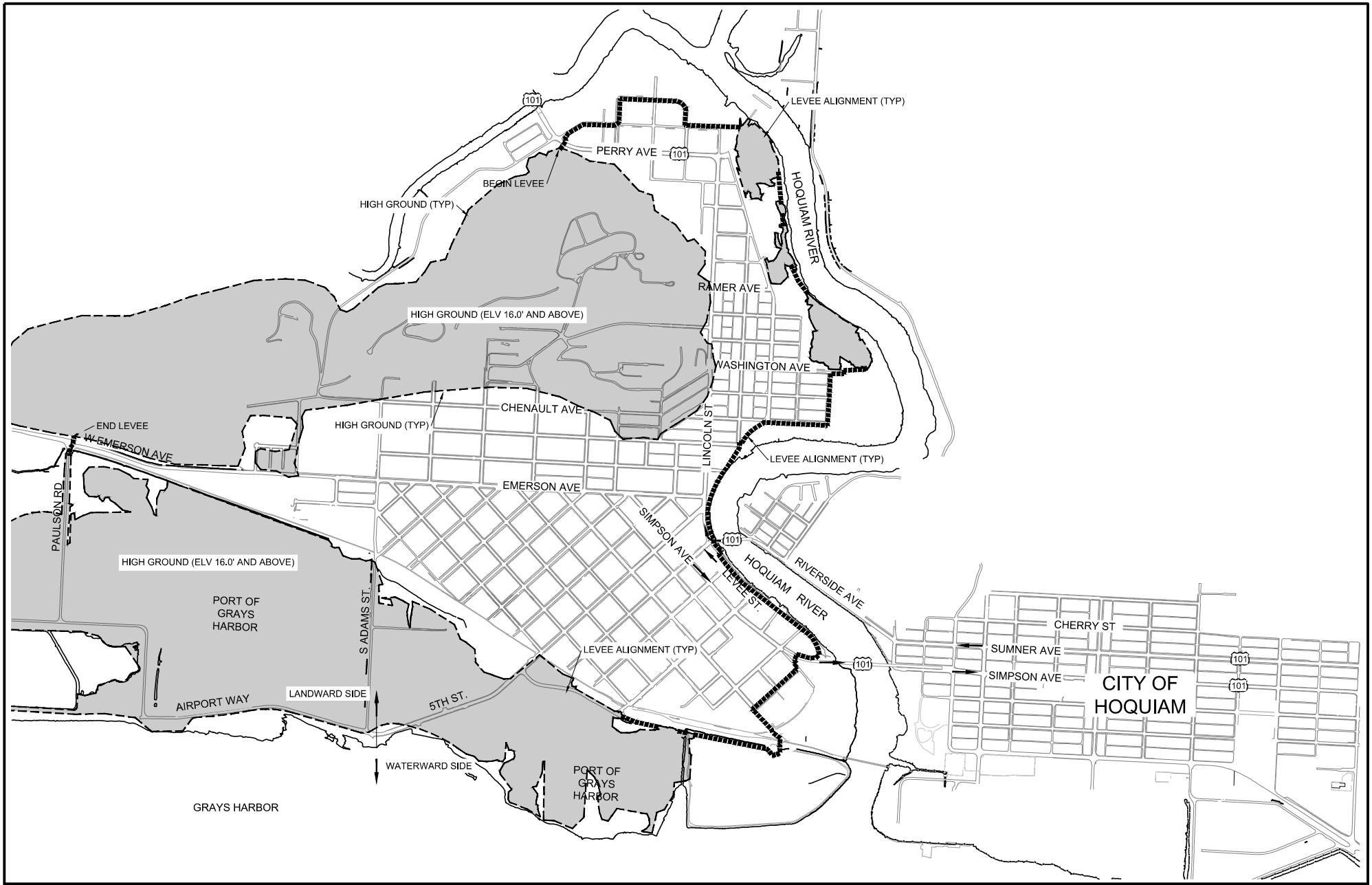
In case of pump station failure, a trailer mounted 3,000 gallon per minute portable pump and backup generator will be available to the City at all hours. The trailer will be located on City of Hoquiam property for easy access and use.

APPENDIX A

MAPS



PROJ NO: 101819000007	DATE: 12-30-2020	NORTH SHORE LEVEE WEST SEGMENT	FIGURE
kpff 612 Woodland Square Loop Suite 100 Lacey, WA 98503 360.292.7230 www.kpff.com		VICINITY MAP	1



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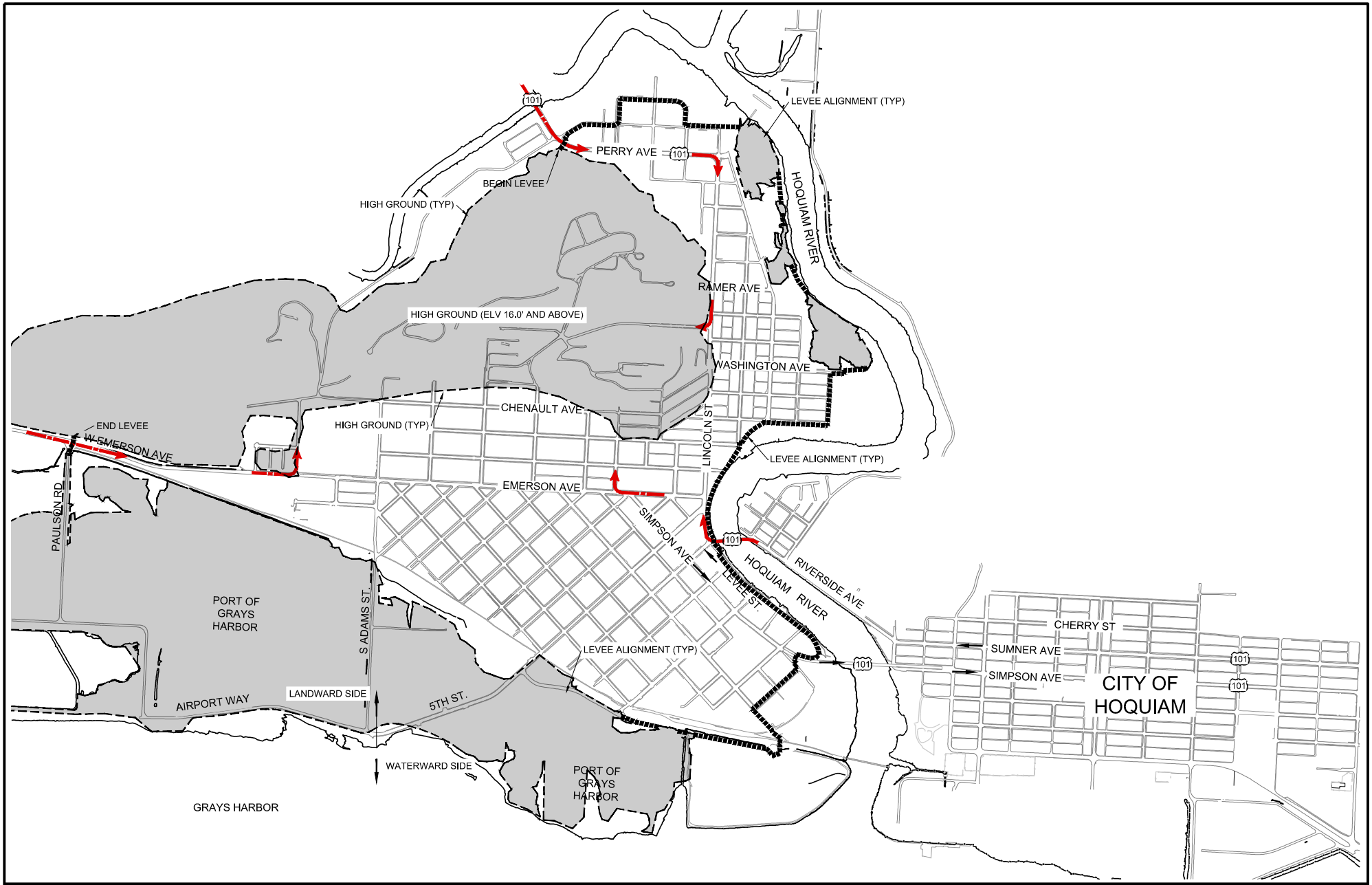
NORTH SHORE LEVEE WEST SEGMENT

SITE MAP

PROJ NO: 10181900007	DRAWN BY: NLA
DATE: 12-30-2020	DESIGNED BY: SDS
SCALE: N.T.S.	CHECKED BY: MRS

FIGURE 2



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NORTH SHORE LEVEE WEST SEGMENT

EVACUATION MAP

PROJ NO: 10181900007	DRAWN BY: NLA
DATE: 12-30-2020	DESIGNED BY: BAL
SCALE: N.T.S.	CHECKED BY: MRS

FIGURE 3

APPENDIX B

PROJECT PLANS/AS-BUILTS

APPENDIX B
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Both half-size and full-size sets of the plans are included elsewhere in the CLOMR submittal and are not included in this appendix with this submittal. A half-size set of the plans and later the as-builts will be included here in the future.

APPENDIX C

CHECK SHEETS

APPENDIX C
CHECK SHEETS

North Shore Levee West Segment Hoquiam, Washington

Type of Inspection (check only one):

( ) Annual ( ) Emergency/Disaster

( ) Semiannual ( ) Other (Describe)

Date: _____

Inspected by (List Lead Inspector first and include other key personnel):

_____
_____
_____
_____
_____

Levee

Item	Station or Location	Condition *	Recommendation **
Snags or Debris			
Woody Plants on top 3rd of Levee			
Trees larger than 10 DBH in lower two-thirds of levee (note all, including those to remain)			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

_____
_____
_____
_____
_____

Riverbank Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

_____
_____
_____
_____
_____

Earthen Levee

Item	Station or Location	Condition *	Recommendation **
Settlement, loss of grade			
Sloughing or caving (either side of levee)			
Seepage or sand boils			
Animal burrows			
Undesirable vegetation			
Drainage to levee crown			
Unauthorized encroachments on right-of-way			
Unauthorized excavation or removal of slope protection			
Unauthorized grazing or vehicular traffic			
Accumulation of drift, trash or debris			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

_____
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_____
_____

Levee Concrete, Sheet Pile Flood Wall Levees, and Stoplog Closures

Item	Station or Location	Condition *	Recommendation **
Tilting, sliding, and settlement			
Spalling, cracking, and scaling of concrete			
Exposed steel (sheet piles or reinforcing)			
Seepage or sand boils			
Weeds of undesirable vegetation			
Unauthorized encroachments on right-of-way			
Unauthorized excavation or removal of slope protection			
Accumulation of drift, trash or debris			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

_____
_____
_____
_____
_____

Levee Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

_____
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_____
_____

Drainage Structures

Item	Station or Location	Condition *	Recommendation **
Debris or Sediment as Closures			
Damage to Flap Gates or Check Valves			
Oil/Lubricate moving parts (To be completed yearly. Note date of Last Maintenance.)			
Cracking, scaling or spalling of concrete. (Specifically note if rebar is exposed.)			
Corrosion of Steel Pipes			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

_____
_____
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_____
_____

Drainage Structure Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

_____
_____
_____
_____
_____

Bridges

Item	Station or Location	Condition *	Recommendation **
Debris or snags			
Erosion along the downstream wing walls			
Cracking, scaling or spalling			
Movement of abutments			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

_____
_____
_____
_____
_____

Bridge Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

_____
_____
_____
_____
_____

Bollard Casing Repair Record

Corrective work completed during period:

Start Date: _____

Completion Date: _____

Additional Remarks:

_____
_____
_____
_____
_____

Ballard Casing

Item	Station or Location	Condition *	Recommendation **
Working casing hinge and cover			
Free of debris and rocks			
Cracking, chipping, or signs of failure			
Casing flush with pavement surface			

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

Additional Remarks:

_____
_____
_____
_____
_____

Additional Repair Record and Inspection / Maintenance Sheets will be added to this document to support the LOMR submittal. The final type and configuration of the some items will be determined during the detailed design and Contractor procurement process. Operation and maintenance requirements for these devices will be updated prior to LOMR.

Following construction, the following items will be included in this document:

- **Locations of all project component requiring maintenance**
- **Operations & Maintenance Manuals for all project components**
- **Chain of Command references**

APPENDIX D

PUMP STATION MAINTENANCE SCHEDULE AND CHECKLIST

APPENDIX D
PUMP STATION MAINTENANCE SCHEDULE AND CHECKLIST

PUMP STATION MAINTENANCE SCHEDULE

Maintenance	Scheduled
Ultra Sound / Infrared	Twice Yearly – January and July
Reduced Pressure Testing	Yearly – January
UPS Battery Replacement	Every 3 years – January 2008, January 2011, etc…
PLC Battery Replacement	Yearly – January
Oil and Lube	Yearly – February
Mercury Switch Inspection	Twice Yearly – March and September
Alarms Check	Twice Yearly – March and September
Wet Well Cleaning	Five times per Year – January, April, June, August, and October
Check Valve Cleaning	Yearly – October
General Inspection	Bi-weekly October through April, monthly May through September

CITY OF HOQUIAM PUMP STATION GENERAL INSPECTION CHECKLIST

PUMP STATION CHECK LIST

Item	Condition *	Recommendation **
Pumps		
Flappers		
Bubbler System		
Sump Pump		
Telephone		
Dehumidifier		
Station Flood Switch		
Lights		
Instruments		
Seal Filters		
VFD Drive (if installed)		
Any Leaks		
Entry Switch Operation (check with Control)		

Notes:

* Indicate satisfactory with a check; briefly describe conditions when other than satisfactory; use additional sheets if more space is required.

**Indicate the recommended action for areas less than satisfactory; include persons or organizations responsible for completing the recommended action.

APPENDIX E

DISTRIBUTION LIST

APPENDIX E
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A list of contacts and organizations with authority over flood control on the Hoquiam River and Grays Harbor will be completed following construction of the project and prior to LOMR.

APPENDIX F

RAILROAD CLOSURE AGREEMENT

APPENDIX F
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A railroad closure agreement for constructing a temporary stoplog closure over the Puget Sound & Pacific Railroad tracks will be negotiated prior to construction of the project.

APPENDIX G

WSDOT AGREEMENT

APPENDIX G

There will be an agreement between the City of Hoquiam and the Washington State Department of Transportation (WSDOT) for placement of the levee within WSDOT right-of-way, use of their abutments for the levee and how WSDOT owned facilities will be inspected and maintained. Although no construction to the bridges is required for the levee, the use of their land and existing structures will require the levee superintendent to coordinate with WSDOT to ensure the appropriate bridge experts are looking at the levee requirements in addition to the bridge requirements during the annual inspections. This agreement will be agreed upon prior to the start of construction.

APPENDIX H

CLOSURE PLAN

APPENDIX H

The levee closure plan gives details regarding each stoplog closure and pedestrian hinged gates. The closure plan shows details such as;

- width of the closure
- the quantity of bollards and stoplogs per stoplog closure
- the spacing between each bollard
- height of the stoplog closure and pedestrian hinged gate
- the amount of time it will take to assemble each individual closure
- and closure locations

The stoplogs have a length of five feet; therefore the spacing between each bollard is five feet. Based on the spacing and the height of the closure the number of stoplogs was determined. The assembly time is related to stoplog width, the average height of the closure, and travel time. The following table shows the assumptions made based on stoplog closure widths:

Stoplog Width (ft)	Min.
5, 10	5
15, 20, 25	10
30,35	15
40, 45	20
≥ 50	30

The stoplogs and bollards are stored in seven trailers that will be parked on City property. When the stoplog closures need to be put in place, the crews will hook up the trailers to city trucks and travel to each individual closure. The total assembly time is about 185 minutes including hook up and travel time. In order to fully assemble all 59 stoplog closures in this time, three crews of four are required. See the table attached for more details.

NORTH SHORE LEVEE WEST CLOSURE PLAN
December 31, 2020

Closure Summary Table

Closure No.	Location	Crew No.	Opening Width	Total Width (ft.)	Spacing (ft.)	Stoplog Height (ft.)	# of Bollards	# of Stoplogs	Assembly Time (min.)	Approx. Base Elev. (ft.)	Station
1	Highway 101	1	45'	45	5	1.77	8	45	40	13.43	1+74
2	Perry Avenue & Queen Ave Bus Stop	1	5'	5	5	4.53	0	11	10	10.67	2+57
3	Queen Avenue	1	30'	30	5	4.94	5	72	30	10.26	3+89
4	Queen Avenue	1	25'	25	5	5.18	4	60	20	10.02	4+37
5	Queen Avenue	1	35'	35	5	4.78	6	77	30	10.42	5+18
6	Queen Avenue	1	30'	30	5	4.91	5	72	30	10.29	5+86
7	Queen Avenue	1	5'	5	5	5.17	0	12	10	10.03	6+79
8	Queen Avenue	1	20'	20	5	5.20	3	48	20	10.00	7+91
9	Queen Avenue	1	65'	65	5	4.77	12	143	60	10.43	9+66
10	Minor Street	1	5'	5	5	4.75	0.0	11	10	10.45	11+07
11	Minor Street	1	5'	5	5	4.72	0.0	11	10	10.48	11+55
12	Minor Street	1	5'	5	5	4.47	0	11	10	10.73	12+35
13	Minor Street & Kuhn Avenue	1	10'	10	5	4.59	1	22	10	10.61	13+04
14	Kuhn Avenue	1	40'	40	5	5.16	7	96	40	10.05	14+03
15	Kuhn Avenue	1	20'	20	5	5.06	3	48	20	10.15	14+74
16	Kuhn Avenue	1	40'	40	5	4.67	7	88	40	10.53	16+04
17	Kuhn Avenue	1	55'	55	5	4.63	10	121	60	10.58	17+36
18	Kuhn Avenue	1	20'	20	5	4.99	3	48	20	10.22	18+79
19	Kuhn Avenue	1	5'	5	5	4.35	0	10	10	10.85	19+58
20	Kuhn Avenue	1	25'	25	5	4.57	4	55	20	10.63	20+09
21	Laurel Street	1	15'	15	5	4.93	2	36	20	10.28	22+00
22	Laurel Street	1	15'	15	5	4.95	2	36	20	10.25	23+17
23	Queen Avenue	1	45'	45	5	4.85	8	108	40	10.35	24+01
24	Queen Avenue	1	30'	30	5	4.75	5	66	30	10.45	25+51
25	Queen Avenue	1	20'	20	5	4.83	3	48	20	10.37	26+87
26	Queen Avenue	1	50'	50	5	4.22	9	100	60	10.98	28+14
27	Food Bank North Entrance	2	50'	50	5	2.50	9	60	60	12.70	71+53
28	Tyler Street	2	55'	55	5	3.36	10	88	60	11.84	74+41
29	Tyler Street	2	35'	35	5	2.09	6	35	30	13.11	79+32
30	Chenault Ave & Roosevelt St	2	60'	60	5	3.03	11	84	60	12.18	83+53
31	Chenault Avenue & Polk Street	2	30'	30	5	3.30	5	48	30	11.90	86+98
32	Chenault Avenue & Polk Street	2	30'	30	5	2.97	5	42	30	12.23	87+38
33	Monroe Street & Eklund Avenue	2	75'	75	5	3.93	14	135	60	11.27	92+15
34	Not Used										
35	Levee Street Crossing	3	30'	30	5	1.37	5	24	30	13.83	107+41
36	Levee Street & 7th Street	3	85'	85	5	2.50	16	102	60	12.70	109+51
37	Levee Street	3	25'	25	5	3.95	4	50	20	11.25	112+51
38	Levee Street & 8th Street	3	90'	90	5	2.85	17	126	60	12.35	114+29
39	Levee Street	3	15'	15	5	3.82	2	27	20	11.38	116+17
40	Levee Street	3	25'	25	5	3.51	4	45	20	11.69	116+62
41	Levee Street	3	25'	25	5	3.17	4	40	20	12.03	117+13
42	Levee Street	3	25'	25	5	3.58	4	45	20	11.62	117+51
43	Levee Street & 9th Street	3	45'	45	5	3.36	8	72	40	11.84	118+02
44	Levee Street	3	20'	20	5	3.50	3	32	20	11.70	118+57
45	Levee Street	3	20'	20	5	3.30	3	32	20	11.90	119+10
46	Levee Street & 10th Street	3	50'	50	5	2.07	9	50	60	13.13	121+76
47	Simpson Avenue Park Pathway	3	10'	10	5	2.81	1	14	10	12.39	125+91
48	I Avenue	3	45'	45	5	3.97	8	90	40	11.23	130+65
49	I Avenue & 11 Street	3	5'	5	5	4.22	0	10	10	10.98	131+29
50	11th Street	3	40'	40	5	4.09	7	80	40	11.11	131+97
51	11th Street	3	25'	25	5	3.96	4	50	20	11.24	132+87
52	11th Street	3	25'	25	5	3.98	4	50	20	11.23	133+37
53	11th Street & J Street	3	60'	60	5	4.00	11	120	60	11.20	134+85
54	11th Street	3	25'	25	5	4.24	4	50	20	10.96	135+85
55	11th Street	3	20'	20	5	4.16	3	40	20	11.04	136+64
56	11th Street & K Street	3	60'	60	5	4.06	11	120	60	11.14	138+60
57	K Street Railroad Tracks Spur	3	20'	20	5	4.44	3	44	20	10.76	142+49
58	K Street Railroad Tracks	3	25'	25	5	1.97	4	25	20	13.23	144+33
59	K Street Pump Station	3	25'	25	5	2.84	4	35	20	12.36	144+68
60	Paulson Road	3	60'	60	5	3.20	11	96	60	12.00	202+25

Crew 1		
Total Effort	580	min.
Crew Size	4	people
Crew Assembly Time	145	min.
Travel Time	25	min.
TOTAL ASSEMBLY TIME	**170**	**min.**

Crew 2		
Total Effort	610	min.
Crew Size	4	people
Crew Assembly Time	153	min.
Travel Time	30	min.
TOTAL ASSEMBLY TIME	**183**	**min.**

Crew 3		
Total Effort	640	min.
Crew Size	4	people
Crew Assembly Time	160	min.
Travel Time	25	min.
TOTAL ASSEMBLY TIME	**185**	**min.**

Closure Plan	
1	The Levee Superintendent appoints three crews of four people (12 total) to perform levee closure work. All stoplog closure parts and assembly tools will be located on seven (7) individual trailers. Trailers are assigned to each installation crew below.
2	Crew assignments are as follows: Crew 1: Closures 1-23 (Trailer #1 & #2) Crew 2: Closures 24-38 (Trailer #3 & #4) Crew 3: Closures 39-60 (Trailers #5, #6, & #7)
3	The crews are on-call to perform the levee closure work immediately when directed to do so by the Levee Superintendent.
4	Crews have access to transportation for travel to closure locations and keys to unlock storage trailers.

Time Assembly Assumptions	
Stoplog Width	**Min.**
5, 10	5
15, 20, 25	10