NORTH SHORE LEVEE

Aberdeen & Hoquiam, WA

MT – 2 FORMS

KPFF Project No. 41600177

July 10, 2017

kpff Consulting Engineers

612 Woodland Square Loop SE, Suite 100
Lacey, WA 98503 360.292.7230

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FORM 1

Overview & Concurrence Form

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☒ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☐ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
530061	City of Hoquiam	WA	53027C	0882D	February 3, 2017
530061	City of Hoquiam	WA	53027C	0901D	February 3, 2017
530058	City of Aberdeen	WA	53027C	0901D	February 3, 2017
530058	City of Aberdeen	WA	53027C	0902D	February 3, 2017
530058	City of Aberdeen	WA	53027C	0904D	February 3, 2017
530058	City of Aberdeen	WA	53027C	0906D	February 3, 2017

2. a. Flooding Source:

b. Types of Flooding: ☐ Riverine ☒ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: North Shore Levee

4. FEMA zone designations affected: AE (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

a. The basis for this revision request is (check all that apply)

☐ Physical Change ☐ Improved Methodology/Data ☐ Regulatory Floodway Revision ☐ Base Map Changes
☐ Coastal Analysis ☐ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections
☐ Weir-Dam Changes ☒ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
☐ New Topographic Data ☐ Other (Attach Description)

Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☒ Levee/Floodwall ☐ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☒ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.
See Biological Assessment and Essential Fish Habitat Evaluation included with this submittal

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $7,250

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Mark Steepy, PE	Company: KPFF Consulting Engineers	
Mailing Address: 612 Woodland Square Loop SE, Suite 100 Lacey, WA 98503	Daytime Telephone No.: (360) 292-7230	Fax No.: (360) 292-7231
	E-Mail Address: mark.steepy@kpff.com	
Signature of Requester (required): Mark Steepy	Date: July 6, 2017	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Kris Koski, PE, City Engineer Brian Shay, City Administrator		Community Name: City of Aberdeen City of Hoquiam	
Mailing Address: Aberdeen City Hall 200 E Market Street Aberdeen, WA 98520	Hoquiam City Hall 609 8th Street Hoquiam, WA 98550	Daytime Telephone No.: (360) 537 - 3218 (360) 538 - 3983	Fax No.: (360) 537 - 3350 (360) 538 - 0938
		E-Mail Address: kkoski@aberdeenwa.gov bshay@cityofhoquiam.com	
Community Official's Signatures (required): Brian J Shay Kris Koski		Date: June 30, 2017	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Mark Steepy, PE	License No.: 34853 (WA)		Expiration Date: FEB 27 2019
Company Name: KPFF Consulting Engineers	Telephone No.: (360) 292-7230		Fax No.: (360) 292-7231
Signature: Mark Steepy	Date: 7-6-17	E-Mail Address: mark.steepy@kpff.com	

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if …
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☒ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☒ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

FORM 2

Riverine Hydrology & Hydraulics Form

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

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PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: The coastal, tidally influenced area of the Hoquiam River

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☐ Not revised (skip to section B) ☒ No existing analysis ☒ Improved data
☒ Alternative methodology ☒ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
Mouth	90.58	N/A	14,800

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model → Specify Model: _____
☒ Regional Regression Equations ☒ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis: See Hydraulic Analysis and Floodplain Memo (Appendices B & C) included in submittal package

If your community requires a regional, state, or federal agency to review the hydrologic analysis, Not Applicable

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

See Attachment #1: North Shore Levee Sediment Transport Explanations (Note 1)

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	Mouth	0	N/A	8.47
Upstream Limit*	End of Model	2.2	N/A	8.91

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS 1D/2D

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: N/A	Plan Name: N/A	File Name:	Plan Name:	
Corrected Effective Model*	File Name: N/A	Plan Name: N/A	File Name:	Plan Name:	
Existing or Pre-Project Conditions Model	File Name: NShoreLevee	Plan Name: NShoreLevee.p03	File Name:	Plan Name:	
Revised or Post-Project Conditions Model	File Name: NShoreLevee	Plan Name: NShoreLevee.p07	File Name:	Plan Name:	
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: 2015 and 2016 aerial photogrammetry data

Source: David Smith and Associates Date: 2015 and 2016

Accuracy: 3ft x 3ft

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☒ No
   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Chehalis River

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☒ Not revised (skip to section B) ☐ No existing analysis ☐ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges Not Applicable

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply) Not Applicable

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model → Specify Model: _____
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis Not Applicable

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology Not Applicable

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised [Not Applicable]

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*				
Upstream Limit*				

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: See Watershed Science & Engineering Tech memo

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4. [Not Applicable]

Models Submitted	Natural Run File Name:	Natural Run Plan Name:	Floodway Run File Name:	Floodway Run Plan Name:	Datum
Duplicate Effective Model*					
Corrected Effective Model*					
Existing or Pre-Project Conditions Model					
Revised or Post-Project Conditions Model					
Other - (attach description)					

* For details, refer to the corresponding section of the instructions.

☐ Digital Models Submitted? (Required) [Not Applicable]

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: 2015 and 2016 aerial photogrametry data.

Source: David Smith and Associates Date: 2015 and 2016

Accuracy: 3ft x 3ft

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☒ No
   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: The coastal, tidally influenced area of the Wishkah River

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☐ Not revised (skip to section B) ☐ No existing analysis ☒ Improved data
☒ Alternative methodology ☒ Proposed Conditions (CLOMR) ☒ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
Mouth	103.28	18,600	20,500

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model → Specify Model: _____
☒ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, Not Applicable

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

See Attachment #1: North Shore Levee Sediment Transport Explanations (Note 1)

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	Mouth	0	12.31 NAVD	8.47 NAVD
Upstream Limit*	End of Model	2.22	14.31 NAVD	12.33 NAVD

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS 1D/2D

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: WishkahRiver	Plan Name: WishkahRiver.p01	File Name:	Plan Name:	NGVD
Corrected Effective Model*	File Name: WishkahRiver	Plan Name: WishkahRiver.p02	File Name:	Plan Name:	NAVD
Existing or Pre-Project Conditions Model	File Name: NShoreLevee	Plan Name: NShoreLevee.p03	File Name: NShoreLevee	Plan Name: NShoreLevee.p09	NAVD
Revised or Post-Project Conditions Model	File Name: NShoreLevee	Plan Name: NShoreLevee.p07	File Name:	Plan Name:	NAVD
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: 2015 and 2016 aerial photogrammetry data

Source: David Smith and Associates Date: 2015 and 2016

Accuracy: 3ft x 3ft

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☒ No
   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

FORM 3

Riverine Structures Form

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program; Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Coastal flood that impacts lower regions of the Hoquiam river, Chehalis River, Wishkah river, and Grays Harbor

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: North Shore Levee

   Type (check one): ☐ Channelization ☐ Bridge/Culvert ☒ Levee/Floodwall ☐ Dam

   Location of Structure: 0+00 to 301+81.40, West terminus: Northing = 619,147.08 Easting = 797,347.39
   East terminus: Northing = 619,849.22 Easting = 814,446.87

   Downstream Limit/Cross Section: Left of lower Hoquiam River

   Upstream Limit/Cross Section: Right of lower Wishkah River

2. Name of Structure: Riverside Avenue Bridge (in levee alignment)

   Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: At Riverside Avenue

   Downstream Limit/Cross Section: 0.8 (Hoquiam R)

   Upstream Limit/Cross Section: 0.82 (Hoquiam R)

3. Name of Structure: Simpson Avenue Bridge (in levee alignment but not hydraulically)

   Type (check one) ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

   Location of Structure: At Simpson Avenue crossing

   Downstream Limit/Cross Section: 0.36 (Hoquiam R)

   Upstream Limit/Cross Section: 0.38 (Hoquiam R)

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

Description Of Modeled Structures (continued)

4. Name of Structure: West Railroad Bridge (not in levee alignment)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: 3700 feet upstream of Hoquiam confluence with Grays Harbor

Downstream Limit/Cross Section: 0.12 (Hoquiam R)

Upstream Limit/Cross Section: 0.14 (Hoquiam R)

5. Name of Structure: East Railroad Bridge (not in levee alignment)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: 1000 ft upstream of Wishkah confluence with Grays Harbor

Downstream Limit/Cross Section: 0.07 (Wishkah R)

Upstream Limit/Cross Section: 0.08 (Wishkah R)

6. Name of Structure: US Highway 12 West Bridge (in levee alignment)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: At Wishkah Street

Downstream Limit/Cross Section: 0.26 (Wishkah R)

Upstream Limit/Cross Section: 0.27 (Wishkah R)

7. Name of Structure: US Highway 12 East Bridge (in levee alignment)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: At East Heron Street

Downstream Limit/Cross Section: 0.19 (Wishkah R)

Upstream Limit/Cross Section: 0.2 (Wishkah R)

8. Name of Structure: Young Street Bridge (not in levee alignment)

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: At Young Street

Downstream Limit/Cross Section: 1.01 (Wishkah R)

Upstream Limit/Cross Section: 1.03 (Wishkah R)

B. CHANNELIZATION

Flooding Source: _____

Name of Structure: _____

Not Applicable

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: Grays Harbor, Wishkah River, Hoquiam River

Name of Structure: Riverside Avenue Bridge, Simpson Avenue Bridge, West Railroad Bridge, East Railroad Bridge, US Highway 12 West Bridge, US Highway 12 East Bridge, Young Street Bridge

1. This revision reflects (check one):

☒ Bridge/culvert not modeled in the FIS

☐ Modified bridge/culvert previously modeled in the FIS

☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

☐ Dimensions (height, width, span, radius, length)
☐ Shape (culverts only)
☐ Material
☐ Beveling or Rounding
☐ Wing Wall Angle
☐ Skew Angle

Plans of bridges in levee alignment will be provided upon detailed design.

☐ Distances Between Cross Sections
☐ Erosion Protection
☐ Low Chord Elevations – Upstream and Downstream
☐ Top of Road Elevations – Upstream and Downstream
☐ Structure Invert Elevations – Upstream and Downstream
☐ Stream Invert Elevations – Upstream and Downstream
☐ Cross-Section Locations

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☒ No

See Attachment #1: North Shore Levee Sediment Transport Explanations (Note 2)

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

D. DAM/BASIN

Flooding Source: _____
Name of Structure: _____ Not Applicable

1. This request is for (check one): ☐ Existing dam/basin ☐ New dam/basin ☐ Modification of existing dam/basin

2. The dam/basin was designed by (check one): ☐ Federal agency ☐ State agency ☐ Private organization ☐ Local government agency

   Name of the agency or organization: _____

3. The Dam was permitted as (check one): ☐ Federal Dam ☐ State Dam

   Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

   Permit or ID number _____ Permitting Agency or Organization _____

   a. ☐ Local Government Dam ☐ Private Dam

   Provided related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

   Was the dam/basin designed using critical duration storm? (must account for the maximum volume of runoff)

   ☐ Yes, provide supporting documentation with your completed Form 2.

   ☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☐ No

   If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why debris/sediment analysis was not considered?

6. Does the Base Flood Elevation behind the dam/basin or downstream of the dam/basin change? ☐ Yes ☐ No

   If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

FREQUENCY (% annual chance)	Stillwater Elevation Behind the Dam/Basin FIS	REVISED
10-year (10%)	_____	_____
50-year (2%)	_____	_____
100-year (1%)	_____	_____
500-year (0.2%)	_____	_____
Normal Pool Elevation	_____	_____

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one): ☐ upgrading of an existing levee/floodwall system ☒ a newly constructed levee/floodwall system ☐ reanalysis of an existing levee/floodwall system

b. Levee elements and locations are (check one):

☒ earthen embankment, dike, berm, etc. → Station 54+50 to 64+00, 71+00 to 85+00, 91+00 to 94+00, 104+00 to 107+50, 111+00 to 159+50, 189+00 to 194+00, 197+50 to 211+50, 247+00 to 249+50

☒ structural floodwall → Station 0+00 to 54+50, 64+00 to 71+00, 85+00 to 91+00, 94+00 to 104+00, 107+50 to 111+00, 159+50 to 189+00, 194+00 to 197+50, 211+50 to 247+00, 249+50 to 297+50

☐ Other (describe):

c. Structural Type (check one): ☒ monolithic cast-in place reinforced concrete ☐ reinforced concrete masonry block ☒ sheet piling ☐ Other (describe): _____ See Structural Explanation below

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☒ No

If Yes, by which agency? _____

Structural Type Explanation:
Two structural types are incorporated with the North Shore Levee project, concrete and sheet pile flood wall. The type of structure was determined based on space constraints. For example, sheet piling was used where a concrete flood wall was not able to fit.

e. Attach certified drawings containing the following information (indicate drawing sheet numbers):

1. Plan of the levee embankment and floodwall structures. Sheet Numbers: C5.00 - C5.50
2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers: C10.00 - C10.06
3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure. Sheet Numbers: C10.00 - C10.06
4. A layout detail for the embankment protection measures. Sheet Numbers: N/A
5. Location, layout, and size and shape of the levee embankment features, foundation treatment, Floodwall structure, closure structures, and pump stations. Sheet Numbers: C6.00 - C6.07, C7.00 - C7.01, C8.00 - C8.03, C9.00 - C9.02, C10.03 - C10.06

2. Freeboard

a. The minimum freeboard provided above the BFE is:

1.0 foot

Riverine Not Applicable

3.0 feet or more at the downstream end and throughout	☐ Yes	☐ No
3.5 feet or more at the upstream end	☐ Yes	☐ No
4.0 feet within 100 feet upstream of all structures and/or constrictions	☐ Yes	☐ No

Coastal

1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater).	☒ Yes	☐ No
2.0 feet above the 1%-annual-chance stillwater surge elevation — See Hydraulic Analysis & Floodplain Mapping Memo included with submittal	☐ Yes	☐ No

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☒ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☒ exists ☐ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

SEE ATTACHED:

MT-2 Attachment #2: North Shore Levee Closure Summary
MT-2 Attachment #3: North Shore Levee Pipe Penetrations

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086.)

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1A: Structural floodwall
STATION 00+00 to 80+00

a. The maximum levee slope land side is: n/a

b. The maximum levee slope flood side is: n/a

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): _____ Not Applicable

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☒ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
3+50; section of proposed sheetpile wall closest to the rivers edge

☒ Overall height: Sta.: 3+50, height 3.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 260 psf

Slope: SS = n/a (h) to n/a (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed. Some stretches were analyzed at multiple critical locations.
Copy 1B: Structural floodwall
STATION 00+00 to 80+00

a. The maximum levee slope land side is: n/a

b. The maximum levee slope flood side is: n/a

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): _____ Not Applicable

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
20+50; soldier pile wall improvements with bridge embankment fill surcharge

☒ Overall height: Sta.: 20+50, height varies ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 260 psf

Slope: SS = n/a (h) to n/a (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1C: Structural floodwall
STATION 00+00 to 80+00

a. The maximum levee slope land side is: n/a

b. The maximum levee slope flood side is: n/a

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): _____ Not Applicable

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach		Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
						D_{100}	D_{50}	Thickness	
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
42+00; T-wall section closest ot the river on the erosional side of river

☒ Overall height: Sta.: 42+00, height 3.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 260 psf

Slope: SS = n/a (h) to n/a (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1D: Earthen embankment, dike, berm, etc.
STATION 00+00 to 80+00

a. The maximum levee slope land side is: 2H:1V

b. The maximum levee slope flood side is: 2H:1V

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): grass cover

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
57+00; earth embankment section closest to river edge within reach.

☒ Overall height: Sta.: 57+00, height 3.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 260 psf

Slope: SS = 2 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 2A: Earthen embankment, dike, berm, etc.
STATION 80+00 to 120+00

a. The maximum levee slope land side is: 2H:1V

b. The maximum levee slope flood side is: 2H:1V

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): grass cover

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
91+00; Earth embankment topography results in tallest waterside slope.

☒ Overall height: Sta.: 91+00, height 6.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 280 psf

Slope: SS = 2 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 2B: Structural floodwall
STATION 80+00 to 120+00

a. The maximum levee slope land side is: n/a

b. The maximum levee slope flood side is: n/a

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): _____ Not Applicable

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach		Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
						D_{100}	D_{50}	Thickness	
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								
Sta	to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
100+50; topography at T-wall results in tallest waterside slope.

☒ Overall height: Sta.: 100+50, height 3.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 280 psf

Slope: SS = n/a (h) to n/a (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 3A: Earthen embankment, dike, berm, etc.
STATION 120+00 to 192+00

a. The maximum levee slope land side is: 2H:1V

b. The maximum levee slope flood side is: 2H:1V

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): grass cover

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
155+00

☒ Overall height: Sta.: 155+00, height 3.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 430 psf

Slope: SS = 2 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
Circular Arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed. Some stretches were analyzed at multiple critical locations.
Copy 4A: Earthen embankment, dike, berm, etc.
STATION 192+00 to 225+00

a. The maximum levee slope land side is: 2H:1V

b. The maximum levee slope flood side is: 2H:1V

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): grass cover

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
192+50;

☒ Overall height: Sta.: 192+50, height 4.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 420 psf

Slope: SS = 2 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 5A: Structural floodwall
STATION 225+00 to 297+50

a. The maximum levee slope land side is: n/a

b. The maximum levee slope flood side is: n/a

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): _____ Not Applicable

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
244+00; T-wall section with critical topography and bathymetry

☒ Overall height: Sta.: 244+00, height 3.2 ft.

☐ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 250 psf

Slope: SS = n/a (h) to n/a (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
Circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

4. Embankment Protection

NOTE: A copy of this page is included for each stretch analyzed. Some stretches were analyzed at multiple critical locations.
Copy 5B: Earthen embankment, dike, berm, etc.
STATION 225+00 to 297+50

a. The maximum levee slope land side is: 2H:1V

b. The maximum levee slope flood side is: 2H:1V

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): grass cover

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

Not Applicable

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
248+00; earth embankment section closest to river edge within reach.

☒ Overall height: Sta.: 248+00, height 3.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 250 psf

Slope: SS = 2 (h) to 1 (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 5C: Structural floodwall
STATION 225+00 to 297+50

4. Embankment Protection

a. The maximum levee slope land side is: n/a

b. The maximum levee slope flood side is: n/a

c. The range of velocities along the levee during the base flood is: 0 ft/s (min.) to 1.3 ft/s (max.)

d. Embankment material is protected by (describe what kind): _____ Not Applicable

e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress Not Applicable
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D_{100}	D_{50}	Thickness	
Sta to								
Sta to								
Sta to				Not Applicable				
Sta to								
Sta to								
Sta to								

(Extend table on an added sheet as needed and reference each entry)

f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No

g. Describe the analysis used for other kinds of protection used (include copies of the design analysis): Not Applicable

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

a. Identify locations and describe the basis for selection of critical location for analysis:
291+00; section of proposed sheetpile wall closest to the rivers edge

☒ Overall height: Sta.: 291+00, height 5.2 ft.

☒ Limiting foundation soil strength:

Strength ϕ = 0 degrees, c = 250 psf

Slope: SS = n/a (h) to n/a (v)

(Repeat as needed on an added sheet for additional locations)

b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):
Circular arc

c. Summary of stability analysis results: See Section 3.3 of the Geotechnical Report included with submittal package for stability analysis results

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1A: Structural floodwall
STATION 00+00 to 80+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.25	1.3
II	Sudden drawdown	1.25	1.0
III	Critical flood stage	1.99	1.4
IV	Steady seepage at flood stage	>5	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1B: Structural floodwall
STATION 00+00 to 80+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.34	1.3
II	Sudden drawdown	1.35	1.0
III	Critical flood stage	1.96	1.4
IV	Steady seepage at flood stage	>5	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage.

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1C: Structural floodwall
STATION 00+00 to 80+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.47	1.3
II	Sudden drawdown	1.47	1.0
III	Critical flood stage	2.38	1.4
IV	Steady seepage at flood stage	>5	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage.

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 1D: Earthen embankment, dike, berm, etc.
STATION 00+00 to 80+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.69	1.3
II	Sudden drawdown	1.71	1.0
III	Critical flood stage	2.82	1.4
IV	Steady seepage at flood stage	3.22	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is <1 hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☐ Other (specify): _____

b. Stability analysis submitted provides for: ☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were: ☐ Lateral earth @ P_A = _____ psf; P_p = _____ psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 2A: Earthen embankment, dike, berm, etc.
STATION 80+00 to 120+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	2.06	1.3
II	Sudden drawdown	2.05	1.0
III	Critical flood stage	3.03	1.4
IV	Steady seepage at flood stage	3.39	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage.

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is <1 hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☐ Other (specify): _____

b. Stability analysis submitted provides for: ☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were: ☐ Lateral earth @ P_A = _____ psf; P_p = _____ psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 2B: Structural floodwall
STATION 80+00 to 120+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	3.00	1.3
II	Sudden drawdown	2.97	1.0
III	Critical flood stage	>5	1.4
IV	Steady seepage at flood stage	4.36	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage.

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 3A: Earthen embankment, dike, berm, etc.
STATION 120+00 to 192+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	3.54	1.3
II	Sudden drawdown	3.57	1.0
III	Critical flood stage	4.80	1.4
IV	Steady seepage at flood stage	3.32	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage.

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is <1 hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☐ Other (specify): _____

b. Stability analysis submitted provides for: ☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were: ☐ Lateral earth @ P_A = _____ psf; P_p = _____ psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 4A: Earthen embankment, dike, berm, etc.
STATION 192+00 to 225+00

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	4.37	1.3
II	Sudden drawdown	4.36	1.0
III	Critical flood stage	>5	1.4
IV	Steady seepage at flood stage	>5	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage.

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is <1 hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☐ UBC (1988) ☐ Other (specify): _____

b. Stability analysis submitted provides for: ☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were: ☐ Lateral earth @ P_A = _____ psf; P_p = _____ psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☐ Wind @ P_w = _____ psf

☐ Seepage (Uplift); _____ ☐ Earthquake @ P_{eq} = _____ %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 5A: Structural floodwall
STATION 225+00 to 297+50

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.17	1.3
II	Sudden drawdown	1.16	1.0
III	Critical flood stage	1.92	1.4
IV	Steady seepage at flood stage	4.39	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 5A: Structural floodwall
STATION 225+00 to 297+50

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.13	1.3
II	Sudden drawdown	1.13	1.0
III	Critical flood stage	1.95	1.4
IV	Steady seepage at flood stage	3.94	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

NOTE: A copy of this page is included for each stretch analyzed.
Some stretches were analyzed at multiple critical locations.
Copy 5C: Structural floodwall
STATION 225+00 to 297+50

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	1.33	1.3
II	Sudden drawdown	1.33	1.0
III	Critical flood stage	2.31	1.4
IV	Steady seepage at flood stage	>5	1.4
VI	Earthquake (Case I)	n/a	1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☒ Yes ☐ No

If Yes, describe methodology used: Seep/W Steady State Seepage at critical flood stage

e. Was a seepage analysis for the foundation performed? ☒ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☒ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☒ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours. Not Applicable

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one): ☒ UBC (1988) ☒ Other (specify): IBC (2015), EM 110-2-2505, EC 110-2-6066

b. Stability analysis submitted provides for: ☒ Overturning ☒ Sliding If not, explain: _____

c. Loading included in the analyses were: ☒ Lateral earth @ P_A = varies psf; P_p = varies psf

☐ Surcharge-Slope @ _____, ☐ surface _____ psf

☒ Wind @ P_w = 30 psf

☒ Seepage (Uplift); ftg uplift ☒ Earthquake @ P_{eq} = 0.26 %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety.
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta	To	Sta	To
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5	>1.5	>1.5		
Dead & Soil	1.5	1.5	>1.5	>1.5		
Dead, Soil, Flood, & Impact	1.5	1.5	1.51	2.22		
Dead, Soil, & Seismic	1.3	1.3	>1.5	>1.5		

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)
Note: (Extend table on an added sheet as needed and reference)

E. LEVEE/FLOODWALL (CONTINUED)

6. Floodwall And Foundation Stability (continued)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum	See table below.	See table below.
Maximum allowable	1,460 ult	1,460 ult

Station	Sustained Load (psf)	Short Term Load (psf)
00+00 to 80+00	770	770
80+00 to 120+00	810	810
120+00 to 192+00	1,190	1,190
192+00 to 225+00	1,160	1,160
225+00 to 297+50	730	730

f. Foundation scour protection ☐ is, ☒ is not provided. If provided, attach explanation and supporting documentation:

Attach engineering analysis to support construction plans.

7. Settlement

a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☒ Yes ☐ No

b. The computed range of settlement is 0.2 ft. to 0.5 ft.

c. Settlement of the levee crest is determined to be primarily from : ☒ Foundation consolidation ☐ Embankment compression ☐ Other (Describe): _____

d. Differential settlement of floodwalls ☒ has ☐ has not been accommodated in the structural design and construction.

Attach engineering analysis to support construction plans.

8. Interior Drainage

a. Specify size of each interior watershed:

See Attachment #4: North Shore Levee Drainage Basins and Pump Capacities

Draining to pressure conduit: _____ acres
Draining to ponding area: _____ acres

b. Relationships Established

Ponding elevation vs. storage	☐ Yes	☒ No
Ponding elevation vs. gravity flow	☐ Yes	☒ No
Differential head vs. gravity flow	☐ Yes	☒ No

c. The river flow duration curve is enclosed: ☐ Yes ☒ No

d. Specify the discharge capacity of the head pressure conduit: _____ cfs → See Attachment #4: North Shore Levee Drainage Basins and Pump Capacities

e. Which flooding conditions were analyzed?

• Gravity flow (Interior Watershed)	☒ Yes	☐ No
• Common storm (River Watershed)	☐ Yes	☒ No
• Historical ponding probability	☐ Yes	☒ No
• Coastal wave overtopping	☐ Yes	☒ No

If No for any of the above, attach explanation. See Hydraulics Analysis and Floodplain Mapping memo include with submittal. See Interior Drainage Analysis included with submittal.

e. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☒ Yes ☐ No If No, attach explanation.

g. The rate of seepage through the levee system for the base flood is _____ cfs

h. The length of levee system used to drive this seepage rate in item g: _____ ft.

See table below.

Sta 00+00 to 80+00	g. 1.94e-6 cfs	h. 8,000 ft
Sta 80+00 to 120+00	g. 3.40e-6 cfs	h. 4,000 ft
Sta 120+00 to 192+00	g. 5.32e-4 cfs	h. 7,200 ft
Sta 192+00 to 225+00	g. 7.87e-5 cfs	h. 3,300 ft
Sta 225+00 to 297+50	g. 1.59e-5 cfs	h. 7,250 ft

NOTE:

Table at left does not account for seepage through sanitary sewer pipes. Seepage from sanitary sewers crossing the levee is expected to flow to pump stations and contribute less than 1% of the preliminary pump capacities. Pumps will be sized to account for sanitary sewer seepage.

E. LEVEE/FLOODWALL (CONTINUED)

8. Interior Drainage (continued)

i. Will pumping plants be used for interior drainage? ☒ Yes ☐ No

If Yes, include the number of pumping plants 11-24 ; or each pumping plant, list:

Note:
The interior drainage analysis includes three alternatives causing variation in the total number of pumps. See Interior Drainage Analysis include with submittal.

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

NOTE:

Pump design is schematic pending preliminary approval of concept. See "MT-2 Attachment #4" for drainage basins and preliminary proposed pump capacities, see Sheet C9.00 - C9.02 for the pump station plan, and see the Interior Drainage Analysis fro a more detailed discussion of pumping. All pump stations will be automatic and not require any prior flood warning for operation.

Will the operation be automatic? ☒ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☒ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria

a. The following items have been addressed as stated:

Liquefaction ☒ is ☐ is not a problem

Hydrocompaction ☐ is ☒ is not a problem

Heave differential movement due to soils of high shrink/swell ☐ is ☒ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Seismic issues are beyond the scope of the analysis performed.

Soils are not susceptible to hydrocompaction or heave differential movement due to high shrink/swell soils.

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☒ Yes ☐ No Attach supporting documentation

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☒ No

See Attachment #1: North Shore Levee Sediment Transport Explanations (Note 3)

If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why sediment transport was not considered.

10. Operational Plan And Criteria

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☒ Yes ☐ No

b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations?
☒ Yes ☐ No

c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations?
☒ Yes ☐ No If the answer is No to any of the above, please attach supporting documentation.

E. LEVEE/FLOODWALL (CONTINUED)

11. Maintenance Plan

Please attach a copy of the fomal maintenance plan for the levee/floodwall
See Operations & Maintenance Manual included with submittal.

12. Operations and Maintenance Plan

Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.
See Operations & Maintenance Manual included with submittal.

CERTIFICATION OF THE LEVEE DOCUMENTION

This certification is to be signed and sealed by a licensed registered professional engineer authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.10(e) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Mark Steepy, PE License No.: 34853 (WA) Expiration Date: FEB 27 2017

Company Name: KPFF Consulting Engineers Telephone No.: (360)292-7230 Fax No.: (360) 292-7231

Signature: Date: 7-6-17 E-Mail Address: mark.steepy@kpff.com

F. SEDIMENT TRANSPORT

Flooding Source: _____

Not Applicable

Name of Structure: _____

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE); and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume _____ acre-feet

Debris load associated with the base flood discharge: Volume _____ acre-feet

Sediment transport rate _____ (percent concentration by volume)

Method used to estimate sediment transport: _____

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition: _____

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport: _____

Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

FORM 4

Coastal Analysis Form

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

COASTAL ANALYSIS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 1 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Grays Harbor
Note: Fill out one form for each flooding source studied.

A. COASTLINE TO BE REVISED

Describe limits of study area: No Proposed Revisions to Coastal Analysis

B. EFFECTIVE FIS

The area being revised in the effective FIS was studied by detailed methods using (check all that apply):

- ☒ Storm surge modeling
- ☒ Wave height computations
- ☒ Wave overtopping computations
- ☐ Primary Frontal Dune Assessment
- ☒ Wave setup computations
- ☒ Wave runup computations
- ☐ Dune erosion computations
- ☐ N/A (area not studied by detailed methods)

C. REVISED ANALYSIS

1. Number of transects in revised analysis: Not Revised — Not Applicable

2. Information used to prepare the revision (check all that apply):

- ☐ Wave setup analyses (complete Items 3, 4, and 5 below)
- ☐ Stillwater elevation determinations (complete Item 3)
- ☐ Erosion considerations (complete Item 4)
- ☐ Wave runup analysis (complete Items 4 and 5)
- ☐ Wave height analysis (complete Items 4 and 5)
- ☐ Wave overtopping assessment (complete Items 4 and 5)
- ☐ More detailed topographic information (complete Section E)
- ☐ Shore protection structures (attach completed Coastal Structures Form - Form 5)
- ☐ Primary frontal dune assessment (complete Item 5)
- ☐ Other, attach basis of revision request with explanation

3. Stillwater Elevation Determination

a. How were stillwater elevations determined?
- ☐ Gage analysis (If revised gage analysis was used, provide copies of gage data and revised analysis.)
- ☐ Storm surge analysis
- ☐ Other (Describe): _____

b. Specify what datum was used in the calculations: _____

If not the FIS datum, have the calculations been adjusted to the FIS datum? ☐ Yes ☐ No Conversion factor: _____

c. Was the storm surge analysis revised? ☐ Yes ☐ No

d. If a new storm surge model was used, attach a detailed description of the differences between the current and the revised analyses, and why the revised analysis should replace the current analysis.

C. REVISED ANALYSIS (continued)

e. If wave setup was computed, attach a description of methodology used.
Amount of wave setup added to stillwater elevation: _____ feet

4. Revised Analysis (i.e., erosion, wave height, wave runup, primary frontal dune, and wave overtopping)

If DHS-FEMA procedures were utilized to perform the revision, attach a detailed description of differences between the current and the revised analyses, and why the revised analysis should replace the current analysis.

If DHS-FEMA procedures were not utilized to perform the revision, provide full documentation on methodology and/or models used; including operational program, detailed differences between methodology and/or models utilized and DHS-FEMA's methodology and/or models. Also, attach an explanation of why new methodology and/or models should replace current methodology and/or models.

If revision reflects more detailed topographic information and fill has been/will be placed in a V Zone, and is not protected from erosion by a shore protection structure, provide a detailed description of how the fill has been treated in the revised analysis.

5. Wave Runup, Wave Height, And Wave Overtopping Analysis

Wave height analyses along a transect are greatly affected by starting wave conditions that propagate inland. Wave runup and overtopping analyses are typically considered when wave heights and/or wave runup are close to or greater than the crest of shore protection structures or natural land forms.

a. Was an analysis performed to determine starting wave height and period for input into WHAFIS?
If Yes, attach an explanation of the method utilized. If No, explain why these analyses were not performed.
☐ Yes ☐ No

b. Was wave setup included in wave height analysis and removed for erosion and wave runup analyses?
☐ Yes ☐ No

c. Was an overtopping analysis performed for any coastal shore protection structures or natural land forms that may be overtopped?
☐ Yes ☐ No

If Yes, attach an explanation of the methodology utilized and describe in detail the results of the analysis.
If overtopping was not analyzed, attach an explanation for why these analyses were not performed.

D. RESULTS

Not Applicable

1. Stillwater storm surge elevation: _____ feet _____ Datum
2. Wave setup: _____ feet
3. Starting deep-water significant wave condition:
height: _____ period: _____
4. Maximum wave height elevation: _____ feet
5. Maximum wave runup elevation: _____ feet
6. Estimated amount of maximum overtopping: _____ cfs/feet
7. Has this revision changed the Limit of Moderate Wave Action (LiMWA)? ☐ Yes ☐ No ☐ N/A
8. The areas designated as coastal high hazard areas (V Zones) have:
☐ increased ☐ decreased ☐ both

Attach a description where they have increased and/or decreased.

9. As a result of the revised analyses, the V Zone location has shifted a maximum of _____ feet seaward and _____ feet landward of its existing position.
10. Does this revision reflect the location of the primary frontal dune?
☐ Yes ☐ No
11. The Base Flood Elevations have:
☐ increased ☐ decreased
a. What was the greatest increase? _____ feet
b. What was the greatest decrease? _____ feet
12. The special flood hazard area has:
☐ increased ☐ decreased ☐ both

Attach a description where it has increased or decreased.

E. MAPPING REQUIREMENTS

A certified topographic map must be submitted showing the following information (where applicable): effective, existing conditions, and proposed conditions 1%-annual-chance floodplain boundaries, revised shoreline due to either erosion or accretion, location and alignment of all transects, correct location and alignment of any structures, current community easements and boundaries, boundary of the requester's property, certification of a professional engineer registered in the subject State, location and description of reference marks, and the referenced vertical datum (NGVD, NAVD, etc.).

Note that the existing or proposed conditions floodplain boundaries to be shown on the revised FIRM must tie-in with the effective floodplain boundaries. Please attach a copy of the current FIRM annotated to show the revised 1%-annual-chance floodplain boundaries that tie-in with effective 1%-annual-chance floodplain boundaries along the entire extent of the area of revision.

FORM 5

Coastal Structures Form

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

COASTAL STRUCTURES FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

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ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

Flooding Source: Coastal flood that impacts lower regions of the Wishkah River, Chehalis River, and Grays Harbor

Note: Fill out one form for each flooding source studied.

A. BACKGROUND

1. Name of structure (if applicable): North Shore Levee

2. Structure location: City of Aberdeen and City of Hoquiam, WA

3. Type of structure (check one):

☒ Levee/Floodwall* ☐ Anchored Bulkhead ☐ Revetment ☐ Gravity Seawall

☐ Breakwater ☐ Pile supported seawall ☐ Other: _____

*****Note: If the coastal structure is a levee/floodwall, complete Section E of Form 3 (Riverine Structures Form). The remainder of this form does not need to be completed. → Coastal structure is a levee/floodwall. The remainder of the form does not need to be completed.

4. Material structure is composed of (check all that apply):

☐ Stone ☐ Earthen fill ☐ Concrete ☐ Steel ☐ Sand

☐ Other _____

5. The structure is (check one):

☐ New or proposed ☐ Existing ☐ Modification of existing structure

☐ Replacement structure of the same size and design as what was previously at the site

Describe in detail the existing structure and/or modifications being made to the structure and the purpose of the modifications:

If existing, please include date of construction: _____

6. Copies of certified "as-built" plans ☐ are ☐ are not attached. Attach all design analyses that apply.

If "as-built" plans are not available for submittal, please explain why and attach a sketch with general structure dimensions including: face slope, height, length, depth, and toe elevation referenced to the appropriate datum (e.g. NGVD 1929, NAVD 1988, etc.).

A. BACKGROUND (continued)

7. Has a Federal agency with responsibility for the design of coastal flood protection structures designed or certified that the structures have been adequately designed and constructed to provide protection against the 1%-annual-chance event?

☐ Yes ☐ No

If Yes, specify the name of the agency and dates of project completion and certification.

_____

If Yes, then no other sections of this form need to be completed.

8. An Operation & Maintenance Plan has been provided.(required for all coastal structures)

B. DESIGN CRITERIA

1. Design Parameters

a. Were physical parameters representing the 1%-annual-chance event or greater used to design the coastal flood protection structure?

☐ Yes ☐ No

b. The number of design water levels that were evaluated (number) range from the mean low water elevation of feet to the 1%-annual-chance stillwater surge elevation of feet. The critical water level is feet. The datum that these elevations are referenced to is e.g.,(NGVD)

Attach an explanation specifying which water levels and associated wave heights and periods were analyzed.

c. Were breaking wave forces used to design the structure?

☐ Yes ☐ No If No, attach an explanation why they were not used for design.

2. Settlement

a. What is the expected settlement rate at the site of the structure?

Please attach a settlement analysis.

3. Freeboard

a. Does the structure have 1 foot of freeboard above the height of the 1%-annual-chance wave-height elevation or maximum wave runup (whichever is greater)?

☐ Yes ☐ No

b. Does the structure have freeboard of at least 2 feet above the 1% annual chance stillwater surge elevation?

☐ Yes ☐ No

4. Toe Protection

Specify the type of toe protection: _____

If no toe protection is provided, provide analysis of scour potential and attach an evaluation of structural stability performed with potential scour at the toe.

5. Backfill Protection

Will the structure be overtopped during the 1%-annual-chance event? ☐ Yes ☐ No

If the structure will be overtopped, attach an explanation of what measures are used to prevent the loss of backfill from rundown over the structure, drainage landward, under or laterally around the ends of the structure, or through seams and drainage openings in the structure.

6. Structural Stability - Minimum Water Level

a. For coastal revetments, was a geotechnical analysis of potential failure in the landward direction by rotational gravity slip performed for maximum loads associated with minimum seaward water level, no wave action, saturated soil conditions behind the structure, and maximum toe scour?

☐ Yes ☐ No

b. For gravity and pile-supported seawalls, were engineering analyses of landward sliding, landward overturning, and of foundation adequacy using maximum pressures developed in the sliding and overturning calculations performed?

☐ Yes ☐ No

c. For anchored bulkheads, were engineering analyses performed for shear failure, moment failure, and adequacy of tiebacks and deadmen to resist loading under low-water conditions?

☐ Yes ☐ No

B. DESIGN CRITERIA (CONTINUED)

7. Structural Stability - Critical Water Level (Note: All structures must be designed to resist the maximum loads associated with the critical water level to be credited as providing protection from the 1% annual chance event.)

a. For coastal revetments, were geotechnical analyses performed investigating the potential failure in the seaward direction by rotational gravity slip or foundation failure due to inadequate bearing strength?

☐ Yes ☐ No

b. For revetments, were engineering analyses of rock, riprap, or armor blocks' stability under wave action or uplift forces on the rock, riprap, or armor blocks performed?

☐ Yes ☐ No

c. Are the rocks graded?

☐ Yes ☐ No

d. Are soil or geotextile filters being used in the design?

☐ Yes ☐ No

e. For gravity and pile supported seawalls, were engineering analyses of landward sliding, landward overturning, and foundation adequacy performed?

☐ Yes ☐ No

f. For anchored bulkheads, were engineering analyses of shear and moment failure performed using "shock" pressures?

☐ Yes ☐ No

For all analyses marked “No” above for the appropriate type of structure, please attach an explanation why the analyses were not performed.

8. Material Adequacy

The design life of the structure given the existing conditions at the structure site is _____ years.

9. Ice and Impact Alignment

a. Will the structure be subjected to ice forces? ☐ Yes ☐ No If Yes, attach impact analysis and design details for such forces.

b. Will the structure be subjected to impact forces from boats, ships, or large debris? ☐ Yes ☐ No If Yes, attach impact analysis.

10. Structure Plan Alignment

The structure is (check one): ☐ Isolated ☐ Part of a continuous structure with redundant return walls at frequent intervals.

Please provide a map showing the location of the structure and any natural land features that shelter the structure from wave actions.

C. ADVERSE IMPACT EVALUATION

If the structure is new, proposed, or modified, will the structure impact flooding and erosion for areas adjacent to the structure?

☐ Yes ☐ No

If Yes, attach an explanation.

D. COMMUNITY AND/OR STATE REVIEW

Has the design, maintenance, and impact of the structure been reviewed and approved by the community, and any Federal, State, or local agencies having jurisdiction over flood control and coastal construction activities in the area the structure impacts?

☐ Yes ☐ No If Yes, attach a list of agencies who have reviewed and approved the project.
If No, attach an explanation why review and approval by the appropriate community or agency has not been obtained.

E. CERTIFICATION

As a Professional Engineer, I certify that the above structures will withstand all hydraulic and wave forces associated with the 1% annual chance flood without significant structural degradation. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Mark Steepy, PE License No.: 34853 (WA) Exp. Date: FEB 27 2019

Company Name: KPFF Consulting Engineers Telephone No.: (360) 292-7230 Fax No.: (360) 292-7231

Signature: _____ Date: 7-6-17

Seal (optional)

MT – 2 ATTACHMENTS

Attachment #1 – North Shore Levee Sediment Transport Explanations
Attachment #2 – North Shore Levee Closure Summary
Attachment #3 – North Shore Levee Pipe Penetrations
Attachment #4 – North Shore Levee Drainage Basins and Pump Capacities

MT-2 ATTACHMENT #1
NORTH SHORE LEVEE SEDIMENT TRANSPORT EXPLANATIONS

Note 1:
During hydraulic analysis, the velocities within the evaluated channels did not demonstrate a risk for the flood wall to be impacted by transport sediment.

Note 2:
Sediment transport with relation to bridges was not considered as the velocities within the channel are not affected by the inclusion of the proposed levee. Additionally, there have been no recorded issues with sediment or scour at these bridges since the original study in 1981.

Note 3:
Sediment transport was not considered in the analysis of the proposed levee as the velocities within the channel are not affected by the inclusion of the proposed levee. Additionally, there have been no recorded issues with sediment since the original study in 1981.

MT-2 ATTACHMENT #2
NORTH SHORE LEVEE CLOSURE SUMMARY

Stoplog Closures

Closure No.	Start Station	End Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device
1	12+54.32	12+69.32	Left	Public Street	11.28	Temporary Stoplog
2	15+08.87	15+13.87	Left	Public Sidewalk	10.93	Temporary Stoplog
3	15+59.06	16+04.06	Left	Public Street	10.55	Temporary Stoplog
4	19+73.24	19+78.24	Left	Public Sidewalk	11.06	Temporary Stoplog
5	23+61.09	24+71.09	Left	Public Street/Sidewalk	13.52 - 13.89	Temporary Stoplog
6	44+72.78	45+27.78	Left	Public Street/Sidewalk	10.20	Temporary Stoplog
7	49+16.26	49+61.26	Left	Public Street/Sidewalk	10.91	Temporary Stoplog
8	70+52.66	71+02.66	Left	Public Street	12.19	Temporary Stoplog
9	85+36.70	85+71.70	Left	Public Street	10.30	Temporary Stoplog
10	86+85.94	87+15.94	Right	Private Loading Dock	7.62	Temporary Stoplog
11	87+79.73	88+09.73	Right	Private Loading Dock	7.19	Temporary Stoplog
12	98+37.21	98+62.21	Right	Public Street	11.02	Temporary Stoplog
13	109+11.87	109+71.87	Right	Public Street	13.51	Temporary Stoplog
14	119+79.11	120+14.11	Right	Public Street	13.56	Temporary Stoplog
15	135+70.35	135+95.35	Right	Public Street	12.85	Temporary Stoplog
16	145+68.64	145+98.64	Right	Public Street	13.58	Temporary Stoplog
17	163+38.12	163+98.12	Right	Public Street	13.11	Temporary Stoplog
18	176+45.22	176+80.22	Right	Public Street	12.57	Temporary Stoplog
19	177+52.85	177+87.85	Right	Public Street	12.28	Temporary Stoplog
20	186+15.68	186+55.68	Right	Public Street	12.24	Temporary Stoplog
21	187+56.05	187+74.05	Right	Private RR Spur	9.88	Temporary Stoplog
22	193+95.30	194+25.30	Right	Public Street	12.58	Temporary Stoplog
23	219+58.23	220+13.23	Right	Private Driveway Access	12.03	Temporary Stoplog
24	220+74.12	221+29.12	Right	Public Street	12.45	Temporary Stoplog
25	232+04.66	232+39.66	Right	Public Street	12.72	Temporary Stoplog
26	239+64.05	239+99.05	Right	Public Street	11.44	Temporary Stoplog
27	240+04.93	240+09.93	Right	Public Sidewalk	11.39	Temporary Stoplog
28	240+30.97	240+40.97	Right	Public Sidewalk	11.84	Temporary Stoplog
29	240+79.47	240+89.47	Right	Public Sidewalk	11.84	Temporary Stoplog
30	241+10.64	241+20.64	Right	Public Sidewalk	11.91	Temporary Stoplog
31	242+44.56	242+49.56	Right	Public Sidewalk	12.09	Temporary Stoplog
32	243+04.33	243+09.33	Right	Public Sidewalk	11.70	Temporary Stoplog
33	245+06.36	245+16.36	Right	Public Sidewalk	11.13	Temporary Stoplog
34	245+46.77	245+56.77	Right	Public Sidewalk	11.39	Temporary Stoplog
35	246+21.64	246+31.64	Right	Public Sidewalk	11.29	Temporary Stoplog
36a	254+15.25	254+30.25	Right	Private Dock Access	12.32	Temporary Stoplog
36b	257+13.48	257+38.48	Right	Public Driveway Access	10.75	Temporary Stoplog
37	257+77.76	258+42.76	Right	Public Street	13.50	Temporary Stoplog
38	262+32.53	262+62.53	Right	Public Street	11.73	Temporary Stoplog
39	265+73.88	265+83.88	Right	Public Sidewalk	11.50	Temporary Stoplog
40	265+90.82	266+50.82	Right	Public Street	11.48	Temporary Stoplog
41	267+20.98	267+55.98	Right	Public Driveway Access	11.76	Temporary Stoplog
42	269+72.96	270+02.96	Right	Public Street	11.15	Temporary Stoplog
43	272+16.56	272+76.56	Right	Public Street	11.79	Temporary Stoplog
44	276+61.40	277+21.40	Right	Public Street	12.21	Temporary Stoplog
45	281+82.36	281+87.36	Right	Public Sidewalk	11.71	Temporary Stoplog
46	281+92.23	282+22.23	Right	Public Street	11.33	Temporary Stoplog
47	282+65.35	283+10.35	Right	Public Street	11.18	Temporary Stoplog
48	283+19.66	283+24.66	Right	Public Sidewalk	11.73	Temporary Stoplog
49	286+94.65	286+99.65	Right	Public Sidewalk	14.32	Temporary Stoplog
50	287+63.98	287+83.98	Right	Private Driveway Access	13.03	Temporary Stoplog
51	288+63.87	288+68.79	Right	Public Sidewalk	13.19	Temporary Stoplog
52	288+89.69	289+04.69	Right	Private Driveway Access	12.72	Temporary Stoplog
53	289+15.35	289+30.35	Right	Private Driveway Access	12.68	Temporary Stoplog
54	289+99.72	290+04.72	Right	Public Sidewalk	12.26	Temporary Stoplog

Pedestrian Hinged Gates

Closure No.	Start Station	End Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device
1	18+79.59	18+84.59	Right	Private Property	11.41	Swing Hinged Gate
2	270+74.64	270+79.64	Right	Private Property	12.09	Swing Hinged Gate
3	271+60.08	271+65.08	Right	Private Property	11.92	Swing Hinged Gate
4	273+22.44	273+27.44	Right	Private Property	12.82	Swing Hinged Gate
5	274+01.58	274+06.58	Right	Private Property	13	Swing Hinged Gate
6	274+83.17	274+88.17	Right	Private Property	13.04	Swing Hinged Gate

MT-2 ATTACHMENT #4
NORTH SHORE LEVEE DRAINAGE BASINS AND PUMP CAPACITIES

Interior Basin	Total Basin Area (Acre)	Drainage to Pressure Conduit (Acres)	Preliminary Pump Capacity (GPM)
Broadway Ave	1.59	1.59	500
15th St	21.35	21.35	6,000
19th St	15.00	15.00	4,000
20th St	12.48	12.48	3,500
28th St.	341.91	341.91	93,000
Fry Creek	183.70	183.70	60,000
Duffy St	178.52	178.52	28,000
Division St	247.02	247.02	76,000
Cherry St	214.17	214.17	6,500
Lincoln St	154.05	154.05	45,800
Washington St	29.11	29.11	9,200
Jefferson St	131.00	131.00	41,500
K St	59.91	59.91	21,100
H St	68.07	68.07	25,000
River St	0.29	0.29	200
State St	4.18	4.18	2,000
Zelasko Park	17.79	17.79	7,000
Wishkah St	4.04	4.04	1,700
E St	101.44	101.44	35,000
D St	25.97	25.97	8,500
B St	9.58	9.58	3,000
Arthur St	77.68	77.68	24,000
Stanton St	5.57	5.57	2,000
Chicago St	1.85	1.85	600